The Elasticity of Taxable Wealth: Evidence from the Netherlands *

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Abstract

This paper estimates the effect of taxation on household savings using the Dutch 2001 capital-income and wealth tax reform as a quasi-experiment. The impact of the reform on Dutch households is highly asymmetric and creates variation in the rate-of-return after taxation at each level of income and wealth. This allows me to estimate the causal effect of a change in the rate of return on savings, using a difference-in-difference framework where I compare households that are similar in terms of income and wealth, but that where nevertheless treated differently by the tax reform. I use administrative household panel data from 1995-2004 with information on capital income, wealth and portfolio composition. The central result is that a 0.1 percentage-point increase in the current Dutch wealth tax of 1.2 percent, leads to a reduction in household savings of 1.38 percent.

Keywords: Tax Reform, Capital Income Taxation, Taxation of Wealth, Portfolio Composition, Intertemporal Behavior

JEL-codes: H24, H31, G11, G18

1 Introduction

Piketty (2013) documents a strong increase in wealth inequality in developed countries. One of his proposed solution is to levy a wealth tax on household savings. However, the desirability and effectiveness of a wealth tax depends on the sensitivity of household wealth with respect to the tax. If household wealth is very sensitive to taxation, this implies that wealth taxation comes with a large distortion, making it less desirable from a welfare perspective. So far only a few studies have considered the effect of taxation on wealth accumulation (e.g. Seim (2017); Brülhart et al. (2016); Jakobsen et al. (2018)). I contribute by investigating the impact of a change

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in capital-income and wealth taxation on household savings, exploiting quasi-experimental variation induced by the 2001 tax reform in the Netherlands.

Prior to 2001, Netherlands taxed capital income in the form of interest, dividends and imputed rents on owner-occupied housing together with labor income. In addition, the government levied a wealth tax on overall net wealth (assets minus debt) above a threshold value. In a move unprecedented in the world, the 2001 reform removed the capital-income tax and replaced it with a wealth tax of 1.2 percent. An exception was made for owner-occupied housing which is exempted from the new wealth tax, but instead remains subject to capital-income taxation. In addition to these changes, the reform also affected all thresholds and tax rates.

To study the impact of the reform on savings I use a panel provided by Statistics Netherlands over the period 1995-2004. The dataset is based on the Income Panel Investigation (IPO) which keeps track of administrative records of 0.61 percent of the Dutch population, as well as their household members. The original IPO contains individual tax records on capital and labor income collected from both employers and employees for each household member, as well as a large set of control variables collected at both the national and the municipal level. For the purpose of this study the dataset is extended at the household level with administrative data on household savings and portfolio composition. The dataset allows me to precisely calculate wealth holdings of the household, as well as the effective capital-income and wealth-tax rate.

To estimate the causal impact of the tax reform I use a difference-in-difference regression framework. The outcome variable is the relative change in a household's taxable wealth over the reform. To get a continuous treatment variable I combine the total impact of the wealth - and capital-income tax into a single measure. This measure is the relative change in the after-tax gross rate of return over the reform. In a theoretical model I show that the treatment variable serves as a sufficient statistic for the overall effect of the tax reform on household savings. I am thus estimating the elasticity of wealth with respect to the after-tax gross rate of return.

In most tax reform studies it is impossible to fully control for base year wealth and income, because variation in the tax rate is fundamentally the result of differences in base year income or wealth. Therefore, identification relies on the common-trend assumption that individuals with different initial levels of income/wealth exhibit similar growth rates in the absence of treatment. To partially relax this assumption, most studies since Gruber and Saez (2002) include linear trends by income and/or wealth decile to capture heterogeneity in the growth rate of income/wealth. These trends are identified on the pre-reform period. However, in that case identification of the causal effect of the reform relies on the assumption that heterogeneity in growth rates for the outcome variable can be extended linearly from the pre-reform period, which is not testable.

In this paper I develop an approach that circumvents this issue. The impact of the Dutch tax reform on the rate of return is highly asymmetric and creates variation at each income and wealth level. Therefore, in my main specification I include non-parametric controls for base-year wealth and income. Hence, identification comes from comparing households that are similar in terms of base year income and wealth, but are nevertheless treated differently by the reform.[1]

[1] Another strand of the literature estimates elasticities using kinks in the tax schedule (see e.g. Saez (2010); Seim (2017)). These bunching estimators are also robust to heterogeneity in growth rates of the outcome variable. However, identification in this literature is complicated by the fact that it is difficult for households to accurately

Changes in the treatment variable are partially endogenous, because decisions by the household affect their tax rate due to tax progressivity. To deal with this, I instrument the treatment variable with what the rate of return would have occurred if the household did not change behavior, similar to the instrument used in Gruber and Saez (2002). Therefore, I identify the elasticity of taxable wealth relying only on reform-based variation.

In my main regression, I use 1999 as a base year, because decisions in 2000 may already have been affected by announcement effects. I look at short-run effects up to 2001 and long-run effects up to 2004. My estimates show that a 1 percent increase in the gross rate of return after taxation reduces accumulated wealth by 13.8 percent. This implies that a 0.1 percentage point increase in the wealth tax reduces accumulated wealth by 1.38 percent in the long run. My estimate is in the middle of existing estimates in Seim (2017); Brülhart et al. (2016).

Inspection of the short-run result shows that the short-run elasticity is only slightly smaller than the long-run elasticity. This could be indicative of the fact that responses are mostly due to changes in reporting behavior rather than real responses, because it takes longer for real responses to materialize in the stock of wealth (see e.g. Slemrod (1995); Seim (2017)).

A split-up of the sample between households that own a home, and households that do not own a home shows that the long-run elasticity of home-owners is slightly smaller than the average long-run elasticity. However, the short-run elasticity for homeowners is more than twice smaller than the average short-run elasticity. This indicates that home ownership comes with frictions which make it more difficult to respond rapidly to changes in the tax rate.

I additionally explore other heterogeneous treatment with respect to age, initial wealth, and owners of closely-held corporations, but I find only small differences in the elasticity between these groups.

Review of the Literature This paper is related to the small literature that looks at the effect of wealth taxation on household wealth. Seim (2017) uses a regression-kink design, and finds elasticities that are statistically significant, but economically small. Contrary, Brülhart et al. (2016) use local variation in the wealth tax rate in Swiss cantons, and find that household wealth is very sensitive to changes in the wealth tax. Jakobsen et al. (2018) study the effect of several large wealth tax reforms in Denmark, and also find large responses, especially for very wealthy households. I contribute by providing the first evidence for the Netherlands.

Methodologically, this paper uses many techniques that are first introduced in the literature that estimates the elasticity of taxable income using tax reforms (see e.g. Feldstein (1995); Gruber and Saez (2002); Weber (2014)), and applies these techniques to taxable wealth. I make a small contribution to this literature by studying a tax-reform in which it is possible to fully control for differences in base-year wealth and income, allowing me to make comparisons within, rather than between income groups.

This paper is organized as follows. The next section explains the 2001 tax reform in detail. The third section discusses the IPO data. The fourth section introduces the conceptual framework. The fifth section discusses methodology. The results are presented in the sixth section, and the final section concludes.

target kinks due to optimization errors and regulations (see e.g. Chetty (2012); Kosonen and Matikka (2017)).

2 Institutional Setting

For the purpose of taxation, household wealth is subdivided into three categories: i.) housing wealth, defined as the value of the owner-occupied house minus the mortgage on the house, ii.) tax-deferred pension wealth, and iii.) financial wealth, which is defined as the difference between the remaining assets such as bank accounts, stocks, bonds and other real estate, and the remaining debt.

