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

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Abstract

We evaluate the actual effectiveness of disincentives that have been introduced for early retirement in Germany. Therefore, we set up a detailed model of the German social security and tax system with special attention to 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 allows us to answers the question, whether and to what degree disincentives are able to steer retirement behavior of German pensioners. These estimates are based on high quality administrative data. We also discuss the implications for the financial stability of the PAYG-pension scheme and investigate distributional effects. On the basis of our simulations we try to give some insights on how a complementary private old age insurance plan (e.g. a life annuity) would have to look like, if the pre-reform level of old age income is to be retained.

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. Staubli and Zweimüller (2013) and 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 of the actual effectiveness of disincentives that have been introduced for early retirement in Germany. 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 discuss the implications for the financial stability of the PAYG-pension scheme and investigate distributional effects. On the basis of our simulations we try to give some insights on how a complementary private old age insurance plan (e.g. a life annuity) would have to look like, if the pre-reform level of old age income is to be retained.

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 (201X)). 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 period 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 postestimation 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, replacement rates and different schemes of retirement disincentives. 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 Bismarkian 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.[1] 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. Lüthen (201X) for further details.)

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

[1] See Appendix X for an overview of contribution rates and contribution ceilings for different years.

the *pension for long-term insured* that is open after 63 but needs a waiting period[2] of 35 years. Further there are pensions for the previously unemployed, the disabled and a special pension for women, which can be claimed at age 60.[3] 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 biograhpies. 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.[4] 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%

[2]Waiting periods consist of periods of contributions, wage replacement benefits (unemployment, sick-pay, invalidity), child-raising and times of education.

[3]A detailed overview of the pension eligibility is provided in Lüthen (201X).

[4]See Lüthen (201X) 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 retire, 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.[5]

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.[6] Social security contributions are calculated on hypothetical gross yearly earnings and are deducted from gross monthly earnings up to the respective contribution ceiling.[7] 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.[8] In order to obtain the taxable portion of income, gross earnings are reduced by a lump some deduction for work related expenses (*Werbungskostenpauschale*), and partially by the employee's social security contributions.[9] 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). In-

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

[6]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.

[7]Contribution ceiling and contribution rates are displayed in Tables 5 and 6 in the Appendix

[8]This mirrors the actual income situation of German pensioners (Börsch-Supan and Reil-Held (2001)).

[9]For a detailed description of work related deduction and special expenses see Bönke and Eichfelder (2010).

come tax and solidarity tax surcharge are calculated on yearly taxable income. To 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 Table AX) and, more notable, the tax code occur. Most prominent was 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 and may influence retirement incentives.

3 Conceptual framework

3.1 Dynamic retirement model

We set up a dynamic retirement model that is estimated using administrative data covering the complete earnings biographies of mandatorily insured employees. The methodological framework is similar to Rust and Phelan (1997) and Karlstrom, Palme, and Svensson (2004), but - like more recent papers from the life cycle literature (e.g. van der Klaauw and Wolpin (2008), French and Jones (2011)) - allows for time-constant unobserved heterogeneity. Based on assumptions regarding individuals' preferences (over consumption and leisure time) and a detailed modeling of the German tax and 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 the leisure preferences by allowing for a finite number of unobserved types. This is highly relevant in order to fit the aggregate retirement pattern (peaks at age 63 and age 65) without including too many interaction terms with age in the utility function. 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, 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:

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

where β is a subjective time discount factor, which is set to be 0.96 (Gourinchas and Parker (2002)) and p_{t+j} is the conditional survival probability of the individual for period t+j given survival until period t. Information on conditional survival probabilities originates from life tables of the federal statistical office. We average the age-specific conditional survival probabilities for the age cohorts under consideration because the variation in these probabilities between cohorts is small.

3.1.2 Utility function

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

$$U(\mathbf{s}_{nt}, d_{nt}) = \alpha_1 \frac{c(\mathbf{s}_{nt}, d_{nt})^{(1-\rho)} - 1}{(1-\rho)} + (\alpha_{2n} + \alpha_3(t=1)) retirement(d_{nt}, \mathbf{s}_{nt}) + \epsilon_{nt}(d_{nt}) \quad (2)$$

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 that is associated with state $\mathbf{s}_{nt}$ and choice d_{nt}. $retirement(d_{nt}, \mathbf{s}_{nt})$ indicates that an individual either chooses retirement in the current period or is already retired. The indicator function (t=1) indicates whether an individual just turned 63 (first month when retirement is possible). This becomes necessary because individuals seem to have an increased probability of retiring in this particular month which is difficult to capture through an optimization rationale that is based on age-constant consumption and leisure preferences. α_1 is a consumption weight and ρ is the coefficient of relative risk aversion. Unobserved heterogeneity in the leisure preferences is reflected by α_{2n}, where the individual-specific coefficient depends on the individual's type (see below). This utility function assumes additive separability between consumption and leisure time as well as its unobserved random component. The parameters of the utility function are contained by vector $\boldsymbol{\theta} = (\alpha_1, \rho, \alpha_{2n}, \alpha_3)$.

