Financial incentives to postpone retirement and further effects on employment – Evidence from a natural experiment

Barbara Hanel *

Department of Economics, University of Erlangen-Nuremberg, Lange Gasse 20, D-90403 Nuremberg, Germany

Abstract

This paper examines the effect of the introduction of permanent benefit reductions for early retirees (i) on the duration until benefit claiming and (ii) on the duration until exit from gainful employment. I estimate discrete time duration models using different error term specifications. Administrative data containing the full earnings history of the individuals are used. Since the reform implementing the benefit reductions was a natural experiment, under some assumptions a causal effect can be identified. The permanent reduction of retirement benefit amounts causes a postponement of claiming benefits by about 14 months and a delay of employment exit by about 10 months on average.

1. Introduction

The pension systems of many industrialized countries are facing severe financial problems due to aging societies. Labor market and pension reforms were therefore implemented in several European countries to encourage labor force participation of the elderly. A longer working life would on the one hand reduce benefit payments per capita and it would on the other hand raise contributions. A frequently used policy measure that sets incentives to postpone retirement and to increase labor force participation is a benefit reduction for early retirees. However, especially older individuals may face employment restrictions, limiting their labor market opportunities. Therefore, an increasing duration until retirement in terms of benefit claiming does not necessarily imply that the duration until exit from gainful employment increases equivalently. This paper analyzes the effect of a pension reform in Germany that introduced permanent benefit reductions for early retirees. These reductions vary between 0.3% and 18.0% of monthly benefits depending on the individual birth cohort and the timing of benefit claiming. The reform is used to examine two issues: first, does the duration until benefit claiming increase due to these benefit reductions? Second, does the duration until employment exit increase to the same extent? If the last month of employment and the first month of drawing benefits are not postponed to the same extent, there may be some relief for the retirement systems through benefit reductions, but the relief for the welfare state as a whole may be much smaller. It is therefore important to know to what extent a delay of claiming benefits implies longer employment, too.

The analysis shows that the reform causes an expected postponement of benefit claiming by about 14 months. Women and workers with low benefit entitlements delay their claiming by more than men or those with high benefit entitlements. At the same time, the expected duration until exit from gainful employment increases by about 10 months. The latter effect is stronger for men and for individuals with high benefit entitlements.

Unlike previous studies on the effect of pensions in Germany I utilize a natural experiment and can therefore identify a causal effect. The analyzed sample is drawn from a new data set that provides very detailed information concerning the full employment history and the full earnings history of more than 60,000 individuals. This study appears to be the first one evaluating worker responses to this very recent reform.

The paper is organized as follows: in the next section, the German retirement benefit system and the recent reform are described in some detail, while Section 3 discusses the relevant literature and derives hypotheses. Section 4 describes the empirical strategy for estimating the effects of the reform on the duration until claiming benefits as well as on the duration until employment exit. Section 5 presents the data. In Section 6 the results of these two parts of the analysis are discussed. Section 7 concludes.

2. The recent pension reform in Germany

The first pillar of the Old-Age Security System is the main income source for elderly individuals in Germany. Nearly 80% of the labor
force is covered and about 80% of the average retiree’s income derives from claims to benefits (see Council of the European Union (2003)). Generally, two classes of the public social security system can be distinguished: (i) the tax-financed old-age system for civil servants and (ii) the mandatory retirement insurance for other employees, which is financed by contributions. The first one is not considered in this article, since it is not affected by the above mentioned reform. The second one is described below in more detail.

The retirement insurance covers the vast majority of the population. About 33.5 million individuals have been insured in 2007 (Deutsche Rentenversicherung Bund (2009)), compared to about 55 million individuals in the relevant age group from age 14 to age 65 (Statistisches Bundesamt (2008)). Public benefits are the most important source for old-age-income among the whole population. The net replacement rate is 67% for an individual with 45 contribution years (OECD (2007)). The cap on insurable earnings is high. In 2007 it amounted to 5250€ per month, which is 214% of the average monthly gross wage.