The Dutch tax system levies two types of taxes on (returns from) taxable wealth: a capital-income tax, and a wealth tax. The capital-income tax taxes capital income together with other income. Capital income is defined as the sum of interests, dividends and imputed returns on real estate, minus interest paid. Income is taxed on an individual basis in the Netherlands. However, the capital income earned by a household, is taxed jointly with the income of the primary earner. There are thus no opportunities to shift capital-income to the lowest earning partner as in Alan et al. (2010). Because the income tax in the Netherlands is progressive, the capital-income tax rate depends on the overall income earned by the primary earner.

Unlike most other tax systems, the Dutch capital-income tax does not tax capital gains in any form. Hence, if the assets of a household increase in value this does not result in an extra tax burden for the household, even when the capital gain is realized.

On top of the capital-income tax, the Dutch government levies a wealth tax. Wealth is defined as the difference between taxable assets and loans. The wealth tax is progressive, in the sense that it only applies above a threshold value. Above the threshold value, the tax rate is constant.

Towards the end of the 20th century the Dutch government had to modernize its system of capital-income and wealth taxation. Through financial innovation some households were able to buy financial products that converted interests and dividends into capital gains, hence avoiding the capital-income tax entirely. The reform passed through parliament in the middle of 2000 and came into force on January 1 of 2001. To circumvent any possible announcement effects, I always use 1999 as the base year in my analysis.

The 2001 reform changed both the capital-income and wealth tax system in a radical fashion. The Dutch government no longer taxes capital income stemming from financial wealth. To compensate for the loss in revenue, the government replaced the wealth tax of 0.8 percent with a *de facto* wealth tax of 1.2 percent.[2] The threshold, above which a household is subject to the wealth tax, was also lowered significantly.

To my knowledge the Netherlands is the only country in the world that taxes financial wealth, without also taxing capital income from financial wealth. The argument behind this unique tax reform was a strive for simplicity. It is (somewhat) easier to measure the value of assets, than it is to measure the return.

[2]The Dutch government describes the new wealth tax as a capital-income tax. However, the tax burden is based on imputed rather than actual returns. The government assigns an imputed return on wealth equal to 4 percent for all households. This imputed return is in turn taxed at 30 percent leading to a *de facto* levy on wealth of 1.2 percent. Up to now the government has never adjusted the imputed rate of return, despite strong fluctuations in the nominal interest rate. In addition, there is no way to appeal the imputed return if you, for instance, received a negative return during a particular year. As such, the tax is more easily understood as a wealth tax, than as a capital-income tax.

Taxable housing income is typically negative, because interest on the mortgage exceeds imputed rents. Therefore, imposing the same reform on housing wealth would have lead to a large increase in tax liabilities for home owners. To circumvent this, owner occupied housing was exempted from the new wealth tax. Instead, housing income continues to be taxed jointly with the labor income of the primary earner in the household.

The government simultaneously adjusted tax rates which results in large variation in the tax burden of households.[3] A full overview of all the tax rate before and after 2001 is given in table 1. Note that the tax rates and thresholds in the table apply to a single-person household below the age of 65. Tax rates in the first two tax brackets of the income tax are lower for individuals below the age of 65. Moreover, the threshold in the wealth tax is doubled when the main occupants of the household are married, or have a cohabitation contract. Exact adjustment tables can be found in the Appendix. There are also a number of tax credits and deductions that influence the marginal income tax rate of the household. In the empirical model I take each of these considerations into account when calculating the marginal income, and wealth tax rate a household faces. The interested reader is referred to Bovenberg and Cnossen (2001) for a more comprehensive overview of the tax reform.

	Pre-reform 1999			**Post-reform 2001**		
Wealth Tax						
Applies to	Financial and Housing Wealth			Financial Wealth		
Threshold	89,395			16,818		
Tax rate	0.70%			1.20%		
Income Tax						
Applies to	Sum of All Income			Sum of Labor and Housing Income		
Tax Brackets	Starting	Up to	Percentage	Starting	Up to	Percentage
Bracket 1	0	6,807	35.75%	0	14,209	32.35%
Bracket 2	6,807	21,861	37.05%	14,209	25,808	37.60%
Bracket 3	21,861	48,080	50%	25,808	37,408	42%
Bracket 4	48,080	∞	60%	37,408	∞	52%

Note: The table gives an overview of the pre- and post-reform wealth and income tax in the Netherlands. Deductions and credits apply to a single household without children. Tax rates apply to all income earners below 65. All monetary values are expressed in 1999 euros.

Table 1: Overview of the Tax System

My data does not accurately reflect pension wealth, and during the period under consideration it is in fact impossible to assign pension wealth to individual households. In the remainder of this section I give a brief explanation of the Dutch pension system, and explain why ignoring pension wealth is unlikely to have a large impact on the empirical results.

2.1 Tax-deferred pension wealth

The Dutch pension system rests on three pillars. The first pillar is a pay-as-you-go (PAYG) pension system that is available to everyone above the age of 65. PAYG pension benefits are a general transfer, and as such independent of the income earned during the working life of the

[3] Jongen and Stoel (2016) study the elasticity of taxable labor income using the same reform.

individual. PAYG pension income is taxed together with other income of the household. The PAYG pension is financed through a tax on income from individuals below the age of 65, which is why income tax rates in the Netherlands are higher for individuals below the age of 65, than for those above. The PAYG pension is not affected by the reform

The second, and largest pillar of pension wealth are employer pension funds. Collective labor agreements between employer organizations and unions require employers to set up a pension fund or to join in a sectoral pension funds. Employers and employees are required to make contributions to the fund as a percentage of the wage of the employee. Total savings of the pension funds amount to 138% of GDP in 2013 and are thus a significant portion of total savings. Unfortunately, for the studied period, pension funds did not keep records on pension wealth of individual employees and there is no reliable way to reconstruct pension wealth for households. Fortunately, behavioral responses at the household level are unlikely, because the size of the contributions is set in negotiations between unions and employers. As such, ignoring them is unlikely to bias the result of this study.

In addition to employer pension funds, Dutch households can also save for their pension through private pension plans, comparable to IRAs in the US. This is the third pillar of the Dutch pension system. Under some strict conditions the tax system treats these private pension plans similarly to funds in employer pension funds. Since private pension plans are tax exempt they are not accurately reflected included in my data. However, due to large administrative costs incurred when buying private pension plans, they make up only a small percentage of overall wealth. Hence, ignoring these savings is unlikely to affect the results very much. Moreover, note that private pension plans are most interesting to the self-employed because the self-employed do not have access to employer pension funds. Hence in my robustness analysis I include a specification where this group is excluded to see whether my results are affected by the exclusion of private pension funds.

On top of these formal pension arrangements many households supplement their pension through investment in housing, real estate, bank accounts, stocks etc. These investments are taxed according to the normal wealth and capital-income tax, and therefore they are part of the analysis.

3 Data Description

The data used for the analysis is the Income Panel Investigation (IPO) provided by Statistics Netherlands. The IPO follows about 0.61 percent of individuals in the Dutch population in the period 1989-2010, and it follows all the household members of the original 0.61 percent. In 1989 the dataset contained data on 210,000 individuals in 75,000 households. The size of the sample has steadily increased to correct for the increase in the population by adding newborns and immigrants such that the final sample size in 2010 consists of 270,000 individuals in 94,000 households. The sample is not entirely representative for the Dutch population because some groups were deliberately oversampled. However, sampling weights are provided. Individuals in the panel are unaware of their participation in the sample.

For the purpose of this study, the IPO has been extended to contain administrative data

on household taxable wealth. Data are collected at the household level through administrative records. Taxable wealth can be reliably subdivided into two categories: housing wealth, and financial wealth.[4] Housing wealth is defined as the difference between the value of the house and the value of the mortgage. The valuation of the price of the house is determined by municipalities who levy a small tax on real estate. The valuation is a relatively accurate reflection of the market valuation of the house, as it is based on the price of houses that were recently sold in the neighborhood, as well as on some measurable characteristics of the house, such as the living area within the house.[5] Financial wealth is defined as the difference between overall observable wealth, and housing wealth.