3.1.3 Value function

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 the 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 being 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 Pension points and gross wages

[DETAILED DESCRIPTION]

3.1.5 Budget constraint

The model does not contain savings because this information is unobserved in our administrative data set [DISCUSSION]. Hence, individual consumption depends on $\mathbf{s}_{nt}$, d_{nt}, and the rules and regulations of the German tax and pension system:

$$c(\mathbf{s}_{nt}, d_{nt}) = G\left(\mathbf{s}_{nt}, d_{nt}\right) \tag{4}$$

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. [DETAILED DESCRIPTION]

3.1.6 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 $m \in 1, ..., M$ (random effects). Each type comprises a fixed proportion of the individuals in the population. Hence, the individual-specific parameter α_{2n} that characterizes the preference for leisure time is assumed to be equal to the respective type-specific parameter α_{2m}. The probability that individual n is of type m is given by γ_m, where γ_M is normalized to zero and $\sum_{m=1}^{M} \gamma_m = 1$. This specification of the leisure preferences allows taking into account that there are certain types of individuals in the population who opt for retirement as soon as they are eligible almost no matter what the financial incentives are, while other types seem to have a strong preference for working until the statutory pension age. This heterogeneity is crucial in order to fit the aggregate retirement pattern (peaks at age 63 and age 65) without including interaction terms with age in the utility function.

3.1.7 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)):

$$\begin{aligned} v_t(\mathbf{s}_{nt}, d_{nt}) =& u(\mathbf{s}_{nt}, d_{nt}) + p_{t+1}\beta \\ & \sum_{\mathbf{s}_{nt+1}} \log \left\{ \sum_{d_{nt+1} \in D(\mathbf{s}_{nt+1})} exp(v_{t+1}(\mathbf{s}_{nt+1}, d_{nt+1})) \right\} q(\mathbf{s}_{nt+1}|\mathbf{s}_{nt}, d_{nt}) \end{aligned} \tag{6}$$

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):

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

The log-likelihood function of the sample is given by

$$\sum_{n=1}^{N} \log \left\{ \sum_{m=1}^{M} \gamma_m \prod_{t=1}^{T} L_m(d_{nt}|\mathbf{s}_{nt}, \boldsymbol{\theta}) \right\} \tag{8}$$

where $L_m(d_{nt}|\mathbf{s}_{nt})$ is the likelihood contribution of individual n's observed choice d_{nt} in period t, given that n is of type m. This likelihood contribution corresponds to the respective conditional choice probability 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 [10]. 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 to 2011 form the basis of our study. [11] 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 citizens including naturalized immigrants with complete earnings biographies in Germany and excluding ethnic Germans that immigrated to Germany after having worked in their country of origin. 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 [12]. 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

[10] The final datasets we work with (SUFVSKT2002 and SUFVSKT2004- SUFVSKT2011) is provided to researchers by the Data Research Centre of the German Federal Pension Insurance.

[11] 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.

[12] 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).

individuals for each cohort that oscillates between 1,000 and 1,600 - see Table XX

While the dataset we use is virtually free from measurement errors, some adjustments were necessary in order to prepare the earnings data for the analysis. The most important one concerns 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 [13]. 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. We posit that the top ten percent of individual earnings below the contribution ceiling are Pareto-distributed. Then, we estimate the corresponding Pareto-coefficient 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 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. We also explore the implications of two alternative imputation methods: an imputation of the estimated mean income above the ceiling to all individuals with top-coded earnings and a maximum mobility scenario where the ranking order is reversed every year. Results from those alternative imputations are reported in Online Appendix III.3.

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

[13]In Bönke, Corneo, and Lüthen (forthcoming) a detailed discription of the procedure is outlined in Online Appendix III.3

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.

