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**Conference Paper**

## The introduction of disincentives for early retirement and its effect on labor market participation

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# Early retirement disincentives: Effectiveness and implications for distribution and welfare

August 1, 2014

–Preliminary draft, please do not circle or cite–

## **Abstract**

This paper evaluates the effectiveness of early retirement disincentives introduced in Germany and investigates the distributional, individual welfare, and fiscal implications. Therefore, we set up a detailed model of the German social security and tax system with a focus on the PAYG-pension system. Building on the fact that the institutional changes were phased in - impacting birth cohorts to a different degree - we are able to estimate the parameters of a structural dynamic retirement model. This enables us to analyze whether and to what extent disincentives are able to steer retirement behavior. The estimates are based on high quality administrative data. We also compute changes in Gini coefficients of expected remaining lifetime consumption as well as equivalent and compensating variations to assess individual welfare effects. We show that the associated welfare losses are largest for medium income individuals and are only partially compensated by recently introduced subsidies for private old age provisions. At last, we consider the fiscal implications and compute the net public returns of the introduction of retirement disincentives.

**Keywords:** dynamic programming, discrete choice, retirement behavior, tax and pension system.

# 1 Introduction

Statutory pay-as-you-go (PAYG) pension systems are under the process of major adjustments in many countries. Triggered by increasing financial pressure, this central feature of European style welfare states has been subject to fundamental reforms in order to secure its financial basis (e.g. Mastrobuoni (2009); Staubli and Zweimüller (2013); Haan and Prowse (2014); Laun and Wallenius (201X)). In some countries fundamental pension reforms were implemented as early as in the 1980s. However, in most European welfare states this reform process is still ongoing or has not started yet. So, which path to choose is currently under debate. This debate is fueled by the pressure exerted by the recent economic crisis and the experiences of the spearheading countries in terms of pension reforms can be looked upon as guidance.

The main emphasis of this study lies in the evaluation the effectiveness of early retirement disincentives that have been introduced in Germany and in the investigation the distributional, individual welfare, and fiscal implications. The contributions of our research are manifold. We estimate the parameters of a structural dynamic retirement model to answer the question of how disincentives are able to steer retirement behavior of German pensioners. These estimates are based on high quality administrative data. We also compute changes in Gini coefficients of expected remaining lifetime consumption as well as equivalent and compensating variations to assess individual welfare effects. We show that the associated welfare losses are largest for medium income individuals and are only partially compensated by recently introduced subsidies for private old age provisions. At last, we consider the fiscal implications and compute the net public returns of the introduction of retirement disincentives.

Some of Germany's major reforms undertaken in the early 1990's are fully implemented now. Hence, Germany's experiences can serve as a blueprint for countries where the reformation of the statutory PAYG pension schemes has yet to come. This is why a broad interest in the German case exists. Until the late 1970s, the German PAYG system was expanded to one of the world's most generous ones, both in terms of replacement rates and early retirement provisions. Population aging, the German reunification and high unemployment rates (Germany faced rising unemployment rates since the late 70's and another surge in the aftermath of German reunification in the

1990's), however, caused a rising fiscal imbalance. This financial pressure - not unlike the one faced by many European welfare states during the current debt crisis - forced the policymakers to react. In Germany, the eligibility age has been elevated, replacement rates have been lowered and subsidies have been introduced to stimulate private old-age provisions (e.g. Bönke, Schröder, and Schulte (2010)).

A more recent reform also introduced disincentives for early retirement through permanent pension reductions (Hanel (2010); Lüthen (2014)). The reforms undertaken and in preparation have direct implications for the financial situation of Germany's current and future pensioners. They alter the legal framework under which individual labor supply, retirement, savings or fertility decisions are made (R., Meghir, and Smith (2002); Börsch-Supan (2002); Hirte (2002); Schnabel (1999); Siddiqui (1997)). The effects are essential as statutory pensions account for about 85% of the average disposable income of the elderly population (Börsch-Supan and Reil-Held (2001)). In order to evaluate the effectiveness of the introduced disincentives for early retirement, we build on the fact that the institutional changes were phased in, impacting birth cohorts to a different degree. The evaluation of this reform is non-trivial because of a lack of intra-cohort variation such that no good control group can be constructed. We cope with this issue by investigating the comprehensive dynamic incentives regarding labor market participation and retirement behavior created by the German pension system. These dynamic incentives are taken into account by estimating a structural dynamic retirement model (see Rust and Phelan (1997) or French and Jones (2011) for other examples) using administrative data provided by the Research Data Center of the German Pension Insurance. The data cover the complete earnings biographies of mandatorily insured employees.

Based on assumptions regarding individuals' preferences (over consumption and leisure time) and a detailed modeling of the German pension, social security and tax system, the model rationalizes individual behavior. Individuals are assumed to be forward looking and maximize expected life-cycle utility in each period of time by deciding between labor market participation and retirement. Since retirement is an absorbing state, this results in an optimal stopping problem of the individuals (Rust (1987); Rust and Phelan (1997)). An individual's rationale is based on the current period's utility flow and the option value that is associated with the respective choices in a certain pe-

riod of time (Bellman’s principle of optimality). The model is estimated by the method of maximum likelihood. The estimation procedure benefits from behavioral responses to changes in the institutional framework because the additional variation helps identifying the structural parameters. On the basis of the estimated parameters and their sampling distribution we can use the model to simulate confidence intervals for post-estimation outcomes of counterfactual scenarios. This not only enables us to simulate the implications of the reform, , but also serve as the basis for further simulations of distributional outcomes, welfare effects and the fiscal implications. These results are highly relevant when discussing policy options for the reformation of statutory PAYG pension schemes.

The next Section describes the institutional setting in Germany with a focus on the PAYG-pension scheme, the introduced pension reforms and a concise overview of the key features regarding social security contributions and income tax system. Section 3 is devoted to the conceptual framework of the dynamic retirements model. In the following Section 4 we present our dataset. The core of the paper is Section 5 where we display our estimation results and conduct a policy analysis. Section 6 concludes.

## 2 Institutional setting

### 2.1 PAYG-pension scheme

The German statutory pension system is a pay-as-you-go system of Bismarckian variety. The greater majority of employees is mandatorily insured and has to pay a contribution rate up to a contribution ceiling based on their gross wage.<sup>1</sup> For their contributions the insurants acquire pension entitlements in form of earnings points. Earnings points are calculated as ratio of employee’s wage to average wage. Hence, the number of earnings points is one if the employee’s yearly wage corresponds to the average yearly wage. Over the working life, the employee accumulates earnings point until retirement. At retirement, the pension level is calculated based on these earnings points and thus the pension level mirrors the length of the working live and the average position in the earnings distribution (e.g. ? for further details.)

The pension scheme offers various retirement possibilities depending on the retiree’s

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<sup>1</sup>See Appendix X for an overview of contribution rates and contribution ceilings for different years.

individual situation. For the cohorts considered five different types of old-age pensions exist. Here we consider the *regular old-age pension* that can be claimed after age 65 and the *pension for long-term insured* that is open after 63 but needs a waiting period of 35 years.<sup>2</sup> Further there are pensions for the previously unemployed, the disabled and a special pension for women, which can be claimed at age 60.<sup>3</sup> The focus of our study lies on agents who have a choice between continuing to work and starting retirement and therefore we abstract from previously unemployed and/or disabled persons. Women are excluded due to the low number of cases when focussing on consistent employment biographies. The reform analysis thus concentrates on men with a stable working career, whom are eligible to retire at age 63 even if they choose to work longer.

## 2.2 Introduction of early retirement disincentives

Cohorts born after 1936 are affected by a major pension reform in 1992, which introduces permanent pension deductions of 0.3% per month retiring before 65. The deductions are gradually phased in and came into full affect for birth cohorts born after 1938. The deductions start in January 1937 and increase by 0.3% per month up to 7.2% for those born after 1938. The deduction level results from the distance (in month times 0.3%) between the actual retirement age and 65.<sup>4</sup> Still, all cohorts are still allowed to retire at 63. Table 1 provides an overview and exemplary date of birth examples.

Table 1: Pension reform effects

Date of birth	Retirement age without deduction	Distance to 65 without deductions (in month)	Maximal deduction
Before 1937	63	24	0%
Januar 1937	63 + 1 month	23	0.3%
June 1937	63 + 6 month	18	1.8%
Januar 1938	64 + 1 month	11	3.9%
June 1938	64 + 6 month	5	5.7%
After 1938	65	0	7.2%

<sup>2</sup>Waiting periods consist of periods of contributions, wage replacement benefits (unemployment, sick-pay, invalidity), child-raising and times of education.

<sup>3</sup>A detailed overview of the pension eligibility is provided in ?.