The dataset also contains reliable information on taxable capital income prior to the reform. The data includes dividends, interests and imputed rents on all taxable income from financial assets and housing. After the reform, capital income on financial wealth is no longer taxable, and hence, not accurately observed. In the Methodology section, I discuss under which assumptions this lack of observability does not influence the results.

The dataset also contains additional information at the individual level such as primary income from labor, transfers, subsidies, gross income, taxable income after deductions, net income and disposable income. Demographic variables such as age, and country of origin are also included.

In this paper I use IPO data from 1995 to 2004. Of the total sample of households around 70,000 are consistently in the sample in the period 1999-2001. Of these, I drop all households where the primary earner reports a negative taxable income during any year. I also remove all households with wealth levels below 10,000 euros. Most households in this group do not pay wealth tax or capital-income tax. Hence, the reform does not provide variation in their rate of return. They also do not serve as a control group, since in my main specification I include non-parametric controls for base-year wealth. Note that this is a quite large group, because the distribution of wealth in the Netherlands, as in most other countries, is strongly skewed to the right. In addition, I drop outliers in terms of taxable returns on financial and housing wealth. The reason is that a small fraction of households appears to have a taxable return that is either unrealistically large, or unrealistically small (negative). Returns are calculated by dividing the income from financial wealth (housing wealth) through financial wealth (housing wealth). Therefore, it is likely that the outliers are the result of incorrectly entered wealth levels. The outlier procedure I use simply removes the top and bottom 1 percent in terms of each of the returns. After the outliers are removed, returns are within realistic boundaries.

After data selection the short-run sample from 1999-2001 consists of around 37,000 households, whereas the long-run sample from 1999-2004 consists of 32,000 households. Table 2 provides summary statistics.

[4]The data does contain a further subdivision of financial wealth into stocks, bonds, bank accounts, real estate and loans. However, since the tax burden of the household does not depend on this subdivision, it is not entirely clear how reliable this data is. Hence, I ignore the subdivision in the analysis.

[5]It is possible to appeal the valuation, and many households do this. Because appeals can only result in lower housing values, housing values may still be downward biased.

Variable	Pre-reform	(1995-1999)	Postreform	(2001-2004)
	Mean	Mean Std	Mean	Mean Std
Single	0.082	0.272	0.063	0.242
Couple	0.376	0.484	0.391	0.488
Single with child	0.010	0.098	0.007	0.081
Couple with child	0.532	0.499	0.540	0.498
Nr Children<18	1.002	1.089	1.101	1.177
Nr Household Members	3.072	1.206	3.350	1.248
Age	41.117	9.339	45.797	9.435
Wealth	118,965	118,343	219,544	244,821
Share Financial Wealth	0.279	0.261	0.220	0.209
Primary Household Labor Income	49,143	23,935	58,093	31,817
Effective Wealth Tax Rate	0.005	0.003	0.007	0.006
Marginal Income Tax Rate	0.438	0.077	0.423	0.052
Net After-Tax Return Financial Wealth	0.007	0.203	0.006	0.034
Net After-Tax Return Housing Wealth	-0.087	0.313	-0.023	0.144
Net After-Tax Return Total Wealth	-0.029	0.132	-0.013	0.035

Note: Summary statistics of the filtered sample. All monetary values are expressed in 1999 euros. Post-reform returns are calculated under the assumption that before-tax returns remain equal, such that only the tax rate changes. Mean std denotes the mean standard deviation over all years.

Table 2: Summary Statistics for Main Estimation Panel

4 Conceptual Framework

The main objective of this study is to relate household savings to changes in capital-income and wealth taxation. To structure the analysis I set up a simple two-period model, and show how (changes in) tax rates affect the household's intertemporal budget constraint. I show that changes in the tax rate only affect the incentive to save through their impact on the rate of return. I then show how the Dutch tax reform affects the rate of return. In the final subsection, I discuss the limitations to this basic framework.

4.1 Setup

Households are assumed to live for two periods. During each period households earn income and consume a general consumption good. Let Y_i denote disposable labor income of household i, and let C_i denote consumption. I abstract from labor supply responses, and assume Y_i is exogenously given.

In the first period households can invest part of their income into two assets: housing wealth w_i^H, and financial wealth w_i^F. Let $W_i \equiv w_i^H + w_i^F$ denote the total wealth of the household.

I assume that the returns on both assets are known with certainty prior to investment. The return on housing and financial wealth can be subdivided into two components. First, assets generate a return that is not taxable under Dutch tax law. The untaxed return of household i on asset j is denoted by ρ_i^j. The untaxed returns include capital gains, and the consumption benefits of owning real estate. Second, assets generate a taxable return. As discussed in the previous section, taxable returns consist of returns paid in cash, such as interests and dividends,

and imputed rents on real estate and owner-occupied housing. Taxable returns are denoted by r_i^j. Taxable returns may be negative when the interest a household pays over its loans exceeds the interests, dividends and imputed rents the household receives over its assets. This is particularly relevant for housing wealth, because for most Dutch households the interest paid over the interest on the mortgage exceeds the imputed rent.

Households face two types of taxes on their investments. First, households pay a capital-income tax on the taxable return of each asset. Let T_i^j denote the marginal tax rate a household pays over the taxable return on asset j. In addition, households pay a wealth tax. Let τ_i^j denote the marginal wealth tax a household pays over asset j. It follows that the gross marginal rate of return on each asset after taxation can be written as:

$$R_i^j = 1 + \rho_i^j + \left(1 - T_i^j\right) r_i^j - \tau_i^j. \tag{1}$$

The rate of return on the portfolio can be found by weighting the return of each asset by the share invested in each asset:

$$R_i = \alpha_i^F R_i^F + \left(1 - \alpha_i^F\right) R_i^H, \tag{2}$$

where $\alpha_i^F \equiv \frac{w_i^F}{W_i}$ is the portfolio share invested in financial wealth.

I will treat the portfolio share of the household as exogenous to focus the analysis squarely on the effect of the tax reform on overall savings. Under this assumption the only choice faced by the household, is how much of its first-period income to save for the next period. The household budget constraint in the first and second period are given by:

$$C_{i,1} = Y_{i,1} - W_i, \tag{3}$$

$$C_{i,2} = Y_{i,2} + R_i W_i + V_i, \tag{4}$$

where V_i denotes virtual income. To understand the role of V_i, recall that R_i denotes the marginal rate of return. For various reasons, including progressive taxation, the marginal rate of return may differ from the average rate of return, and hence the true budget constraint is non-linear. Equation (4) linearizes the budget constraint around $W = W_i$. V_i is the intercept of this linearized budget constraint.

As can be seen in the budget constraints, taxation of wealth and capital income only enters the budget constraint through the rate of return, R_i. Therefore, within this basic framework the effect of the tax reform on the incentive to save for household i is equal to the effect of the tax reform on R_i. In the next subsection, we discuss how the tax reform affects R_i.

4.2 Impact of the Tax Reform

In this subsection I consider the impact of the tax reform on R_i. The tax reform generates variation in R_i by affecting the capital-income and the wealth tax rate. In particular, prior to the reform the tax system treated housing wealth and financial wealth symmetrically. Mathe-

matically:

$$\begin{aligned} T_{ib}^{H} &= T_{ib}^{F}, \\ \tau_{ib}^{H} &= \tau_{ib}^{F}, \end{aligned}$$

where subscript b refers to the before-reform period. After the reform each of the assets is taxed differently, since housing wealth is no longer subject to the wealth tax, while financial wealth is no longer subject to the capital income tax:

$$\begin{aligned} T_{ia}^{H} &\neq T_{ia}^{F} = 0, \\ \tau_{ia}^{F} &\neq \tau_{ia}^{H} = 0, \end{aligned}$$

where subscript a refers to the after-reform period. Moreover, the marginal capital-income and wealth tax rates of households changed, due to changes in rates and thresholds. How these changes affect the overall rate of return R_i can be seen by studying equations (1), and (2).