The insurance is organized as a pay-as-you-go-system, and financed by payroll-taxes. Individual benefit claims depend on the individual earnings history. “Premium Points” are used to calculate the amount of benefit entitlements. For every year of average contributions, one premium point is credited to the individuals’ insurance account. For years with lower or higher contributions the amount of premium points is adjusted proportionally. The number of premium points accumulated until age 65 determines the benefit entitlement.

The amount of € paid for one premium point is determined by law on a yearly basis. In 2008, 26.56€ per month were paid for one premium point. In contrast to, for example, the system of social security in the U.S, all contributions are weighted equally over the lifetime. Neither the age nor the date of payments to the public retirement insurance influences the entitlement for benefits.

The minimum age for claiming benefits is 65 years as a matter of principle, but since 1972 there were several exceptions from that minimum age for certain groups of insured workers. To allow a “flexible retirement entry”, unemployed persons, women, and disabled individuals who meet certain criteria concerning their employment history could retire between age 60 and age 65, while the long-term insured with more than 35 years of contribution could retire between age 63 and age 65. There were no benefit reductions following retirement prior to age 65 for those groups until 1997, and thus there was a strong incentive to retire at the earliest possible point in time. For example, about 79.9% of all men and 47.4% of all women born in 1931 started to draw benefits before 1996, i.e. before the regular retirement age of 65 years (Deutsche Rentenversicherung Bund (2008)).

In order to reduce these incentives, the “Act on the Promotion of Growth and Employment” (Wachstums- und Beschäftigungsförderungsgesetz) was passed, which introduced benefit reductions for workers retiring prior to the age of 65, starting in 1997. The minimum age at which full pensions can be claimed was raised to age 65 for all insured workers. The implementation of the reform stretches over a long period, as the minimum age for receiving a full pension was increased in monthly steps over several years. Thus, in a transition period (1997 to 2005), different birth cohorts could claim a full pension at different ages. For example, individuals born in January 1938 aged 61 years and 1 month can receive “old-age pension for the unemployed” with full benefits. Individuals born in February 1938 can receive the full pension when they are 61 years and 2 months old, and so on.

As a further consequence of the reform, prior to the cohort-specific regular retirement age benefits can only be claimed at the price of a permanent benefit reduction. Fig. 1 illustrates the retirement options for the transition cohorts (1937–1945). For every month that benefit claiming takes place prior to the age of eligibility for the full pension, the benefits are reduced by 0.3 percentage points. Hence, given a specific retirement age, different birth cohorts have to accept different reduction rates. For example, a person starting to receive “old-age pensions for the unemployed” at age 61 and 1 month suffers no benefit reduction if born in January 1938, since for this cohort the age of 61 and 1 month is the age of entitlement for full benefits. But persons born in January 1940 with the same retirement decision would have to accept a reduction of 7.2%. In that case, the minimum age of entitlement for full benefits is 63 years and one month, and 24 months of 0.3%-points reduction accumulate. This regulatory framework allows one to identify the effect of payment reductions on the retirement decision.

3. Literature and hypotheses

There is a large literature pointing out the importance of pensions for the timing of retirement. One strand of the literature deals with the effect of expected income from social security or pension benefits (i.e. the level of social security or pension wealth) on the retirement decision. Classical life-cycle-models used for example by Gordon and Blinder (1980) or Gustman and Steinmeier (1986) show that the amount of provided benefits compared to potential wages has an influence on the retirement decision of an individual maximizing utility from income and leisure. Hurd (1990a) examined the peak in retirement entries in the United States at age 62, when benefit receipt is first available. This peak has grown over time with growing social security benefits. Blau (1994) estimated hazard rates into retirement dependent on social security wealth and found a strong connection between benefit levels and exit rates. A well-known study to be mentioned is conducted by Krueger and Pischke (1992). They used a natural experiment in the U.S. in 1972, when a sharp decline in benefit levels was introduced for given birth years onwards, while older generations remained unaffected. The main advantage of this approach is the exogenous variation in benefits. Most studies of retirement behavior suffer from a correlation between the level of benefit entitlements or the replacement rate, and the employment biography, which again should be correlated with the retirement decision. Krueger and Pischke found a significant, but only very small impact of pension levels on retirement behavior.