<sup>4</sup>See ? for further details. The reform also introduces a pension bonus of 0.5% per month retiring after 65, but this affects only a negligible amount of individuals as most contracts force worker to retire at 65.

## 2.3 Income tax and social security contributions

The burden of taxes and social security contributions heavily depends on whether being an employee or an retiree, and therefore influences retirement decisions. For instance, a portion of retirement income is exempt from taxation. In addition, besides not having to pay contributions to the PAYG-pension scheme, retirees are not mandatorily insured in the unemployment insurance. In the following, key features are described with a focus on differences between employees and pensioners.<sup>5</sup>

Between years 1998 and 2011, employees face a joint burden on gross earnings from contributions to the PAYG-pension scheme, unemployment insurance, health care and long term care of roughly 23% on average, not including the employer's share.<sup>6</sup> Social security contributions are calculated on hypothetical gross yearly earnings and are deducted from gross monthly earnings up to the respective contribution ceiling.<sup>7</sup> In contrast to employees, pensioners are subject to a combined average burden of 8 - 10% which is deducted from the monthly pension.

The income tax is calculated on yearly taxable income and, in our case, income is solely comprised of gross earnings and gross pensions.<sup>8</sup> In order to obtain the taxable portion of income, gross earnings are reduced by a lump sum deduction for work related expenses (*Werbungskostenpauschale*), and partially by the employee's social security contributions.<sup>9</sup> In case of pensions, only the return portion (*Ertragsanteil*) is taxable. The return portion varies between 17 and 29%, depending on retirement age and assessment year.

After deductions, the income tax schedule is applied (for married couples joint assessment and a single earner/pensioner without spousal income is assumed). Income tax and solidarity tax surcharge are calculated on yearly taxable income. To

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<sup>5</sup>The tax code is considered in much greater detail as described. For a thorough overview see Bönke and Eichfelder (2010).

<sup>6</sup>Social security contributions are usually almost evenly split between employee and employer. Gross earnings are net of the employer's contribution and therefore, only the employee's contributions need to be deducted. Of course, the burden differs with total remuneration. Low income earners and such that receive incomes above the respective contribution ceilings of the various branches of the social security system are subject to a lower relative burden.

<sup>7</sup>Contribution ceiling and contribution rates are displayed in Tables 5 and 6 in the Appendix

<sup>8</sup>This mirrors the actual income situation of German pensioners (Börsch-Supan and Reil-Held (2001)).

<sup>9</sup>For a detailed description of work related deduction and special expenses see Bönke and Eichfelder (2010).

obtain the monthly income tax, the yearly tax burden is distributed according to the monthly share of taxable income on yearly taxable income. Disposable net income equals then gross income from earnings and pension net the social security contributions and monthly taxes.

Our period of interest covers assessment years 1998 to 2011. Over this period, some minor changes in social security contributions rates and ceiling (see Tables 5 and 6) and, more notable, the tax code occur. Most prominent is the reduction of tax rates (e.g. top marginal tax rates were reduced from 53 to 45%) and the reform of pension taxation (introduction of deferred pension taxation and changes in the deductibility of social security contributions). In addition, some minor alteration (e.g. changes in lump sum deduction) took place. In sum, all of which has an impact on monthly disposable income and have to be accounted for to insure to an accurate estimation of retirement behaviour.

## **3 Conceptual framework**

### **3.1 Dynamic retirement model**

We set up a dynamic retirement model that is estimated using administrative data covering complete earnings biographies of mandatorily insured employees. Based on assumptions about individuals' preferences (over consumption and leisure time) and a detailed modeling of the German tax code, the social security contributions and the pension system, the model explains individuals' retirement choices through the regular old age pension scheme. Individuals are assumed to be forward looking and maximize expected lifetime utility in each period of time by deciding between employment and retirement. Since retirement is an absorbing state, this results in an optimal stopping problem of the individuals. An individual's rationale is based on the current period's utility flow and the option value that is associated with the respective choices in a certain period of time (Bellman's principle of optimality). The model accounts for time-constant unobserved heterogeneity in leisure preferences by allowing for a finite number of unobserved types. Our model is estimated by the method of maximum likelihood. In the following subsections, we outline the features of the dynamic retirement model in greater detail.



### 3.1.1 Objective function

We specify a dynamic programming discrete choice (DPDC) model of individuals' retirement behavior. Since the analysis focuses on employees who enter old age retirement after regular employment, these individuals only choose between employment and retirement (unemployment and disability are not considered). Individuals are finitely lived and die no later than period  $T$ , which is set to be age 100. Discrete time is indexed by  $t$  and indicates individual age on a monthly basis. There is a number of  $N$  individuals, indexed by  $n$ . Each individual  $n$  receives a utility flow  $U(\mathbf{s}_{nt}, d_{nt})$  in period  $t$  where  $\mathbf{s}_{nt}$  is a vector of state variables (i.e. age, birth cohort, accumulated pension points, gross wage, and previous period's choice), and  $d_{nt}$  indicates the individual's choice. Individuals who did not opt for early retirement during the 24 month between age 63 and age 65 are assumed to retire upon reaching the statutory pension age which is the first month after having turned 65 (for the age cohorts under consideration).

Every period  $t$ , an individual  $n$  observes the state variables  $\mathbf{s}_{nt}$  and makes the choice  $d_{nt}$  that maximizes expected lifetime utility:

$$E \left\{ \sum_{j=0}^{T-t} p_{t+j,b} \beta^j U(\mathbf{s}_{nt+j}, d_{nt+j}) \right\} \quad (1)$$

where  $\beta$  is a subjective time discount factor, which is set to be 0.96 (Gourinchas and Parker (2002)) and  $p_{t+j,b}$  is the conditional survival probability of an individual in the birth cohort  $b$  for period  $t+j$  given survival until period  $t$ . Information on conditional survival probabilities originates from life tables of the federal statistical office. These life tables contain cohort-specific projections such that the continuous rise in life expectancy of the German population can be taken into account. This not only makes the set up of the model more realistic, but also helps identifying the parameters in the estimation procedure by inducing cohort-specific heterogeneity in the dynamic incentives.

### 3.1.2 Utility function

Individuals have preferences about consumption and leisure time that are represented by the following time separable random utility model:

$$U(\mathbf{s}_{nt}, d_{nt}) = \alpha_1 \frac{c(\mathbf{s}_{nt}, d_{nt})^{(1-\rho)} - 1}{(1-\rho)} + \alpha_{2n} \text{retirement}(d_{nt}) + \epsilon_{nt}(d_{nt}) \quad (2)$$

$$\alpha_{2n} = \alpha_{21n} + \alpha_{22} \text{ret63}_1(d_{nt}) + \alpha_{23} \text{ret65}_1(d_{nt})$$

where  $\epsilon_{nt}(d_{nt})$  is assumed to be type 1 extreme value distributed.  $c(\mathbf{s}_{nt}, d_{nt})$  is the level of consumption being associated with state  $\mathbf{s}_{nt}$  and choice  $d_{nt}$ .  $\text{retirement}(d_{nt})$  indicates that an individual either chooses retirement in the current period or is already retired. The utility function must take into account that individuals seem to have a preference for retirement either in the first or last possible month (peaks at age 63 and age 65 in the aggregate retirement pattern) which is difficult to capture by an optimization rationale based only on age-constant consumption and leisure preferences. Therefore,  $\text{ret63}_1(d_{nt})$  and  $\text{ret65}_1(d_{nt})$  are interacted with  $\text{retirement}(d_{nt})$  and indicate if an individual opts for retirement in the first month after having turned 63 or in the first month after having turned 65 respectively. This allows for an increased flow utility if an individual retires in one of these periods.

$\alpha_1$  is a consumption weight and  $\rho$  is the coefficient of relative risk aversion. Unobserved heterogeneity in the leisure preferences is reflected by  $\alpha_{2n}$ , where the individual-specific coefficient depends on the individual's type (see below). The utility function assumes additive separability between consumption and leisure time as well as its unobserved random component. The vector  $\boldsymbol{\theta} = (\alpha_1, \rho, \alpha_{21n}, \alpha_{22}, \alpha_{23})$  contains all the parameters of the utility function.