Equation (1) shows that returns on each asset unambiguously decrease in the wealth tax. Hence, the removal of wealth taxation from housing wealth unambiguously increases the rate of return on housing wealth, for those households that were subject to wealth taxation prior to the reform. Contrary, most households saw an increase in their wealth tax rate on financial wealth, as both the threshold was lowered, and the tax rate was increased. Therefore for most households, the wealth tax reform lowered the return on financial wealth.

The effect of the capital-income tax reform on the rates of return is ambiguous. If taxable returns are positive, $r_i^j > 0$, the rate of return decreases in the capital-income tax rate, T_i^j. On the other hand, if taxable returns are negative, the rate of return increases in T_i^j. For most households in the sample, taxable returns on financial wealth are positive. As a result, the after-tax rate of return on financial wealth increases through the removal of capital-income taxation on financial wealth. On the other hand, most households face a negative taxable return on housing wealth. Since, for most households the income tax rate was lowered, the reform causes a decrease in the after-tax return on housing wealth.

Summarizing, the reform of the wealth tax reduces the return on financial wealth, and increases the return on housing wealth for most households. Conversely, the reform of the capital-income tax increases the return on financial wealth and reduces the return on housing wealth for most households.

However, as can be seen from the discussion above, the overall impact of the reform on the rate of return, R_i, is highly heterogeneous between different households. The impact varies with the taxable rate of return r_i^j, the portfolio weight α_i^F, and the the change in the tax rates ΔT_i^j, $\Delta \tau_i^j$ faced by the household. The variation in the tax rates in turn varies with age, because primary earners over 65 are taxed at a lower rate, household composition since the threshold value in the wealth tax depends on how many partners are in the household, base year income, as capital income is taxed together with other income according to a progressive tax schedule, and base year wealth, because wealth taxation only applies above a threshold. The variation in the rate of return therefore depends upon six factors, which can also interact.

The asymmetric impact of the reform is depicted in figure 1 and 2. The figure shows the

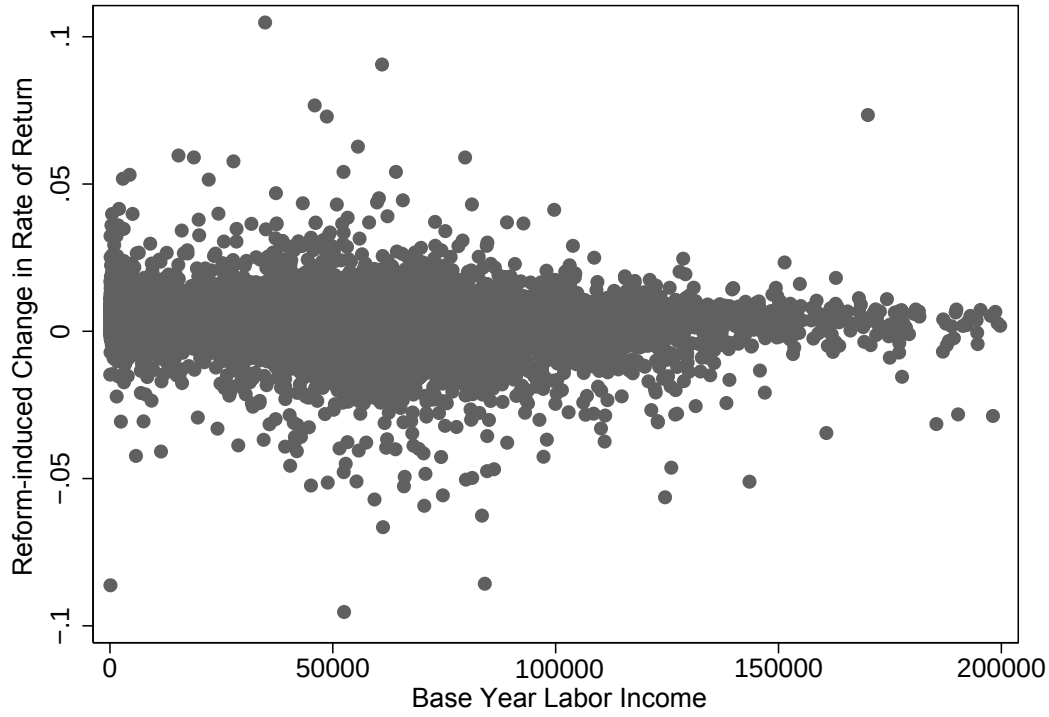

Figure 1: The reform-induced change in the rate of return vs base year income of the primary earner

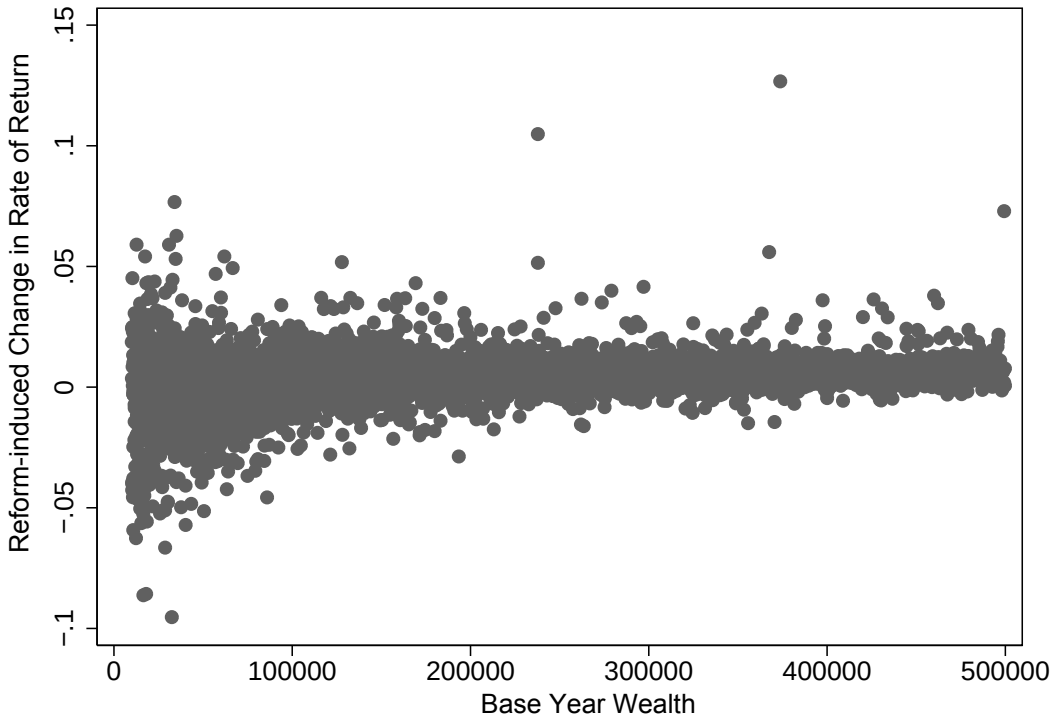

Figure 2: The reform-induced change in the rate of return vs base year wealth

change in the rate of return, R_i, induced by the reform on the vertical axis. Figure 1 has taxable income on the horizontal axis, and figure 2 has taxable wealth on the horizontal axis. The change in the rate of return is calculated under the assumption that only the tax variables T_i^j, and τ_i^j change, while r_i^j and ρ_i^j remain constant. As can be seen, the reform provides variation at each wealth, and each income level.