---

4 Self-employed workers are mandatorily covered only in exceptional cases.
5 The net replacement rate is defined as the individual net pension divided by the most recent net earnings. Another possibility of definition is relative to average lifetime earnings, typically resulting in an even higher replacement rate.
6 This refers to the average contributions of all insured individuals in the given year.
7 Employment after age 65 is not subject to the retirement insurance. No further contributions have to be paid, benefits can be drawn regardless of the current employment status, and it is not taken into account for the amount of benefits.
Besides the level of available benefits, accruals in social security wealth may play an important role for the retirement decision, i.e. whether or not an individual can increase future pension payments by postponing the retirement entry. Some studies included the amount of available benefits in case of one or several further years of work in the estimation of labor force participation, such as Fields and Mitchell (1984) or Sueyoshi (1989). Diamond and Gruber (1999) calculated implicit tax rates on further employment for some typical workers, and a similar study was applied on real individuals by Coile and Gruber (2000). For the German case, Börsch-Supan and Schnabel (1999) found negative accruals through another year of work at most ages, which could explain in parts the strong tendency to retire early in Germany. The Option Value model established by Stock and Wise (1990) elaborates the anticipatory retirement behavior of workers. It states that the available stream of income and leisure corresponding to any future retirement date has to be taken into account rather than the accrual in income from one year to another. An application of the Option Value model is done by Coile and Gruber (2000), who estimate probit models for retirement using the Option Value as an explanatory variable. Also, studies for Germany found a positive impact of pension accruals on labor force participation. Börsch-Supan et al. (2004) and Berkel and Börsch-Supan (2004) simulated the effect of actuarially fair payment reductions on the retirement decision through changes in the Option Value. Siddiqui (1997) estimated hazard rates into retirement depending on future income streams. All three studies found that the duration until retirement entry significantly increases when early retirees face pension reductions. There is a strong agreement across the literature that pension accruals fundamentally influence the retirement decision. Samwick (1998) compared the effect of the level of social security wealth and accruals in social security wealth and found the impact of accruals to be the central determinant of the timing of retirement.

Now, to analyze the impact of the German reform on retirement behavior, one has to consider its effects on the level and accruals in social security wealth: after full implementation of the reform in 1997, the level of social security wealth remained unchanged, if an individual were to retire at age 65. At the same time, social security wealth is considerably lowered for the affected cohorts compared to unaffected cohorts, if they retire prior to age 65. Consequently, the accruals in social security wealth resulting from a delay of benefit claiming are larger (or less negative) for affected than for unaffected cohorts.

Consider that an individual takes the decision regarding the optimal date of retirement entry according to the Option Value Model of Stock and Wise (1990), i.e. she compares all possible future streams of utility from income and leisure and delays retirement entry if she can thereby receive a higher stream of utility. In this framework, retiring at any early date \( s \) instead of any later date \( t \) has four effects: (i) it lowers utility due to a loss of wage earnings during the period between \( s \) and \( t \), (ii) it increases utility from leisure during \( s \) and \( t \), (iii) it lengthens the period of benefit receipt, thereby raising utility according to the amount of benefits that are paid between \( s \) and \( t \), and (iv) it changes the expected present value of future benefits during the remaining lifetime according to the pension formula. Hence, retiring at date \( s \) instead of \( t \) will be preferred only if the loss in wage income is at least outweighed by (a) the utility from leisure between \( s \) and \( t \), (b) the retirement income received between \( s \) and \( t \), plus (b) the difference in the present values of future income if the individual retires at date \( s \) instead of date \( t \).

After full implementation, the reform of the pension formula in Germany changed the incentives to retire at any age between the age of 60 and the normal retirement age 65: first, if an individual decides to retire at any date prior to age 65, the potential benefits and hence the gain in utility from income during the period of preponement is lowered. Second, also future benefits are substantially lowered if an individual decides to retire early. Hence, the present value of early retirement income minus the present value of income when retirement takes place at age 65, is more negative or less positive for affected than for unaffected cohorts. It is therefore more unlikely that the change in total retirement income outweighs the loss in wage income. Consequently, I expect that individuals with a high minimum age of full benefit claims should retire later than individuals with a low minimum age of full benefit claims.