### 3.1.3 Value function

The individuals' beliefs about future states are captured by a Markov transition function  $q(\mathbf{s}_{nt+1}|\mathbf{s}_{nt}, d_{nt})$ . Since the state variables evolve deterministically (except for the random component in the utility function which is not interpreted as a state variable in our analysis),  $q(\mathbf{s}_{nt+1}|\mathbf{s}_{nt}, d_{nt})$  is a deterministic function (see next subsection about the accumulation of pension points and our assumptions on gross wages). By Bellman's

principle of optimality, the value function  $V_t(\mathbf{s}_{nt})$  can be represented recursively as

$$V_t(\mathbf{s}_{nt}) = \max_{d_{nt} \in D(\mathbf{s}_{nt})} \left\{ U(\mathbf{s}_{nt}, d_{nt}) + p_{t+1} \beta \int_{\epsilon} \left[ \sum_{\mathbf{s}_{nt+1}} V_{t+1}(\mathbf{s}_{nt+1}) q(\mathbf{s}_{nt+1} | \mathbf{s}_{nt}, d_{nt}) \right] g(\epsilon_{nt+1}) \right\} \quad (3)$$

where  $D(\mathbf{s}_{nt})$  is the choice set available to individual  $n$  in period  $t$  and  $g(\cdot)$  is the probability density function of the unobserved random components of the utility function.  $D(\mathbf{s}_{nt})$  simply contains the choice between employment and retirement until retirement which can be made as soon as individuals become eligible (age 63). Individuals who did not opt for retirement until age 65 have to enter retirement. The model abstracts from the fact that there is a small - empirically irrelevant - share of individuals that is allowed to retire later than age 65. After retirement, individuals have no more options to choose from.

### 3.1.4 Wages, pension claims and budget constraint

Before retirement, individuals earn a gross wage. If the wages are unobserved (because the individual has actually opted for retirement), counterfactual wages are imputed by resorting to the last observed wage in the respective month (12 month prior). Hence, we account for monthly wage volatility. If more than 12 month of earnings need to be imputed, the wage earned 24 month prior is chosen as the monthly gross wage. It follows that our model assumes that real wages do not rise between age 63 and age 65 if the wages are unobserved. In line with the rules and regulations of the pension system, working individuals accumulate pension claims that are proportional to real wages. This creates dynamic incentives for the individuals that are taken into account by the DPDC framework.

Individuals are assumed to save according to the expected saving rate conditional on their net wages. Analogously, we assume that the individuals' initial net wealth at age 63 corresponds to expected net wealth.<sup>10</sup> After retirement individuals are assumed to dissave according to an actuarially fair life annuity that could be bought with the accumulated wealth at retirement. Hence, the model contains the following budget

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<sup>10</sup>In the current version of the model that we estimate, both savings and net wealth are set to be zero.

constraint:

$$\begin{aligned} c(\mathbf{s}_{nt}, d_{nt}) &= G(\mathbf{s}_{nt}, d_{nt}) - \text{savings}(\mathbf{s}_{nt}, d_{nt}) \\ \text{wealth}(\mathbf{s}_{nt+1}) &= (\text{wealth}(\mathbf{s}_{nt}) + \text{savings}(\mathbf{s}_{nt}, d_{nt}))(1 + r) \end{aligned} \tag{4}$$

where  $c(\mathbf{s}_{nt}, d_{nt})$  is the level of consumption associated with state  $\mathbf{s}_{nt}$  and choice  $d_{nt}$ , and  $G(\cdot)$  indicates net income by applying the rules and regulations of the German tax and pension system. The second equation accounts for the net wealth transitions, where the real interest rate  $r$  is assumed to be 0.02 after taxes.

### 3.1.5 Unobserved heterogeneity

Following the approach of Heckman and Singer (1984), unobserved heterogeneity is accounted for semi-nonparametrically by allowing for a finite number of unobserved types  $m \in 1, \dots, M$  (random effects). Each type comprises a fixed proportion of the individuals in the population. Therefore, the individual-specific parameter  $\alpha_{21n}$  that characterizes the preference for leisure time is assumed to be equal to the respective type-specific parameter  $\alpha_{21m}$ . The probability that individual  $n$  is of type  $m$  is given by  $\gamma_m$ , where  $\gamma_M$  is normalized to zero and  $\sum_{m=1}^M \gamma_m = 1$ . Allowing for unobserved heterogeneity is crucial in order to account for some individuals having a strong preference for working until the statutory pension age no matter what the financial incentives are.

### 3.1.6 Choice probabilities and log-likelihood

Given the finite horizon of the individual's optimization problem, it can be solved recursively. The expected value function,  $v_t(\mathbf{s}_{nt}, d_{nt})$ , for period  $T$  is simply given by this period's expected utility flow:

$$v_T(\mathbf{s}_{nT}, d_{nT}) = u(\mathbf{s}_{nT}, d_{nT}) \tag{5}$$

By Bellman's principle of optimality, the individual's optimization problem can be written as a two-period problem for other time periods. It follows from the type 1 extreme value distribution of  $\epsilon_{nt}(d_{nt})$  that the expected value function has a closed

form solution (Rust (1987)):

$$v_t(\mathbf{s}_{nt}, d_{nt}) = u(\mathbf{s}_{nt}, d_{nt}) + p_{t+1}\beta$$

$$\sum_{\mathbf{s}_{nt+1}} \log \left\{ \sum_{d_{nt+1} \in D(\mathbf{s}_{nt+1})} \exp(v_{t+1}(\mathbf{s}_{nt+1}, d_{nt+1})) \right\} q(\mathbf{s}_{nt+1} | \mathbf{s}_{nt}, d_{nt}) \quad (6)$$

The computation of the expected value functions between age 66 and age 100 is comparatively simple because individuals make choices only until age 65 and from age 66 onwards the real net income stream remains constant. Rust (1987) shows that under the assumptions of additive separability and conditional independence, the conditional choice probabilities have a closed form solution (here mixed logit probabilities):

$$Prob(d_{nt} | \mathbf{s}_{nt}) = \frac{\exp(v_t(\mathbf{s}_{nt}, d_{nt}))}{\sum_{j \in D(\mathbf{s}_{nt})} \exp(v_t(\mathbf{s}_{nt}, j))} \quad (7)$$

The log-likelihood function of the sample is given by

$$\sum_{n=1}^N \log \left\{ \sum_{m=1}^M \gamma_m \prod_{t=1}^T \left[ \sum_{d_{nt}} Prob_m(d_{nt} | \mathbf{s}_{nt}, \boldsymbol{\theta}) \times I(d_{nt}) \right] \right\}$$

where  $I(d_{nt})$  indicates individual  $n$ 's observed choice in period  $t$ . The likelihood contributions simply correspond to the respective conditional choice probabilities because the model does not include random transitions of state variables.

## 4 Data

Our analysis is based on administrative data of the German social security. Most employees in Germany mandatorily participate in its national pay-as-you-go pension system which, being of the Bismarckian variety, carefully records all contributors' earnings biographies. The dataset we analyze is based on the Insurance Account Sample (Versicherungskontenstichprobe, VSKT for short) of the Federal Pension Register.<sup>11</sup> The VSKT is a stratified random sample of individuals who live in Germany, have at least one entry in their social security record and are aged between thirty and sixty-seven in the reference year of the sample. VSKT waves of reference years 2002 and 2004

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<sup>11</sup>The final datasets we work with are the scientific use file for on-site-use (SUFVSKT2002 and SUFVSKT2004 to SUFVSKT2011) provided to researchers by the Data Research Centre of the German Federal Pension Insurance.

to 2011 form the basis of our study.<sup>12</sup> Each sample contains the earnings biographies of the observed individuals up to the reference year. The data are collected following individuals over time so as to form a panel. For each individual, a monthly history of employment, unemployment, sickness, and contributions to the pension system is recorded. It starts when the individual reaches age fourteen and it ends when the individual turned sixty-seven in case of complete biographies. Information about the contributions made to the pension system allows one to recover the earnings received by that individual in each month.

The current investigation focuses on German males. Because of insufficient comparability of earnings information and wage levels in the FRG and the GDR, we restrict the attention to individuals who have only been working in West Germany<sup>13</sup>. Furthermore, we exclude contributors for whom a consistent earnings biography cannot be reconstructed. In this way we exclude contributors who worked also as self-employed or civil servants, or who emigrated abroad at some point in time, and who may thus have substantial earnings that are not recorded in the Federal Pension Register. After elimination of those observations, we are left with a number of individuals for each cohort that oscillates between 1,000 and 1,600 - see Table XX

While the dataset records earnings very accurately, one major one concerns is the imputation of top coded incomes. In Germany, employees contribute a share of their gross wage to the mandatory pension system up to a wage ceiling. As a result, our social security data is right-censored as individuals whose wages exceed that ceiling are recorded as if their wages were equal to the ceiling. On average over all years and cohorts, censoring concerns about seven percent of the recorded earnings of men. In order to better approximate the true distribution of top earnings, we impute them to the individuals affected by top coding. Our imputation method rests on the assumption that the upper tail of the earnings distribution behaves according to the Pareto law.<sup>14</sup>

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<sup>12</sup>A detailed description of the data is given by Himmelreicher and Stegmann (2008). We use all nine samples in our analysis. See Appendix A for further details.