The discussion above also shows that a reduced-form regression does not yield any meaningful insights. For example, consider a reduced-form regression between the change in household wealth, and the change in the capital-income, and wealth tax rate. The coefficient one would find on both tax variables would be meaningless, because the way the rate of return is affected by changes in the tax rate depends on the taxable rate of return r_i^j and portfolio composition α_i^F.

Instead, to analyze the impact of the Dutch tax reform on household wealth, it is necessary to make a structural assumption. In the theoretical model derived above, the tax rates only affect the savings decision of households through their impact on the rate of return. Following the theoretical model, I therefore assume that the relative change in the rate of return over the reform, $\log R_{ia} - \log R_{ib} \equiv \Delta \log R_i$ is a "sufficient statistic" for the impact of the tax reform on the incentive to save for Dutch households. That is, the impact of the tax reform on the incentive to save for households is fully captured by $\Delta \log R_i$. The main regression equation in this paper therefore regresses the relative change in savings, $\Delta \log W_i$, on $\Delta \log R_i$. I discuss the econometric methodology in more detail in the Methodology section. Below I discuss how sensitive the conclusion that $\Delta \log R_i$ is a sufficient statistic is on the assumptions made in the model.

4.3 Discussion of Assumptions

The theoretical model above relies on a number of strong assumptions. I will discuss the sensitivity of the result that $\Delta \log R_i$ can serve as a sufficient statistic, with respect to the assumptions below.

First, I assume the world ends after two periods. In a multi-period framework, the household's intertemporal budget constraint takes a similar form (see e.g. Bernheim (2002)). However, one needs to take care to control for life-cycle effects. If variation in the rate of return is correlated to the age of the household, this may bias the relationship between wealth and the rate of return. In the empirical analysis I control for life-cycle effects by including age and household-composition dummies.

Second, I assume returns and income are known with certainty. In a setting where returns are uncertain the expected rate of return decreases in both the capital-income tax rate and the wealth-tax rate, similar to the model discussed above. However, the capital-income tax would in addition reduce the volatility of returns (see Domar and Musgrave (1944); Sandmo (1969)). This adds an extra dimension of complexity to the analysis, implying that $\Delta \log R_i$ can no longer serve as a sufficient statistic for the impact of the tax reform.

Fortunately, this is not likely to be relevant for the Dutch capital-income tax. To see this, note that the Dutch tax system only taxes returns in the form of interest, dividends, and imputed rents on real estate. Imputed rents, and most interest payments are known with certainty prior

to investments. Dividend pay-outs are arguably somewhat more volatile, but are still far less volatile than capital gains (see e.g. Shiller (1981) and LeRoy and Porter (1981)). Moreover, dividend pay-outs are only a small fraction of the overall taxable returns on capital income. Hence, the most logical way to incorporate uncertainty in the rate of return in the model above, is by assuming that untaxable returns, ρ_i^j, are random, while taxable returns r_i^j are not. In such a setting, the Dutch capital-income tax does not affect the volatility of investment returns.

In a setting with income uncertainty, households have an additional incentive to save: to smooth consumption across different states of the world. This may affect results when shocks in income are correlated to changes in the rate of return. To account for this I include non-parametric controls for income in the regression framework.

Third, I assume that households observe the change in the rate of return when they make their financial decisions. In reality households may make optimization errors. In that case the estimates obtained in the model would provide a lower bound because optimization errors attenuate the estimated effect of the rate of return on wealth accumulation, but this has no effect on the overall structure of the model (see Chetty (2012)).

It is of a larger concern if either capital-income or wealth taxation is more salient to tax payers (see Chetty et al. (2009)). In that case, $\Delta \log R_i$ is clearly no longer a sufficient statistic, as changes in one tax rate will be more salient than changes in the other independent of how they affect $\Delta \log R_i$. However, this is unlikely to be an issue, because income and wealth taxation are administered on the same tax return form in the Netherlands.

Fourth, in the model I assume that the portfolio weight, α_i^F, is exogenous. In reality portfolio shares may be endogenous for two reasons. First, rational households may want to update their portfolio composition as a result of the reform. Second, households may be constrained in adjusting housing wealth implying that changes in overall wealth are absorbed in changes in financial wealth. I deal with this using an IV strategy, of which the details can be found in the Methodology section.

Finally, from a theoretical perspective I would ideally estimate the elasticity of wealth with respect to the after-tax *net* rate of return, because this elasticity can serve as a sufficient statistic for policy analysis (see Saez and Stantcheva (2018)). However, empirically I run into two issues. First, I do not observe capital gains, and hence, it is difficult to determine the *level* of the rate of return of a household. This is not a large issue when determining the relative change in the gross-rate of return, because $\Delta \log R_i \approx \frac{\Delta R_i}{R_{ib}} \approx \Delta R_i$, since $R_{ib} \approx 1$ for most households. However, it is a large issue when calculating the relative change in the net-rate of return since $\Delta \log(R_i - 1) \approx \frac{\Delta R_i}{R_{ib}-1}$. Therefore, the relative change in the net-rate of return strongly depends on the level of the rate of return. As a result, to calculate the relative change in the gross-rate of return, I (by approximation) only need to to observe the absolute change in the gross rate of return. However, to calculate the relative change in the net-rate of return I need to observe both the change and the level of the rate of return. A second issue is that some households earn negative net returns, in which case it is possible and meaningful to calculate the relative change in the gross rate of return, but it is not meaningful to calculate the relative change in the net rate of return.

5 Methodology

The main regression equation in this paper links the change in wealth of the household to the change in the rate of return:

$$\Delta \log W_i = \gamma + \varepsilon \Delta \log R_i + X_i \beta + \xi_i, \tag{5}$$

where γ is a constant capturing the growth of wealth in the absence of changes in R_i, ε is the elasticity of wealth with respect to the gross rate of return, X_i is a vector of control variables, and ξ_i is the error term. In the regression I use 1999 as a base year, because wealth in 2000 may have already been adjusted due to announcement effect. For the post-reform year I use 2001 to measure the short-term impact of the reform, and 2004 to measure the long-term impact. Hence, the Δ operator either refers to the two-year difference between 2001 and 1999, or the five-year difference between 2004 and 1999.

Without additional control variables equation (5) can be seen as a difference-in-difference regression equation with a continuous treatment variable, $\Delta \log R_i$. Identification then relies on the assumption that wealth grows at the same rate for households that are treated differently by the reform. In the next section I inspect this common trend assumption graphically.

The remainder of this section focuses on three issues. First, I discuss how control variables relax the common-trend assumption. Second, I consider issues related to the observability of the returns. Finally, I discuss potential endogeneity concerns, and show how I deal with them using an instrumental variable approach.

5.1 Control Variables

In the regressions I include age dummies for the primary earner in the household to control for life-cylce effects. Further, I include controls for the household composition of the household. I differentiate household composition into four categories: singles with and without children, and couples with and without children. To fully control for possible household composition transitions over the reform, I assign the full set of dummy variables for each possible transition between the four states. In addition, I control linearly for the number of household members in the household, and for the number of children below 18.

The main methodological contribution of this paper is the inclusion of dummy variables for the income and wealth deciles a household was in, in the base year. Previous papers in the literature on the elasticity of taxable income also include dummies for base year deciles (see e.g. Gruber and Saez (2002)). However, these regressions span the reform period as well as a pre-reform periods. As a result, the coefficients on the dummies are effectively identified on the basis of pre-reform years, and extended linearly to the reform period. Hence, the dummies only control for heterogeneity in growth rates, in as far as the heterogeneity evolves linearly.

Contrary, I only consider a single cross-section and identify both the treatment effect and the decile-dummies solely on the basis of the reform period. The reason this is possible is that the Dutch tax reform, unlike most other tax reforms, provides variation in the rate of return within each income and wealth decile.