Fig. 2 provides some first insights, supporting this hypothesis. It shows the distribution of claiming ages for different birth cohorts by gender. The birth cohorts unaffected by the reform are those prior to 1937 for men, who can apply for “pension for the long-term-insured” at age 63 or “pension for the unemployed” at age 60. While the distribution of claiming ages is almost constant over birth years 1931 to 1936, a clear behavioral change begins with birth year 1937. Claiming benefits at age 60 and age 63 become less frequent over time, while claiming at age 65 and at age 64 substantially gains importance. The same pattern is visible for women. The most important benefit type for them is “women’s pension”. Reductions for this benefit type were introduced for birth years 1940 onwards. While about 45% of the women claimed benefits at age 60 and only about 10 to 15% at ages 61 to 64 for birth cohorts 1931 to 1939, this behavior changed for birth cohorts 1940 to 1942. The frequency of claiming benefits at age 60 decreased to 35%, while claiming at ages 61 to 64 almost doubled to 29%.

Fig. 2. Relative frequency of claiming ages (by birth cohort).
Up to now, it is assumed that the individual decides either to work and receive labor income, or to retire and receive pension benefits. Hence, retirement entry, labor force exit and claiming of benefits are interchangeable terms. But there may be differences in the reform’s effects i) on retirement in the sense of claiming benefits, and ii) on retirement in the sense of exiting employment. Coile et al. (2002) investigated for the U.S. the optimal delay of benefit claiming after employment exit given the incentives set by the insurance system, and to what extent this option is used. They found that more than 10% of the male retirees postpone benefit claiming for at least 1 year after becoming entitled due to job exit.

Consider again the framework of Option Value models. Once we assume the date of retirement (= the date of labor force exit) is allowed to differ from the date of benefit claiming, retiring at any early date s instead of any later date t, has lower effects than before: it still lowers utility from total wage earnings and increases utility from leisure. But it lengthens the period of benefit receipt only if the date of benefit claiming is preponed by the same period of time, and also the expected present value of future benefits during the remaining lifetime is changed only if the date of claiming is preponed according to the date of retirement. Hence, since there is a weaker dependence of the retirement decision on pensions, the change in the pension formula is expected to lead to smaller behavioral adjustments. It is therefore expected that we observe a weaker reaction to the reform if retirement is defined as labor force exit, rather than benefit claiming.

If labor force exit and benefit receipt take place at different points in time, there has to be an alternative employment status and income source that is used in the period between both events. An unemployment spell may emerge or be widened, or individuals may receive transfers from disability programs. There are several possible income sources besides labor income and retirement benefits to finance consumption in the time between employment exit and benefit claiming: individuals may dissave, receive private transfers, or try to apply for minimum assistance, unemployment benefits, or other public income transfers. In many European countries, including Germany, systematic interdependencies of the eligibility for retirement and unemployment benefits exist that to some extent allow a substitution of those programs. Eased eligibility for pre-retirement in case of unemployment is often a part of public retirement programs. For example Portugal, Finland, Germany, Belgium, or the Netherlands provide displaced workers with public retirement benefits or public subsidies for pre-retirement in the framework of industrial agreements (European Commission, 2006). Likewise, longer or eased eligibility for unemployment benefits for older workers near retirement is very common across Europe. Such regulations can be found in nearly every member state of the EU and even in Switzerland. The actuarial adjustment of retirement benefits, intended to set incentives for continuing work, could hence be avoided rather easily by switching into other social security programs instead of early retirement.