<sup>13</sup>West-East migration was almost inexistent before reunification; after reunification it affected a tiny share of the labor force from West Germany, see Fuchs-Schndeln and Schndeln (2009).

<sup>14</sup>In Bönke, Corneo, and Lüthen (forthcoming) a detailed discription of the procedure is outlined in Online Appendix III.3. The imputation relies on the assumption that that the top ten percent of individual earnings below the contribution ceiling are Pareto-distributed. Then, the corresponding Pareto-coefficient is estimated by OLS. The estimation is conducted separately for all years and birth cohorts. The estimated Pareto-coefficients are then used to determine the distribution of the unobserved earnings above the contribution ceiling. The assignment of estimated earnings to individuals

In order to validate the earnings data we work with, we have compared it with the corresponding earnings data from the SOEP, i.e. earnings data that concern the same population in terms of gender, age, region, and employment status as the one we investigate. The SOEP is based on an annual survey of private households and is constructed so as to be highly representative of the total population in Germany. As shown in Appendix A, the cross-sectional earnings distributions obtained from the VSKT reproduce remarkably well those obtained from the SOEP for the same years and the two are statistically undistinguishable. Furthermore, the SOEP data reveal that the VSKT represents about 80 % of the total male labor force in West Germany.

Table 2: Descriptives

Cohort	Retirement Age	Monthly Pension
1935	63.55	1468.13
1936	63.67	1471.97
1937	63.61	1465.50
1938	63.75	1424.93
1939	63.89	1485.99
1940	64.03	1463.40
1941	64.06	1502.13
1942	64.34	1532.64
1943	64.37	1540.82
1944	64.32	1538.50
1945	64.27	1563.98

*Source:* SUFVSKT 2002-2011

*Note:* The average pensions per cohort are in 2010 real values.

[Insert here: Additional information soep: wealth for pensioners (cohorts covered in data, marriage, other income of family members, pension and retirement age)]

## 5 Results

### 5.1 Estimation

The model is estimated by the method of maximum likelihood allowing for two unobserved types ( $M=2$ ). The results are in line with those of a different model specification estimated by the Expectation Maximization algorithm where we approximated

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is done so as to preserve the individual rankings in the distribution of annual earnings. Thereby, the rank of an individual is based on the last observable rank in relation to all individuals at or above the contribution ceiling in the cohort-specific earnings distribution.

the distribution of leisure preferences by a fixed point mixing distribution (100 fixed grid points/types). This non-parametric approximation of leisure preferences shows that the distribution is bimodal with peaks at the two types. We decided to base our analysis on the more simple specification because both specifications lead to almost identical postestimation outcomes and the classical maximum likelihood approach facilitates the estimation of standard errors substantially. Based on the inverse of the Hessian of the log-likelihood function, we can apply a parametric bootstrapping method in order to construct confidence intervals for the postestimation outcomes. The bootstrapping procedure relies on 200 draws from the asymptotic sampling distribution of the model's parameters.

Table 3: Maximum likelihood procedure

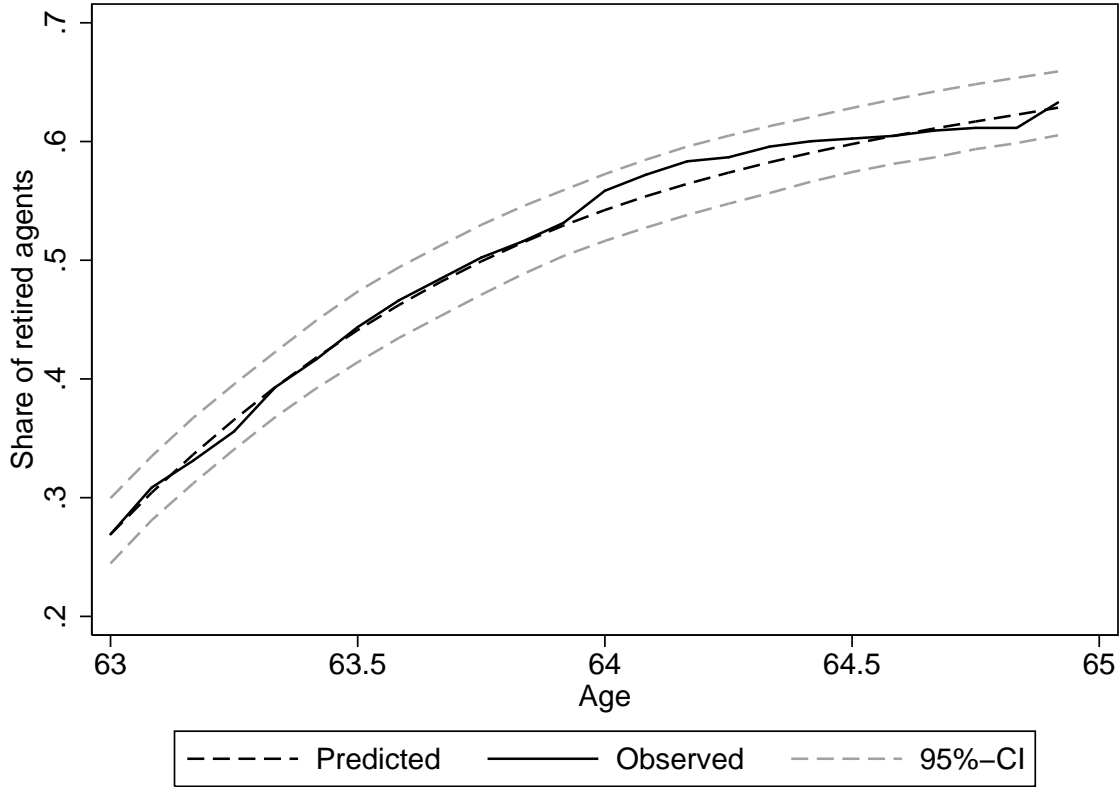
	Estimates	Standard errors
<b>Utility function:</b>		
$\alpha_1$ (consumption)	0.384	(0.0760)
$\rho$ (crra)	1.662	(0.1685)
$\alpha_{211}$ (leisure, type 1)	-0.758	(0.2823)
$\alpha_{212}$ (leisure, type 2)	0.279	(0.0312)
$\alpha_{22}$ (leisure $\times$ <i>ret63</i> <sub>1</sub> )	1.898	(0.1172)
$\alpha_{23}$ (leisure $\times$ <i>ret65</i> <sub>1</sub> )	3.954	(0.0146)
$\gamma_1$ (prob. of type 1)	0.144	(0.0338)
<b>Log-likelihood:</b>	-1,851.4	

Table 3 shows the parameter estimates of the maximum likelihood estimation. These estimates are independent of the choice of starting values and we obtained the same estimates when applying the Expectation Maximization algorithm. The coefficient of relative risk aversion is estimated to be 1.66 which is in line with the findings from other recent studies. There is substantial heterogeneity in the leisure preferences with a negative parameter value for individuals of type 1 (14.4% of the individuals). Individuals of this type have a very high probability of working until the statutory pension age of 65 years no matter what the financial incentives. Individuals of type 2 on the contrary optimize a trade-off between leisure time (positive preferences) and consumption when making their retirement decision. The estimates for  $\alpha_{22}$  and  $\alpha_{23}$



capture the fact that individuals seem to have a particular preference to retire in the first month after having turned 63 or in the first month after having turned 65.

Figure 1: Comparison of predicted and observed shares of retirees



We base model predictions on the posterior type probabilities of the individuals that can be computed by applying Bayes' rule. Figure 1 demonstrates a very good internal validity of our model by comparing the observed shares of retirees in the sample with the shares of retirees that are predicted by the model for the different ages. The graph also shows confidence intervals at the 95%-significance level.

## 5.2 Policy Analysis

On the basis of the estimated parameters and their sampling distribution, we can use the model to simulate confidence intervals for postestimation outcomes of counterfactual scenarios. This not only enables us to simulate behavioral responses to the reform and effects on consumption and retirement income, but also serve as the basis for further simulations of distributional outcomes, welfare effects and the fiscal implications.