[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

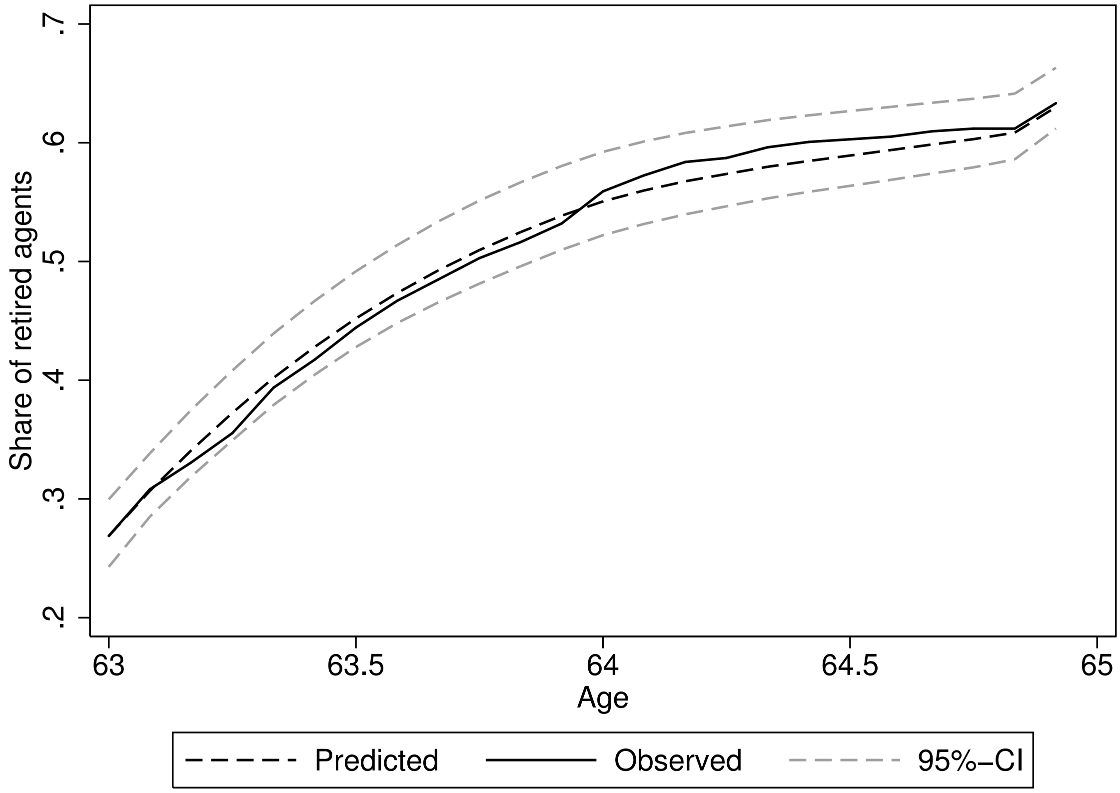
The model is estimated by the method of maximum likelihood allowing for two unobserved types (M=2). This specification is in line with the results of a different model specification that we estimated by the Expectation Maximization algorithm where we approximated the distribution of the leisure preferences by a fixed point mixing distribution (100 fixed grid points/types). This non-parametric approximation of the 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.

Table 3: Maximum likelihood procedure

	Estimates	Standard errors
Utility function:		
α_1 (consumption)	0.376	(0.0760)
ρ (crra)	1.674	(0.1685)
α_{21} (leisure, type 1)	-3.036	(0.2823)
α_{22} (leisure, type 2)	0.289	(0.0312)
α_3 (leisure $\times$ (t=1))	1.816	(0.1172)
γ_1 (prob. of type 1)	0.375	(0.0146)
Log-likelihood:	-1,892.2	

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 for this model specification when applying the Expectation Maximization algorithm. The coefficient of relative risk aversion is estimated to be 1.7 which is in line with the findings from other recent studies. There is substantial heterogeneity in the leisure preferences with a highly negative parameter value for individuals of type 1. 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 are. Individuals of type 2 optimize a trade-off between leisure time (positive preferences) and consumption when making their retirement decision. In the first month of age 63 these individuals have a relatively high probability of retirement being indicated by the coefficient α_3 on the interaction term between the indicator function for period 1 and the dummy variable for retirement that captures leisure time.