Besides preferences for leisure, a lack of available jobs may cause the employment exit of older workers irrespective of the timing of claiming benefits. Older worker’s exit from employment is not always “voluntary” but often driven by employment constraints. There is a growing literature that distinguishes between “voluntary” and “involuntary” withdrawal from the labor force. Dorn and Sousa-Poza (2007) for example find that strict employment protection regulation and increasing unemployment rates increase the fraction of early retirees reporting their decision for early retirement as “involuntary”. Chan and Huff-Stevens (2002) find for the US that the effect of displacement on the probability of early retirement significantly exceeds the effect explained by the subsequent changes in the Option Value, i.e. the incentives relevant for the employee. Hakola and Uusitalo (2005) examine a reform in Finland, where the employer’s contributions to the unemployment insurance are experience rated: if an employer displaces an employee who receives a pension for the unemployed afterwards, the employer has to pay higher contributions to the unemployment insurance in the future. In a reform in 2000, the sensitivity of contributions to past displacements was raised. Such a rise in the employer’s liability for pension benefits significantly reduced the share of employees retiring early. This research suggests that at least some older workers would leave employment because they do not have the opportunity to stay in their current (or in a comparable) job and would not do so otherwise. In that case, again some individuals may postpone benefit claiming in order to avoid permanent benefit reductions, but stop employment anyway due to a lack of demand for their labor. In the time between employment exit and claiming benefits, a period of e.g. unemployment benefit receipt may occur. But regardless whether one considers “individual preferences for leisure” or “a lack of attractive job opportunities” as the main reason, employment exit and benefit claiming must not be postponed to the same extent.

Some first evidence is given by Fig. 3.10. It shows the distribution of the labor force status at given ages by birth cohorts. In the first panel we see that the frequency of retirement (in the sense of receiving benefits) at age 60 substantially decreases with the introduction of the reform, while the frequency of employment at the same age increases. Yet, the increase in employment is not as strong as the decrease in benefit receipt. At the same time, unemployment as well as disability gains importance. A similar pattern can be seen for age 61 to age 63. It seems that indeed the reform has an effect on benefit receipt as well as on employment, but the first one is considerably stronger than the latter. Therefore, the effect of the reform on both decisions has to be analyzed separately to estimate the reform’s total effect on the system of social security.

4. Estimation strategy

The key issue of interest is the effect of social security benefits on the duration until retirement entry. This is initially estimated in the framework of a survival analysis, which considers every individual from the first moment “at risk” (i.e. the first moment a person is eligible for early retirement benefits) until retirement entry. The analysis is divided into two parts: a first one that defines retirement entry as “benefit claiming”, and a second one that defines retirement entry as “exit from work”. Both decisions are estimated identically, except of the definition of the dependent variable. I will describe the model for both decisions using the neutral term “retirement entry” and will present the exact definition of the dependent variable in the next paragraph, when the data is described.

The data contains monthly information, and I find a considerable accumulation of retirement entries particularly in the first month after reaching eligibility. Hence, continuous-time models are inappropriate due to a large number of tied observations. To solve this problem, discrete time models are used. Let T be a random variable measuring the duration until retirement entry in months. The probability of retiring before month \( t + 1 \) is described by the probability distribution \( F \), the probability of retiring within month \( t \) is given by the density function \( f \) and \( \theta \) describes the probability that an individual retires in month \( t \) given the spell did not terminate before.

\[
F(t) = \Pr(T \leq t) \\
\theta(t) = \Pr(T = t \mid T \geq t) \\
f(t) = \Pr(T = t)
\]

Of course, “involuntary” does not mean that the decision is enforced, but that there are no jobs available which are sufficiently attractive to prevent workers from stopping employment. The distinction between “preferences for leisure” and “attractiveness of employment” is, of course, not very explicit. The decision to accept or reject a job opportunity is naturally based on the interaction of preferences and job characteristics, such as wages.

\[9\] The figure is drawn from the data used for the estimations later on that are described in Section 5 in more detail. The dataset does not contain birth cohorts before year 1935. Therefore, a longer trend prior to the reform cannot be shown.
The survival function provides the probability that an individual will "survive" month $t$, i.e. will retire at month $t + 1$ at the earliest: $S(t) = 1 - F(t) = Pr(T > t)$. It can be expressed in terms of $\theta$ as $S(t) = \prod_{\tau = 1}^{t} (1 - \theta(\tau))$ while $f(t) = \theta(t) \cdot \prod_{\tau = 1}^{t-1} (1 - \theta(\tau))$.