By including non-parametric controls for household wealth, income, age and composition I

relax the common-trend assumption. Without control variables the common-trend assumption requires that wealth of households that are treated differently by the reform grows at the same rate in the absence of treatment. With my non-parametric controls, I only require a common trend among households that are similar in terms of income, wealth, age and composition.

Finally, in some of my specifications I control for the log of labor income earned over the reform period, as households that earn more labor income may have more income available for saving. This slightly decreases the number of observations in the analysis as not all households have positive labor income.

5.2 Observability

Due to the fact that I am relying on tax data, I do not observe all components of returns. To study the main independent variable in more detail, it is useful to expand $\Delta \log R_i$ using equations (1,2):

$$\begin{aligned}\Delta \log R_i &= \Delta \log \left(\alpha_i^F R_i^F + \left(1-\alpha_i^F\right) R_i^H\right) \\ &\quad \Delta \log \left[\alpha_i^F \left(1+\rho_i^F + \left(1-T_i^F\right) r_i^F - \tau_i^F\right) + \left(1-\alpha_i^F\right)\left(1+\rho_i^H + \left(1-T_i^H\right) r_i^H - \tau_i^H\right)\right],\end{aligned}$$

where I have used the approximation $\log(1+x) \approx x$. Unfortunately I do not observe all components of $\Delta \log R_i$. Capital gains, ρ_i^j, are not taxed and therefore missing from the data. Moreover, since taxable returns on financial wealth are not taxed after the reform, they are missing from the data after the reform. To circumvent this issue, I calculate $\Delta \log R_i$ ignoring changes in r_i^j, and ignoring ρ_i^j completely.[6] Mathematically:

$$\Delta \log R_i \approx \Delta \log \left[\alpha_i^F \left(1+\left(1-T_i^F\right) r_{ib}^F - \tau_i^F\right) + \left(1-\alpha_i^F\right)\left(1+\left(1-T_i^H\right) r_{ib}^H - \tau_i^H\right)\right], \qquad (6)$$

where r_{ib}^j is the taxable return on asset j prior to the reform. This approximation does not bias the estimate of ε as long as changes in the pre-tax rate of return are uncorrelated to the tax reform after controlling for X_i. For financial wealth this assumption is likely satisfied. The Netherlands is a small open economy and it is unlikely that the Dutch tax reform affects world market returns in any significant way. On the other hand, returns in the housing market might be affected by the tax reform. However, this does not affect the estimates as long as the effect of the tax reform on the housing market is symmetric for all households, or its effect is asymmetric, but absorbed by the control variables in X_i. This latter scenario seems likely. Although households with different wealth or income levels may face different shocks in their before-tax housing return, it is difficult to see how within wealth and income groups the change in housing returns is directly related to the tax rate.

5.3 Instrumental Variable Approach

Two sources of reverse-causality may bias a direct estimation of equation (5) using OLS. First, because both the capital-income, and the wealth tax are non-linear, changes in W_i may affect

[6] For consistency I also drop the information on taxable returns for housing wealth after the reform, even though this information is present in the data.

the rate of return. This is not likely to be a concern for the capital-income tax rate, because capital income is taxed together with non-capital income. Non-capital income is typically orders of magnitude larger than capital income. Therefore, it is unlikely that capital-income tax rates are affected by changes in W_i. Hence, the variation in the capital-income tax rate of a household is plausibly exogenous to wealth accumulation.

However, the wealth tax rate is affected by W_i, because the wealth tax only applies to wealth beyond a threshold. Intuitively, if a household receives a positive shock to its wealth, $\xi_i > 0$, this may push the household beyond the wealth tax threshold, which in turn lowers its rate of return. This creates a spurious negative correlation between the error ξ_i and the independent variable $\Delta \log R_i$.

The second source of endogeneity follows from possible rigidities in portfolio composition. As discussed in the previous section, households may not be able to adjust the amount invested in housing wealth. In that case, households who receive a large shock in their wealth, $\xi_i > 0$, mechanically see an increase in the portfolio weight for financial wealth α_i^F, which in turn affects the independent variable $\Delta \log R_i$. This also produces a spurious correlation between ξ_i and $\Delta \log R_i$, although the direction of the bias is less clear.

I deal with both sources of endogeneity through an instrumentable variable approach. Following Gruber and Saez (2002), I instrument $\Delta \log R_i$ with what the relative change in the rate of return would have been under unchanged behavior. I define unchanged behavior by two conditions: i.) portfolio shares after the reform, are equal to portfolio shares in the base year, $\Delta \alpha_i^F = 0$, and ii.) real wealth after the reform is equal to real wealth in the base year, $\Delta W_i = 0$. I then calculate the change in the wealth tax that would have occurred under unchanged behavior, and denote it by $\widetilde{\Delta \tau_i^j}$. The rate of return under unchanged behavior is thus calculated as follows:

$$\widetilde{\Delta \log R_i} \approx \Delta \log \left[\alpha_{ib}^F \left(1 + \left(1 - T_i^F \right) r_{ib}^F - \widetilde{\tau_i^F} \right) + \left(1 - \alpha_{ib}^F \right) \left(1 + \left(1 - T_i^H \right) r_{ib}^H - \widetilde{\tau_i^H} \right) \right],$$

where α_{ib}^F denotes the pre-reform portfolio share of financial wealth.

My estimation strategy can thus be summarized as follows. First, I use equation (6) to approximate the independent variable $\Delta \log R_i$. Second, I estimate equation (5) using two-stage least square regression where I instrument $\Delta \log R_i$ with $\widetilde{\Delta \log R_i}$.

Weber (2014) criticizes the instrumentation strategy developed by Gruber and Saez (2002). I consider her suggestions in a robustness exercise.

6 Results

6.1 Graphical Evidence

Figure 3 provides graphical evidence of the impact of the tax reform on accumulated wealth. Households are divided in four quartiles based on the value of the instrument $\widetilde{\Delta \log R_i}$. The first quartile consists of the 25 percent of households that have seen the strongest decrease in their rate of return as a result of the reform. The fourth quartile consists of the 25 percent of households whose rate of return has increased most through the reform. The reform was, on

average, most costly for households with low levels of wealth as can be seen by the fact that the first quartile also has the lowest level of wealth prior to the reform. The other 3 quartiles have very similar wealth levels.

Prior to the reform, wealth of each of the four groups appears to follow a common trend. Between 1995 and 1999 log wealth for each of the four groups increased by between 0.65-0.75, although for the first quartile the pattern is more noisy than for the other 3 group. This implies that the common-trend assumption is likely satisfied, even without the inclusion of control variables.

The graph also provides some evidence that the tax reform has affected wealth accumulation. The growth in log wealth between 1999 and 2001 is somewhat weaker for the first quartile than for the other quartiles. This is consistent with the hypothesis that households save more when their rate of return increases. However, differences between the other three quartiles are not readily discernible in the graph.

6.2 Main Result

In table 3 I study the effect of a relative change in the rate of return on savings, where I instrument the relative change in the rate of return by what the relative change in the rate of return would have been under unchanged behavior. The instrument is strong with the F-statistic typically exceeding 100, and always exceeding 20 as is typical in the literature (see e.g. Weber (2014)).

Panel A represents the short-run results. In the main specification a 1 percent increase in the gross rate of return increases savings by around 11.6 percent in the short run. The elasticity is significant at the 1 percent levels.

Long-run elasticities are only slightly higher with an elasticity of around 13.8 as can be seen in panel B. The small difference between short-run and long-run elasticities is somewhat surprising. Most of the adjustment in wealth occurs in the first year. It appears unlikely that such small differences between short- and long-run responses are the result of changes in real savings behavior. In life-cycle models it takes time to adjust wealth to a new steady state after a change in the rate-of-return (see e.g. Bernheim (2002)). Therefore, it is likely that most of the change in taxable wealth is the result of changes in reporting behavior rather than of changes in real wealth holdings. Seim (2017) similarly finds small differences between short- and long-run responses using Swedish data.