Table 4: Simulated effects that are induced by reform

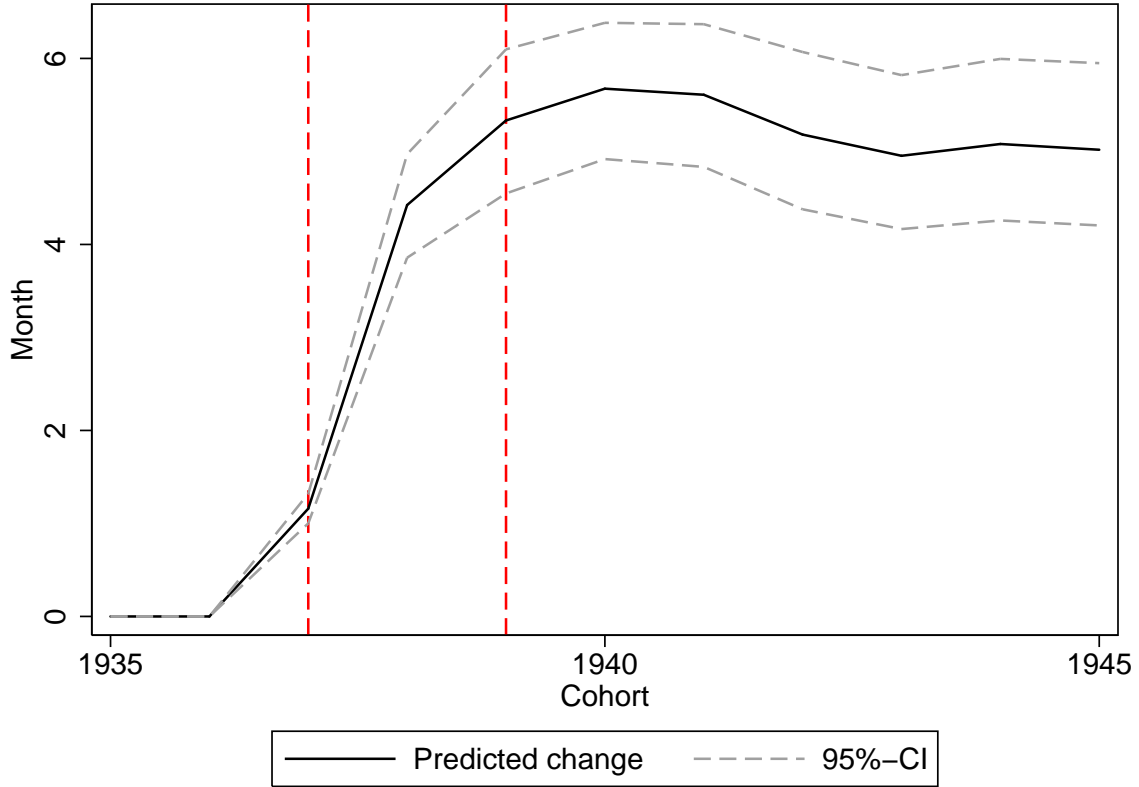
	Reform effects	CI (95%)
$\Delta E[\text{retirement age}]$ (months)	5.24	[4.46,6.09]
$\Delta E[\text{NPV of consumption}]$	€-839	[€-2331,€416]
$\Delta E[\text{NPV of consumption}]$ (%)	-0.37%	[-0.88%,0.02%]
$\Delta \text{Gini coefficient}$ (%)	3.28%	[1.75%,4.87%]
$\Delta \text{Monthly retirement income}$	€-32.8	[€-37.7,€-28.1]
Average equivalent variation	€-6369	[€-7051,€-5776]
Average compensating variation	€6823	[€6089,€7623]
NPV of net public returns	€25,017	[€22,764,€27,146]
$\Delta E[\text{NPV of pension benefits}]$	€13,677	[€12,932,€14,391]
$\Delta E[\text{NPV of pension contributions}]$	€4075	[€3441,€7623]
$\Delta E[\text{NPV of other contr. \& taxes}]$	€7264	[€6178,€8147]

Confidence intervals have been computed using a parametric bootstrapping procedure by taking 200 draws from the asymptotic sampling distribution of the model's parameters and computing postestimation outcomes for each of these draws. The reform effects are estimated relative to a baseline scenarios where no retirement disincentives are introduced. Expected consumption is measured as net present value of expected remaining lifetime consumption at age 63. The equivalent and compensating variations refer to NPVs at age 63 that are annuitized over the remaining lifetime. The NPV of the net public returns per individual at age 63 of the reform is composed of the change in pension benefits, pension contributions, and other contributions and tax payments.

Table 2 shows the average simulated changes in expected retirement age at age 63, changes in the net present value (NPV) of expected remaining lifetime consumption and the Gini coefficient of these NPVs, compensating and equivalent variations, and the net public returns per individual at age 63 of the reform. The net public returns are composed of the change in pension payout, pension contributions, and other contributions and tax payments. The simulations are implemented by simulating a counterfactual baseline scenario where no retirement disincentives are introduced and, then, comparing simulated outcomes under the observed scheme with the outcomes under the baseline scenario. The average effects are computed for the cohorts 1939-1945 that are fully affected by the reform. In addition to the effects of the actually implemented reform, we simulate a variety of scenarios for different levels of retirement disincentives. While the actually implemented reform introduced retirement disincentives of 0.3% per month, we also look at the whole range of incentive levels between

0 and 1% per month. This sheds some insights on the “dose-response” relationship between the level of incentives and our outcome measures.<sup>15</sup>

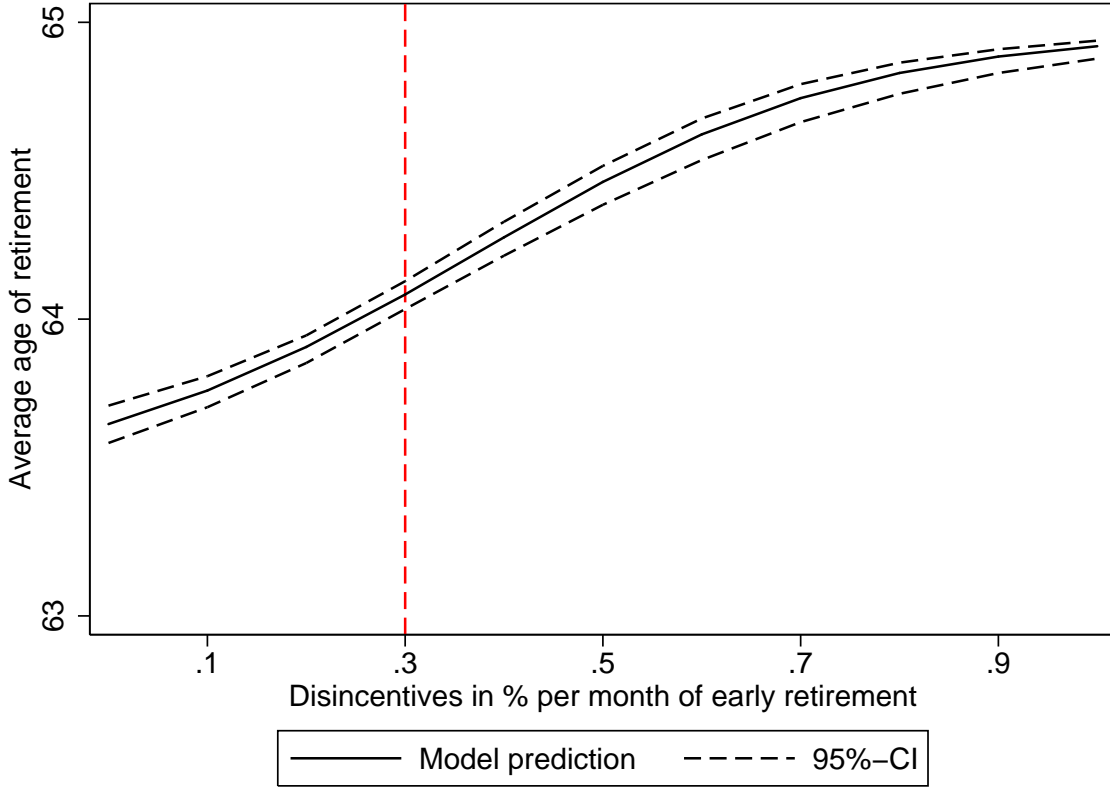
Figure 2: Effects of reform on expected retirement age by birth cohort



The average simulated change in expected retirement age at age 63 is 5.24 months. Hence, the change in incentives induced by the reform explains a substantial part of the observed change in retirement patterns by cohorts (average retirement age increased by about 7 months between the 1935 and the 1945 cohort). Figure 2 shows simulated changes in expected retirement age at age 63 by birth cohorts. Note that the cohorts born in 1937 and 1938 have only been partially affected by the retirement disincentives because of the reform’s phasing in. Figure 3 displays the average simulated retirement age by the level retirement disincentives. The figure presents simulation results regarding 11 counterfactual scenarios that we simulated for the cohorts 39-45 (the cohorts that have been fully affected by the actual reform). In these scenarios, we allow retirement

<sup>15</sup>Confidence intervals have been computed using a parametric bootstrapping procedure by taking 200 draws from the asymptotic sampling distribution of the model’s parameters and computing postestimation outcomes for each of these draws.