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 the 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 the implications of the reform, but also serve as the basis for further simulations of distributional outcomes, replacement rates and different schemes of retirement disincentives. Table 2 shows the average simulated changes in expected retirement age at age 63 as well as percentage changes in the net present value of expected remaining lifetime consumption and in the Gini

Table 4: Effets of introduction of retirement disincentives for birth cohorts 39-45

	Baseline scenario I	Baseline scenario II
ΔE[retirement age] (months)	1.39	1.4
	[0.96,1.7]	[0.95,1.71]
ΔE[consumption] (%)	-2.39	-0.08
	[-2.74,-2.15]	[-0.26,0.31]
ΔGini coefficient (%)	2.07	2.21
	[1.39,3.27]	[1.66,3.16]

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 effects are estimated relative to two simulated baseline scenarios. In baseline scenario I no retirement disincentives are introduced. In baseline scenario II no retirement disincentives are introduced and the tax system is kept constant as it was in effect in 1998. Expected consumption is measured as net present value of expected remaining lifetime consumption at age 63.

coefficient of these net present values. The simulations are implemented by simulating a counterfactual baseline scenario where no retirement disincentives have been introduced and, then, comparing simulated outcomes under observed scheme with the outcomes under the baseline scenario. The average effects are computed for the cohorts 39-45 that have been fully affected by the reform. 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. We consider two different baseline scenarios. In baseline scenario I no retirement disincentives are introduced. In baseline scenario II no retirement disincentives are introduced and the tax system is kept constant as it was in effect in 1998. Expected consumption is measured as net present value of expected remaining lifetime consumption at age 63.

The average simulated change in expected retirement age at age 63 is 1.4 months. Hence, the change in incentives induced by the reform explains a substantial part of the observed change in retirement patterns by cohorts. Individuals' consumption is affected by two countervailing effects. First, early retirement is associated with a penalty on pension benefits. Second, individuals tend to participate longer in the labor market and, thus, pay more contributions to the pension scheme. The simulations suggest that expected consumption at age 63 declines on average by 2.4%. Since only individuals with positive leisure preferences adjust their behavior (type 2), we can directly infer that welfare declines for an average individual of this type (less leisure and less consumption). Of course, the picture differs from an intergenerational perspective. The increase in expected retirement age also suggests that the goal of securing the pension system's financial stability can be pursued through the introduction of retirement disincentives. However, this comes at the cost of more inequality within the population of employees. The Gini coefficient of expected consumption is predicted to rise by about 2%.