To put the elasticity in perspective consider a 0.1 percentage-point change in the wealth tax. For reference, the current wealth tax is set at 1.2 percent such that a 0.1 percentage point change constitutes a 8 percent change in the tax rate. Such a change in the tax rate reduces the gross rate of return by approximately 0.1 percent.[7] The estimates indicate that such a change in the wealth tax rate reduces accumulated wealth by approximately 1.38 percent in the long run. This estimate is much lower than the 3.5 percent Brülhart et al. (2016) find, but significantly higher than the 0.027 upper-bound estimate found in Seim (2017).[8]

[7] Here I am assuming the wealth tax applies to all wealth, rather than just financial wealth.

[8] The estimates in Seim (2017) are not directly comparable because he calculates the elasticity of taxable with respect to the net-of-wealth-tax rate $1 - \tau_i$ rather than with respect to the gross rate of return R_i. However, since the tax rate in Sweden is only 1.5 percent, a 0.1 percentage-point increase in the wealth tax reduces the

	(1)	(2)	(3)
VARIABLES	Main	Earned Income	No Splines
Panel A: Short-Run Results			
$\Delta \log R_i$	11.62***	13.00***	5.447***
	(1.125)	(1.020)	(0.906)
Log Earned Income 1999-2001		0.0122***	
		(0.00264)	
Household and Age Dummies	YES	YES	YES
10-piece spline for Income/Wealth	YES	YES	NO
Nr of Observations	37,095	35,632	37,095
R-squared	0.069	0.073	0.059
Panel B: Long-Run Results			
$\Delta \log R_i$	13.79***	13.84***	5.447***
	(1.899)	(1.936)	(1.547)
Log Earned Income 1999-2004		0.00980***	
		(0.00377)	
Household and Age Dummies	YES	YES	YES
10-piece Spline for Income/Wealth	YES	YES	NO
Nr of Observations	32,447	31,322	32,447
R-squared	0.088	0.089	0.080

Note: The dependent variable is the relative change in household wealth between 1999-2001 for the short-run results, and between 1999-2004 for the long-run results. The main independent variable is change in the rate of return, $\Delta \log R_i$. The regression equation is estimated using IV (2SLS). The instrument for $\Delta \log R_i$ is the change in the rate of return under unchanged behavior. Wealth (Income) splines are dummy variables indicating in which decile of the wealth (income) distribution the household was in 1999. Age and household controls contain dummy variables for the age of the primary income earner in the household, transition dummies for whether the household is i.) single, ii.) single with children, iii.) a couple or iv.) a couple with children before and after the reform, a linear term for the number of children and a linear term for the number of household members. Column 2 includes the log of the sum of labor income earned during the period 1999-2001 (1999-2004) for the short-run (long-run) results. Standard errors are IV-robust. Clustering the standard errors at wealth and/or income deciles does not affect the significance of the main coefficients. $***p < 0.01, **p < 0.05, *p < 0.1$. $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 3: Main Result

In the second column I include controls for labor income earned during the reform period. The coefficient on earned labor income is significant and positive, indicating that households with higher labor income save more, as expected. Controlling for earned labor income, also results in slightly higher elasticities, although the difference is not significant. It should be noted that the sample in this specification is slightly smaller due to the fact that not all households earn labor income.

Interestingly, the estimates presented in the table 3 are sizable whereas the graphical evidence in figure 3 appears rather small. The main difference between the two approaches is that the regression equation include non-parametric controls for base-year income and wealth, whereas the raw-data plot in the figure provides no such controls. Column 3 of the table excludes controls for base-year income and wealth. Consistent with the figure, this indeed leads to a large reduction in the estimated elasticity.

6.3 Heterogeneous Treatment Effect

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Main	Age<65	Home-Owners	Wealth> 75%	No Directors
Panel A: Short-Run Results					
$\Delta \log R_i$	11.62***	10.65***	5.172***	13.00***	12.10***
	(1.125)	(1.193)	(0.693)	(1.823)	(1.153)
Household and Age Dummies	YES	YES	YES	YES	YES
10-piece spline for Income/Wealth	YES	YES	YES	YES	YES
Nr of Observations	37,095	29,890	26,788	13,077	36,746
R-squared	0.069	0.085	0.192	0.140	0.071
Panel B: Long-Run Results					
$\Delta \log R_i$	13.79***	14.59***	10.55***	16.69***	13.88***
	(1.899)	(2.118)	(1.500)	(2.599)	(1.938)
Household and Age Dummies	YES				
10-piece Spline	YES				
Nr of Observations	32,447	25,213	23,167	11,636	32,148
R-squared	0.088	0.104	0.214	0.205	0.089

Note: The dependent variable is the relative change in household wealth between 1999-2001 for the short-run results, and between 1999-2004 for the long-run results. The main independent variable is change in the rate of return, $\Delta \log R_i$. The regression equation is estimated using IV (2SLS). The instrument for $\Delta \log R_i$ is the change in the rate of return under unchanged behavior. Column 2 considers households where the primary earner is below 65, column 3 only considers home-owners, column 4 only considers households in the top 75th percentile of wealth, column 5 excludes directors of closely-held corporations. The tax elasticity is the predicted decrease in the dependent variable as a result of a 1 percent increase in the wealth tax. Standard errors are IV-robust. $***p < 0.01, **p < 0.05, *p < 0.1$. $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 4: Heterogeneous Treatment Effects

In table 4 I consider heterogeneous treatment effects. For reference, the first column presents the main result. In the second column I consider only households with primary earners below 65. This does not appear to have a strong impact on the elasticity of taxable wealth.

net-of-wealth tax by approximately 0.1 percent. Combining this transformation with his upper-bound estimate of 0.27 for the net-of-tax rate elasticity, I calculate that a 0.1 percent change in the wealth tax reduces wealth by $0.1 \times 0.27 = 0.027$ percent approximately.

In the third column I consider home owners. The elasticity of this group is significantly lower in the short run. However, the long-run elasticity presented in panel B is only slightly smaller than the elasticity estimated on the full sample. Hence, households without a house adjust their wealth instantaneously to the tax reform, while the reaction of home owners is sluggish. The large difference between the short - and long-run elasticity could indicate that home-owners are less flexible in adjusting their wealth. It could be costly for home-owners to adjust their housing wealth in the short run due to long-term mortgage contracts.

The fourth column considers households whose base year wealth is in, or above, the 75th percentile. This group is slightly more responsive to the tax reform, though the difference is not large.

The final column excludes owners of closely-held corporations. This group may theoretically react differently to a tax reform, as a large part of their wealth is invested in their own corporation. However empirically, excluding this group has little impact on the estimated elasticity.

6.4 Robustness Analysis

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Main	IV 1998	IV 1997	IV 1995-1997	Includes Outliers
Panel A: Short-Run Results					
$\Delta \log R_i$	11.62***	2.328**	2.546**	1.366	4.870***
	(1.125)	(1.032)	(0.990)	(1.029)	(1.059)
Household and Age Dummies	YES	YES	YES	YES	YES
10-piece Spline for Income/Wealth	YES	YES	YES	YES	YES
Nr of Observations	37,095	34,950	33,906	30,748	41,005
R-squared	0.069	0.097	0.097	0.110	0.133
Panel B: Long-Run Results					
$\Delta \log R_i$	13.79***	4.278**	4.900**	4.826**	15.37*
	(1.899)	(1.942)	(1.913)	(2.013)	(7.930)
Household and Age Dummies	YES	YES	YES	YES	YES
10-piece spline for Income/Wealth	YES	YES	YES	YES	YES
Nr of Observations	32,447	29,691	29,014	28,342	36,514
R-squared	0.088	0.116	0.117	0.120	0.120

Note: The dependent variable is the relative change in household wealth between 1999-2001 in panel A, and between 1999-2004 in panel B. The main independent variable is the relative change in the rate of return, $\Delta \log R_i$. The regression equation is estimated using IV (2SLS) where the instrument for $\Delta \log R_i$ is the change in the rate of return under constant portfolio weight and real wealth. Column 2 presents results where the spline terms are lagged. Column 3-6 present results under different IV assumptions. Column 7 considers the sample including outliers. Standard errors are IV-robust. $***p < 0.01, **p < 0.05, *p < 0.1$. $***p < 0.01, **p < 0.05, *p < 0.1$.