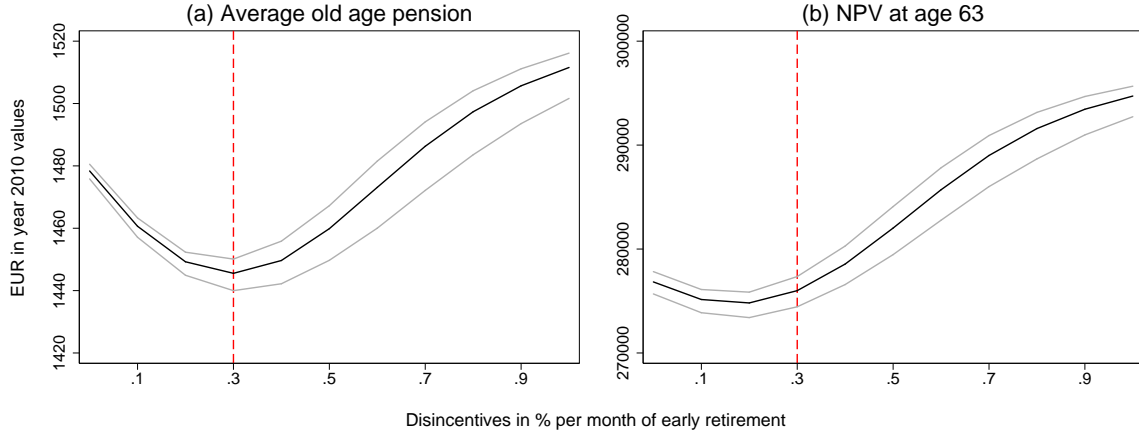
Figure 3: Expected retirement age by disincentive level



disincentives to vary between 0 and 1 % per month of early retirement. These simulations suggest a concave relationship and demonstrate how retirement disincentives can be used to steer these individuals' retirement behavior.

Individuals' consumption is affected by two countervailing effects. First, early retirement is associated with a penalty on pension benefits. Second, individuals participate longer in the labor market and, thus, receive labor earnings for a longer period of time ( $\text{wage} > \text{pension benefits}$  in most cases) and pay more contributions to the pension scheme which allows them to earn higher pension claims. The simulations suggest that expected consumption at age 63 declines on average by 0.37%. This effect is small and significant. It appears that the two countervailing effects cancel out. For other levels of disincentives, the situation is different. Figure 4 shows that when increasing the level of disincentives the behavioral effect at some point overcompensates the effect of the penalties on expected consumption. For very high levels of disincentives, most individuals retire at age 65 such that almost no more penalties are realized ("prohibitive

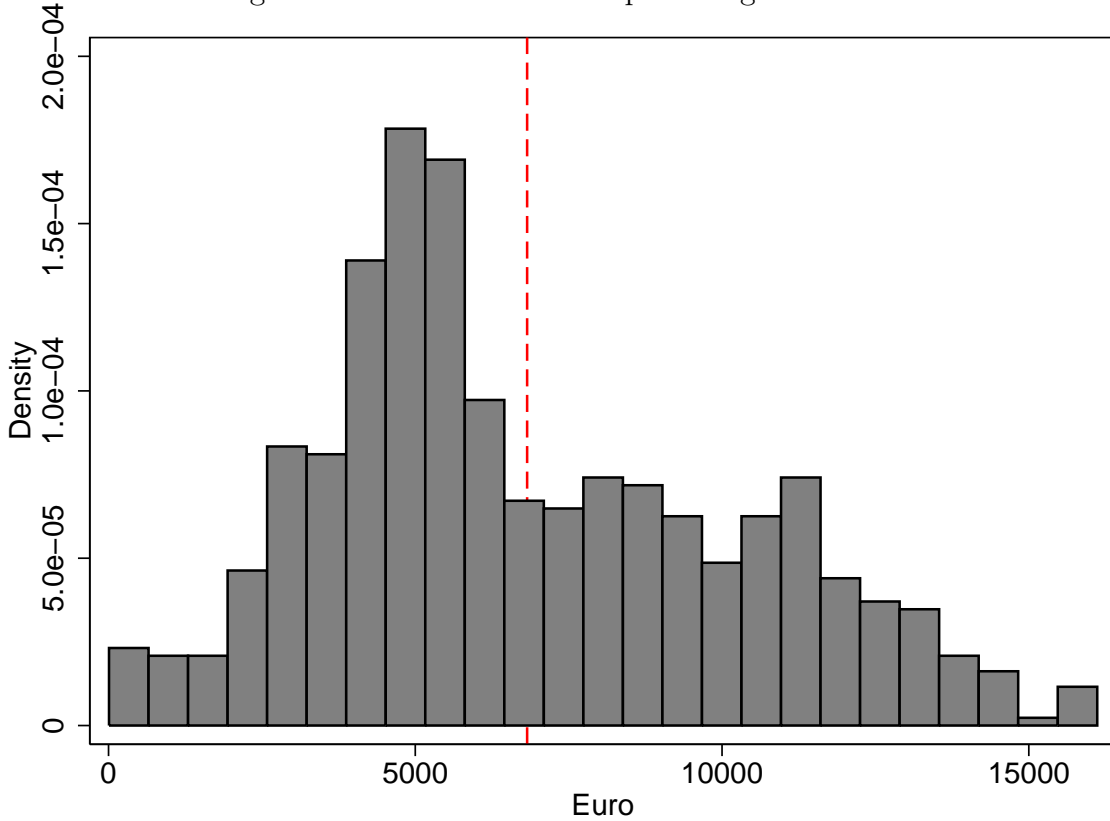
Figure 4: NPVs of expected consumption and retirement income by disincentive level



effect“). However, we do find an effect on average retirement income (€-32.8). The relationship between the level of disincentives and retirement income exhibits a U-shape with the lowest average income at the actually implemented disincentive level of 0.3% per month. Hence, both reductions and increases in the disincentive level would lead to a higher average retirement income. The Gini coefficient of expected consumption is predicted to rise by about 3.28%. This is mainly because in the absence of such disincentives there is more heterogeneous retirement behavior offsetting to some extent initial inequalities in pension claims at age 63.

For individuals with positive leisure preferences, we can directly infer that welfare declines or remains constant (less leisure and less consumption). Individuals that would have worked until age 65 even without disincentives are unaffected. We assess welfare effects of the reform by computing compensating and equivalence variations. The variations refer to NPVs at age 63 that are annuitized over the remaining lifetime. Hence, the equivalence variation indicates how much an individual would be willing to pay at age 63 to avoid the introduction of the retirement disincentives and the compensating variation indicates the amount that an individual would have to receive at age 63 to be fully compensated for the reform. The estimates provide a quantification for the average decline in welfare and also allow a disaggregated analysis of the individual welfare losses along the income distribution. The average compensating variations suggest an average loss of €6823 in monetary terms. Figure 5 shows that the losses are very heterogeneously distributed in the sample population. This complicates a compen-