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

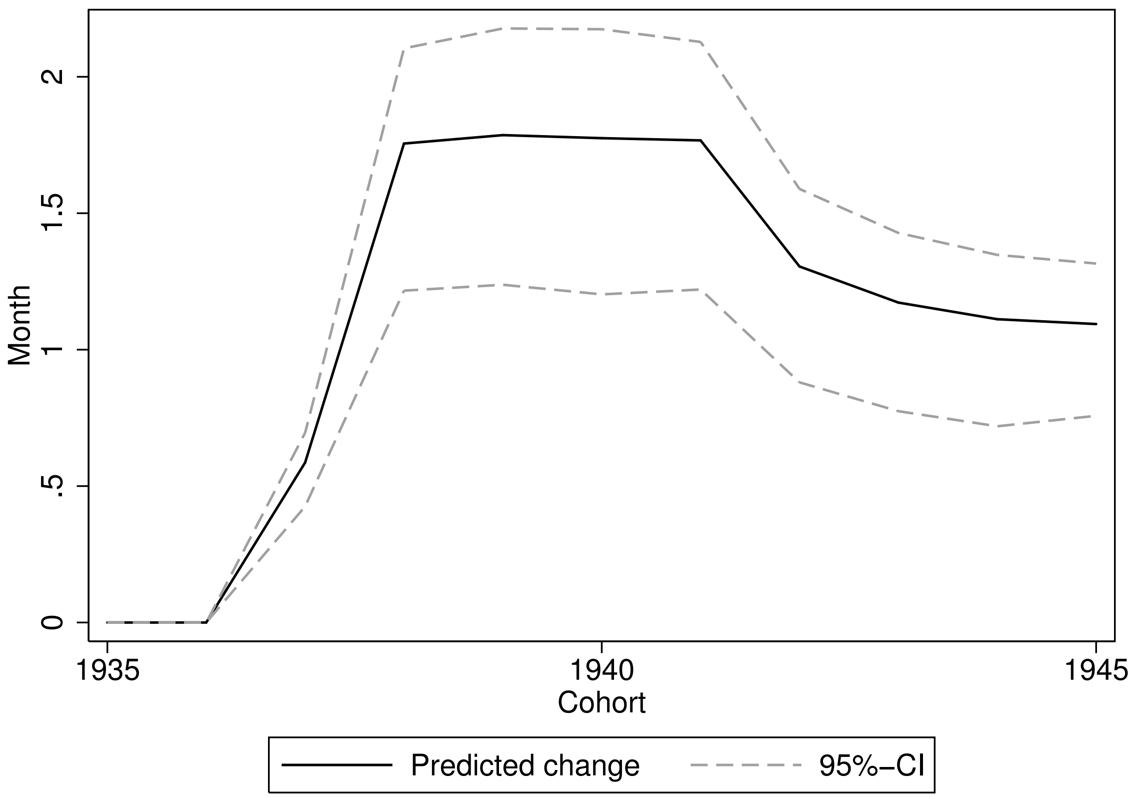
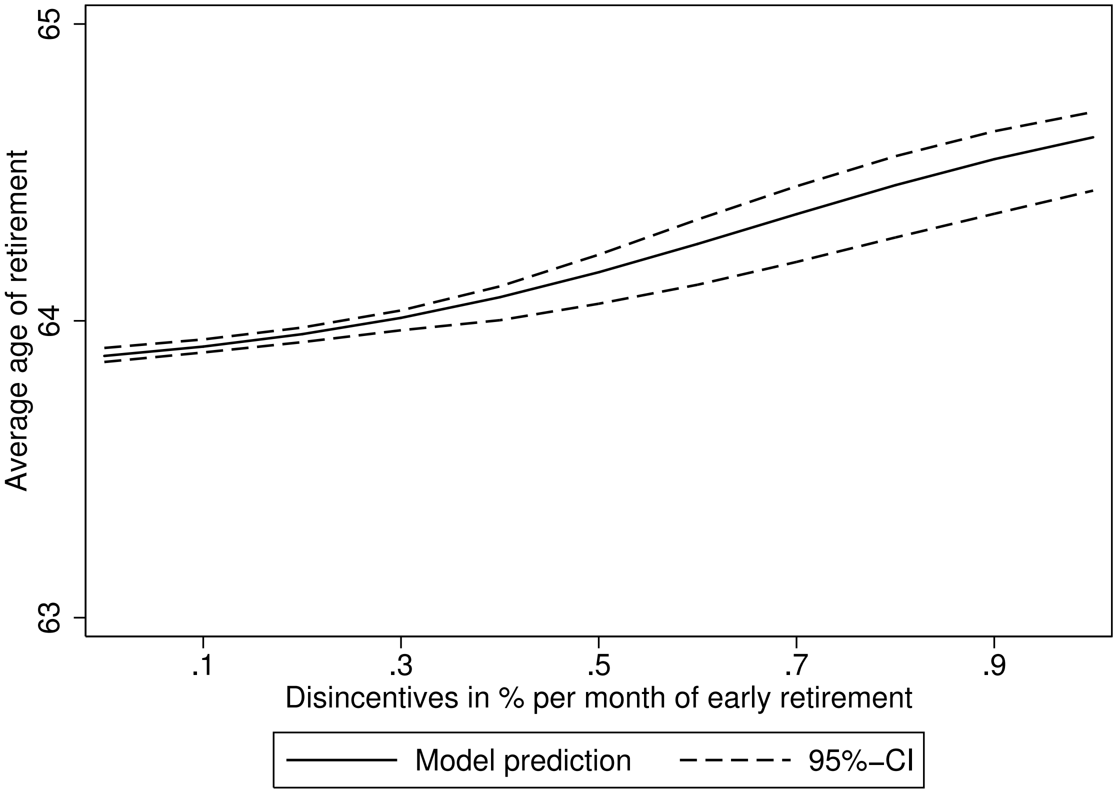


Figure 2 shows simulated changes in expected retirement age at age 63 by birth cohorts. Note that the cohorts born in 1937 and 1938 have only been partially affected by the retirement disincentives because of the reform's phasing in.

Figure 3 presents simulation results regarding 11 counterfactual scenarios that we simulated for the whole sample population. In these scenarios, we allow retirement disincentives to vary between 0 and 1 % of reductions in pension benefits per month of

Figure 3: Expected retirement age by scenarios 0-10



early retirement. This exercise demonstrates how the level of retirement disincentives translates into changes in expected retirement age.

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6 Appendix

6.1 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 bioraphies 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 biograhpies 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 loose information.

Table 5: Determinants of the pension system

Year	Average social security income	Pension insurance contribution ceiling	Pension insurance 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

	Health insurance		Unemployment insurance		Long-term care	
Year	contribution ceiling	contribution rate	contribution ceiling	contribution rate	contribution rate	VPI 2010
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