Table 5: Robustness Analysis

Table 5 presents some sensitivity analysis to the main results. I first consider the sensitivity with respect to changes in the instrument as suggested in Weber (2014). In my baseline specification I use 1999 as a base year to construct my instrument $\widetilde{\Delta \log R_i}$. Weber (2014) argues that this instrument may be endogenous because of persistence in shocks to accumulated wealth. If a household who receives a positive shock to its wealth in 1999 is more likely to receive a positive (or negative) shock to wealth in the post-reform period, the instrument is invalid. She argues the

instrument should be constructed on the basis of earlier years. That is, the instrument should represent the rate of return that would have occurred had the household not changed its wealth and portfolio composition since year y where $y < 1999$.

There are two potential downsides to her approach. First, the number of observations reduces because a household needs to be in the sample for a longer time period. Second, an instrument based on lagged behavior is potentially weaker which increases bias.

Column 2 of table 5 considers the case where the instrument is based on behavior in 1998, instead of 1999. The central estimate reduces strongly in that case. Column 3 constructs the instrument based on behavior in 1997, and this results in approximately the same conclusion. Column 4 uses three instruments, based on 1995-1997 behavior respectively. In this case the elasticity drops even further, but the estimate also becomes more noisy as indicated by the larger standard error. Hence, similar to Weber (2014) I find that results are quantitatively highly sensitive to the instrumental-variable approach I use. However, qualitatively, in each case my central estimate remains lower than that found in Brülhart et al. (2016) and higher than the estimate found in Seim (2017).

In the final column I consider the impact of including the outliers that were previously removed from the sample. This leads to a wide fluctuation between short - and long-run estimates, where the short-run elasticity is far below the main result, while the long-run elasticity is somewhat above the main result. Moreover, the standard error increases a lot, in particular in the long run. This leads me to conclude that there is indeed significant measurement error in the rate of return for the outliers.

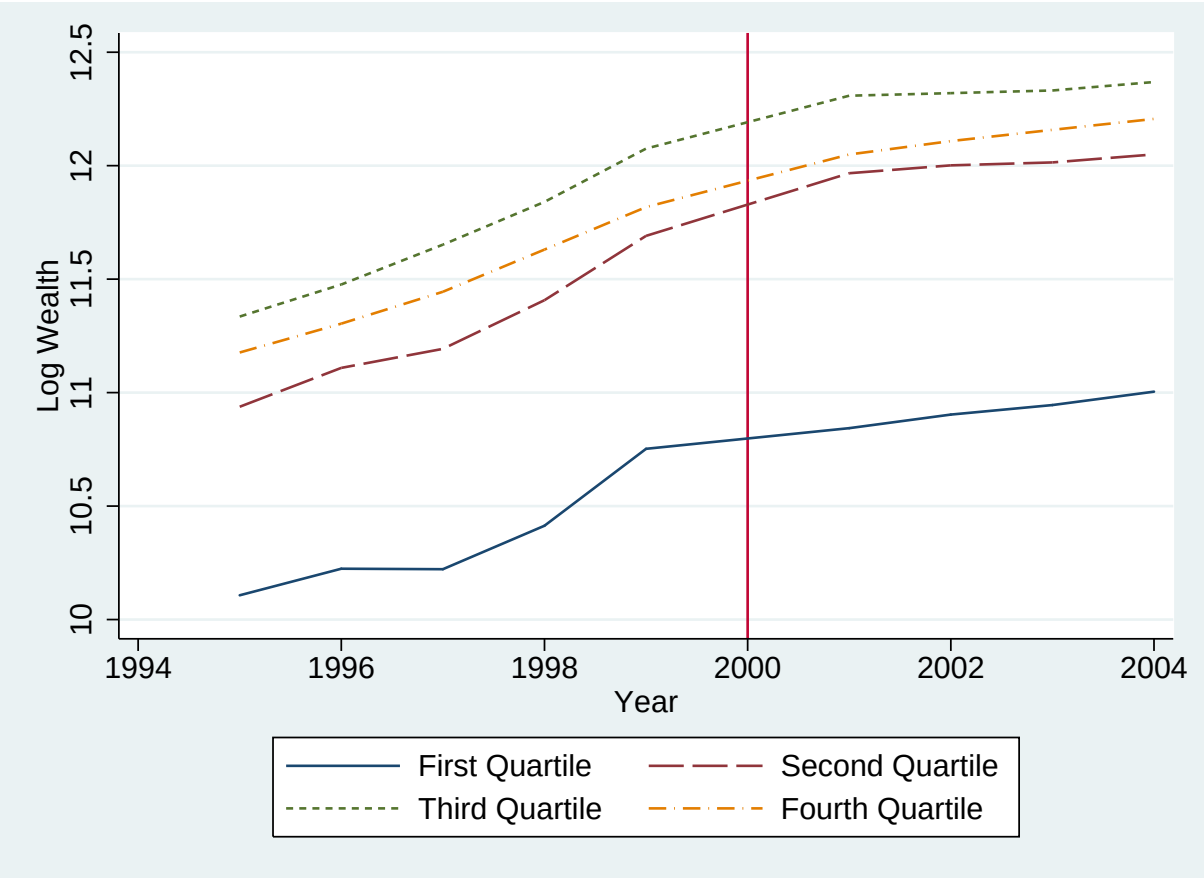

Figure 3: Graphical evidence of the impact of the tax reform

Note: Households are divided in four quartiles based on how they are affected by the tax reform. The first quartile consists of the 25 percent of households that have seen the largest decrease in their rate of return, whereas the fourth quartile consists of the households that have seen the largest increase in the rate of return.

7 Conclusion

In this paper I use the Dutch 2001 capital-income and wealth tax reform to estimate the effect of capital-income and wealth taxation on household savings. I find a significant elasiticty of taxable wealth. The estimated effect of the reform on wealth accumulation is in the middle of previous findings in the literature.

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A Tax Schedules for Other Household Types

	Pre-reform 1999			**Post-reform 2001**		
Tax Brackets	Starting	Up to	Percentage	Starting	Up to	Percentage
Bracket 1	0	6,807	17.85%	0	14,209	14.45%
Bracket 2	6,807	21,861	19.15%	14,209	25,808	19.70%
Bracket 3	21,861	48,080	50%	25,808	37,408	42%
Bracket 4	48,080	∞	60%	37,408	∞	52%

Note: The table gives an overview of the pre- and post-reform wealth and income tax in the Netherlands for singles over 65. All monetary values are expressed in 1999 euros.

Table 6: Income Tax Rates for Households over 65

	Pre-reform 1999	**Post-reform 2001**
Wealth Tax		
Applies to	Financial and Housing Wealth	Financial Wealth
Threshold	111,630	35,200
Tax rate	0.70%	1.20%

Note: The table gives an overview of the pre- and post-reform wealth tax in the Netherlands for couples. All monetary values are expressed in 1999 euros.

Table 7: Wealth Tax Thresholds for Couples