Figure 5: Distribution of compensating variations

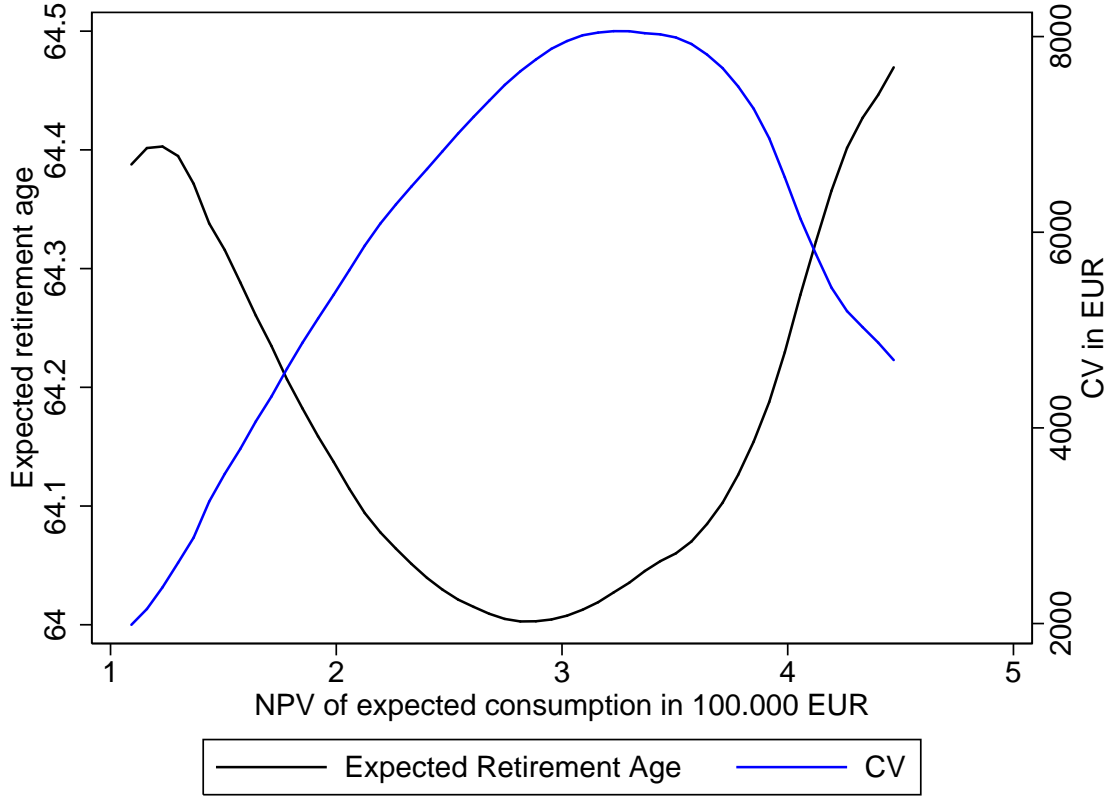


sation through e.g. saving subsidies because such a scheme may not allow targeting individuals according to their specific losses.

Figure 6 shows predicted compensating variations from a non-parametric regression of the estimated compensating variations on the NPVs of expected consumption. These predictions suggest that medium income individuals lose most through the introduction of retirement disincentives. As can be seen in figure 6, this is driven by heterogeneity in the expected retirement age. Low and high income individuals tend to retire closer to age 65 anyway which is due to low pension claims and high opportunity costs of retirement respectively.

At last, we also shed some light on the reform's fiscal implications. The average simulated net public returns of the reform amount to €25,017. This return is composed of the average change in pension benefits, pension contributions, and other contributions and tax payments. About half of the returns stem from the reduction in pension benefits while the other half stems from the increase in contributions and tax payments due

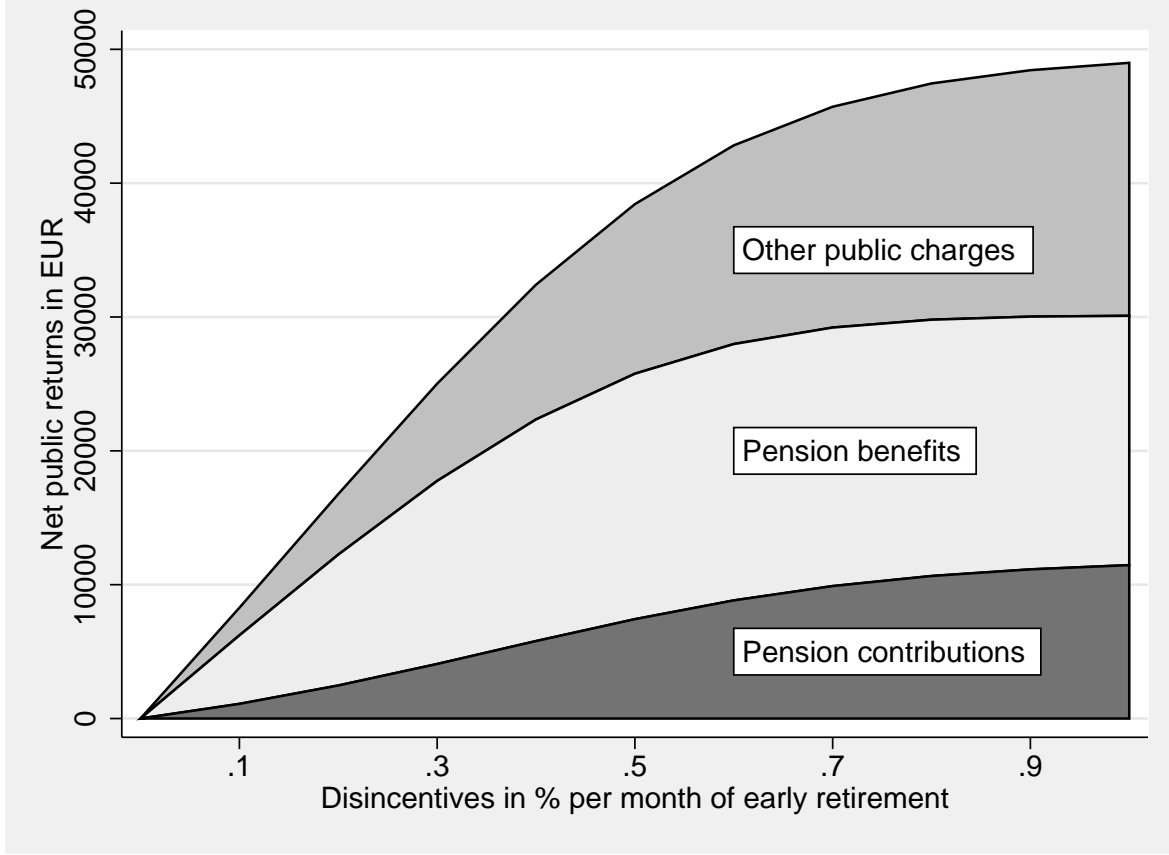
Figure 6: Predicted CVs and E(retirement age) by NPVs of consumption



to the rise in expected retirement age. It follows that the pension system's financial stability can be increased by the introduction of retirement disincentives. However, this comes at the cost of more inequality and non-negligible welfare losses within the population of employees. Of course, overall welfare in the economy may still increase, given that longer life expectancies and demographic change required a reform of either the contribution scheme or the calculation of pension benefits. An analysis of overall welfare in the economy is beyond the scope of our study.

Figure 7 shows the fiscal implications by the level of retirement disincentives. As expected, the relationship is concave. The simulations demonstrate that there is still some scope for higher public returns by increasing the level of disincentives. Hence, the level of disincentives may still be a useful adjustment tool to further increase the pension system's financial sustainability.

Figure 7: Net public returns of retirement disincentives



## 6 Conclusion

We are able to use high quality administrative data to evaluate the effectiveness of early retirement disincentives introduced in Germany and to investigate the distributional, individual welfare, and fiscal implications. We consider German males born between 1935 and 1945. Building on the fact that these birth cohorts were gradually affected by the introduction of retirement disincentives, we are able to estimate the parameters of a structural dynamic retirement model. Our model accounts in great detail for taxes and social security contributions which have a profound impact on net disposable income. This ensures a very good model fit.

The average simulated change in expected retirement age at age 63 induced by the reform is 5.24 months. Hence, the change in incentives explains a substantial part of the observed change in retirement patterns by cohorts. Further simulations demonstrate how retirement disincentives can be used to steer these individuals' retirement behavior.



The effect of the reform on expected consumption is small and insignificant. When increasing the level of disincentives the behavioral effect at some point overcompensates the effect of the penalties on expected consumption. We do find an effect of the implemented reform on average monthly retirement income (€-32.8).

We also compute changes in Gini coefficients of expected remaining lifetime consumption as well as equivalent and compensating variations to assess individual welfare effects. The simulated Gini coefficients indicate an increase in inequality through the reform. Furthermore, the average compensating variations suggest an average loss of €6823 in monetary terms. We show that the associated welfare losses are largest for medium income individuals and are only partially compensated by recently introduced subsidies for private old age provisions.

At last, we consider the fiscal implications and compute the net public returns of the introduction of retirement disincentives. The average simulated net public returns of the reform amount to €25,017. About half of the returns stem from the reduction in pension benefits while the other half stems from the increase in contributions and tax payments due to the rise in expected retirement age. It follows that the pension system's financial stability can be increased by the introduction of retirement disincentives. However, this comes at the cost of more inequality and non-negligible welfare losses within the population of employees.

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## 7 Appendix

### 7.1 Appendix A: Dataset construction

The dataset consists of the SUFVSKT waves from 2002 and from 2004-2011. We can only use cohorts aged 66 or 67 in the respective year of the wave, as we need completed earnings biographies to clearly identify the time of old-age retirement. The cohorts 1938-1944 appear in two different waves, because they are included both at the age of 66 and at the age of 67. Since every SUF is a 25% sample of the VSKT, it is possible to match two waves for each of these cohorts and enhance the number of observations. There is no distinct case number (which is equal in all waves) and thus we identify duplicates (whom appear in two waves) on the basis of their employment biography and their collected earnings points. Since the employment biographies are included from age 14 onwards and completed at the age of 66, we draw on a large number of data points for the matching procedure and do not lose information.

Table 5: Determinants of the pension system

Year	Average social	Pension insurance	
	security income contribution ceiling	contribution rate	
1970	13343	21600	8.5
1971	14931	22800	8.5
1972	16335	25200	8.5
1973	18295	27600	9
1974	20381	30000	9
1975	21808	33600	9
1976	23335	37200	9
1977	24945	40800	9
1978	26242	44400	9
1979	27685	48000	9
1980	29485	50400	9
1981	30900	52800	9.25
1982	32198	56400	9
1983	33293	60000	9.0833
1983	34292	62400	9.25
1985	35286	64800	9.4542
1986	36627	67200	9.6
1987	37726	68400	9.35
1988	38896	72000	9.35
1989	40063	73200	9.35
1990	41946	75600	9.35
1991	44421	78000	8.98
1992	46820	81600	8.85
1993	48178	86400	8.75
1994	49142	91200	9.6
1995	50665	93600	9.3
1996	51678	96000	9.6
1997	52143	98400	10.15
1998	52925	100800	10.15
1999	53507	102000	9.85
2000	54256	103200	9.65
2001	55216	104400	9.55
2002	28626	54000	9.55
2003	28938	61200	9.75
2004	29060	61800	9.75
2005	29202	62400	9.75
2006	29494	63000	9.75
2007	29951	63000	9.95
2008	30625	63600	9.95
2009	30506	64800	9.95
2010	31144	66000	9.95
2011	32100	66000	9.95

Table 6: Other determinants of the social security system

Year	Health insurance		Unemployment insurance		Long-term care	VPI 2010
	contribution ceiling	contribution rate	contribution ceiling	contribution rate	contribution rate	
1998	75600	6.8	100800	3.25	0.85	82.34
1999	76500	6.8	102000	3.25	0.85	82.79
2000	77400	6.8	103200	3.25	0.85	83.97
2001	78300	6.8	104400	3.25	0.85	85.60
2002	40500	7	54000	3.25	0.85	86.87
2003	41400	7.2	61200	3.25	0.85	87.77
2004	41856	7.2	61800	3.25	0.85	89.22
2005	42300	8	62400	3.25	1.1	90.58
2006	42756	7.4	63000	3.25	1.1	92.03
2007	42756	7.7	63000	2.1	1.1	94.11
2008	43200	7.8	63600	1.65	1.1	96.56
2009	44100	7.9	64800	1.4	1.225	96.92
2010	45000	7.9	66000	1.4	1.225	98.01
2011	44550	8.2	66000	1.5	1.225	100.00
2012	45900	8.2	67200	1.5	1.225	101.90
2013	47250	8.2	69600	1.5	1.275	103.43

Table 7: Household income shares - mirrored population (SOEP)

Age	Labor income		PAYG-pensions		Privat pensions		Public transfer		Private transfer		Asset income	
	share	sd	share	sd	share	sd	share	sd	share	sd	share	sd
62	0.8781	0.1869	0.0610	0.1583	0.0030	0.0184	0.0155	0.0006	0.0006	0.0064	0.0418	0.0896
63	0.8465	0.2248	0.0877	0.1901	0.0079	0.0417	0.0225	0.0001	0.0023	0.0025	0.0353	0.0682
64	0.7571	0.2865	0.1723	0.2531	0.0185	0.0522	0.0124	0.0007	0.0019	0.0070	0.0390	0.0840
65	0.5669	0.3886	0.3222	0.3473	0.0410	0.1104	0.0182	0.0006	0.0034	0.0081	0.0512	0.0872
66	0.3922	0.3540	0.4793	0.3281	0.0602	0.1234	0.0223	0.0002	0.0011	0.0048	0.0458	0.0759
67	0.2024	0.2577	0.6367	0.2814	0.0687	0.1047	0.0257	0.0028	0.0008	0.0183	0.0637	0.1038
68	0.1754	0.2669	0.6773	0.2865	0.0781	0.1193	0.0135	0.0000	0.0010	0.0000	0.0557	0.0905

*Source:* SOEP waves 1984-2012

*Note:* West German men, cohorts 1935 to 1945,...

Table 8: Household income shares - whole population (SOEP)

Age	Labor income		PAYG-pensions		Privat pensions		Public transfer		Private transfer		Asset income	
	share	sd	share	sd	share	sd	share	sd	share	sd	share	sd
62	0.4992	0.4043	0.3378	0.3693	0.0328	0.0897	0.0697	0.1964	0.0022	0.0400	0.0582	0.1275
63	0.4624	0.4066	0.3763	0.3806	0.0380	0.1009	0.0643	0.1827	0.0023	0.0412	0.0568	0.1244
64	0.3951	0.3898	0.4528	0.3787	0.0473	0.1174	0.0446	0.1440	0.0019	0.0251	0.0583	0.1171
65	0.2982	0.3663	0.5391	0.3683	0.0527	0.1206	0.0446	0.1485	0.0034	0.0488	0.0618	0.1180
66	0.2330	0.3115	0.6074	0.3219	0.0596	0.1209	0.0357	0.1203	0.0011	0.0253	0.0633	0.1239
67	0.1669	0.2619	0.6710	0.2889	0.0668	0.1281	0.0251	0.0888	0.0008	0.0114	0.0695	0.1265
68	0.1500	0.2582	0.6833	0.2889	0.0754	0.1391	0.0264	0.0984	0.0010	0.0132	0.0639	0.1147

*Source:* SOEP waves 1984-2012

*Note:* West German men, cohorts 1935 to 1945,...



Table 9: Individual income shares - mirrored population (SOEP)

Age	Employment		Self empl.		Other pensions		Unempl. benefit		Unempl. assistance		Priv. pensions		PAYG-pensions	
	share	sd	share	sd	share	sd	share	sd	share	sd	share	sd	share	sd
62	0.9669	0.1528	0.0004	0.0179	0.0000	0.0000	0.0009	0.0131	0.0031	0.0441	0.0000	0.0000	0.0288	0.1455
63	0.9240	0.2221	0.0049	0.0701	0.0000	0.0000	0.0059	0.0584	0.0000	0.0000	0.0000	0.0000	0.0652	0.2061
64	0.8367	0.3113	0.0003	0.0069	0.0001	0.0006	0.0027	0.0305	0.0000	0.0000	0.0010	0.0316	0.1592	0.3072
65	0.5747	0.4572	0.0005	0.0160	0.0009	0.0087	0.0035	0.0238	0.0000	0.0000	0.0066	0.0745	0.4140	0.4566
66	0.3554	0.4063	0.0000	0.0000	0.0052	0.0294	0.0002	0.0062	0.0000	0.0000	0.0010	0.0068	0.6382	0.4105
67	0.1000	0.2233	0.0117	0.0757	0.0013	0.0108	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8871	0.2341
68	0.0781	0.2149	0.0064	0.0526	0.0007	0.0076	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9147	0.2194

*Source:* SOEP waves 1984-2012

*Note:* West German men, cohorts 1935 to 1945,...

Table 10: Individual income shares - whole population (SOEP)

Age	Employment		Self empl.		Other pensions		Unempl. benefit		Unempl. assistance		Priv. pensions		PAYG-pensions	
	share	sd	share	sd	share	sd	share	sd	share	sd	share	sd	share	sd
62	0.3937	0.4774	0.1009	0.2961	0.0019	0.0325	0.0430	0.1889	0.0221	0.1435	0.0048	0.0616	0.4316	0.4847
63	0.3620	0.4672	0.0996	0.2955	0.0054	0.0677	0.0400	0.1804	0.0100	0.0954	0.0079	0.0849	0.4719	0.4833
64	0.3192	0.4441	0.0790	0.2616	0.0071	0.0747	0.0248	0.1408	0.0043	0.0612	0.0045	0.0667	0.5608	0.4702
65	0.2158	0.3947	0.0670	0.2457	0.0078	0.0759	0.0189	0.1272	0.0026	0.0510	0.0070	0.0749	0.6809	0.4462
66	0.1464	0.3180	0.0531	0.2030	0.0094	0.0792	0.0078	0.0729	0.0000	0.0000	0.0057	0.0695	0.7776	0.3698
67	0.0724	0.2182	0.0463	0.1869	0.0069	0.0647	0.0009	0.0232	0.0000	0.0000	0.0049	0.0671	0.8685	0.2872
68	0.0511	0.1764	0.0430	0.1771	0.0066	0.0638	0.0002	0.0064	0.0000	0.0000	0.0009	0.0216	0.8982	0.2475

*Source:* SOEP waves 1984-2012

*Note:* West German men, cohorts 1935 to 1945,...