The likelihood contribution of an observed individual $i$ who retires in month $t$ is $f(t)$, while the likelihood contribution of a right-censored spell observed until month $t$ corresponds to the survival function $S(t)$.

There are various possibilities for the specification of the function $\theta(t)$. Typically, the transition rate is specified as being dependent on some observed characteristics $x_{it}$ that can be time-varying or constant over time, a parameter vector $\beta$ measuring the effect of $x_{it}$ on the transition rate, and a period-specific effect $\alpha_{t}$. Furthermore $\theta(t|\alpha_{t},\beta^{\prime}x_{it})$ has to follow some distribution function. I have used three different distribution functions to test for robustness of the results:

- The logistic distribution, which leads to the likelihood function of a binary logit model,
- the normal distribution, which leads to the likelihood function of a binary probit model, and
- the extreme value distribution, which leads to the likelihood function of a binary complementary log–log model.

The last model is in fact a proportional hazard model as it is used in Cox regressions, modified for the discrete framework. Integrating the continuous-time hazard function $\lambda(u) = \lambda_{0}(u) \cdot \exp(\beta^{\prime}x_{it})$ over a time interval $[t, t + 1]$ leads to the discrete transition rate $\theta(t) = 1 - \exp(\beta^{\prime}x_{it} + \alpha_{t})$. The proportional hazard model for discrete time thus reduces to a complementary log–log model with extreme value distributed spell lengths.\(^{11}\)

Due to the panel structure of the data, the error terms may not be independent. Hence, the standard errors are clustered to account for intra-person correlation. All models allow for a flexible form of duration dependence, since $\alpha_{t}$ can be specified as a set of dummy variables indicating a specific month after starting to be at risk. In a more parsimonious specification $\alpha_{t}$ can also be specified as a linear, quadratic or other arbitrary function of duration. To allow maximum flexiblity, a set of dummy variables was used to represent the duration of the spell.

4.1. Measuring the influence of social security income

The key issue of interest is the effect of benefits paid depending on the date of retirement entry. They differ among individuals according to their employment history, and according to the regulatory framework they are subject to. The Option Value Model as discussed in Section 3 implies the estimation of expected net present values of utility streams at all possible ages of retirement. The difference between utility resulting from immediate retirement and the maximum utility could be used as an incentive measure in a reduced-form-regression, as done by Samwick (1998). Coile and Gruber (2000, 2001) suggest calculating income streams instead of utility streams, since no assumptions regarding the utility function are needed then. They use the difference in income resulting from immediate retirement and the maximum available income (the “Peak value”) as an incentive measure. I use a similar approach. Yet, the construction of an incentive measure has to be adjusted for a framework when the date of benefit claiming and the date of employment exit can differ.

Individuals can influence their social security income over two variables: the date of benefit claiming, and the date of employment exit. Comparing actual social security income to the Peak Value (i.e. when it is maximized over both decisions) does not allow distinguishing between additional income from waiting, and from working. Yet, the effect is likely to differ, since it implies different levels of utility from leisure and work income, and the incentives set by the social economy.
security system cannot be fully captured by a single measure. Instead, the change in retirement income resulting from a delay of employment exit and of benefit claiming should be measured while holding the other variable constant. At first sight, this leads to an infinite number of possible incentive variables, since the change in income if benefit claiming is delayed can differ depending on the date of employment exit and vice versa. However, to solve this problem, we can exploit two facts: first, for every age of employment exit, the net present value of social security benefits is either a monotonically decreasing or a monotonically increasing function of the claiming age until age 65, and the function is monotonically decreasing afterwards. And second, for every age of benefit claiming, the net present value of social security benefits is a monotonically increasing function of the date of employment exit until age 65, and does not change afterwards. Fig. 4 exemplifies that for a hypothetical male, West German worker at the age of 55 after full implementation of the reform, I assume an individual with 35 insurance years with average contributions. For every year of further work, again average contributions are paid and benefit entitlements are increased accordingly. The figure shows the net present value of social security income by age of claiming, for different ages of employment exit. Survival probabilities are drawn from official life table data, and the discount rate is assumed to be 3%.

As pointed above, we see that social security wealth is monotonically decreasing in the date of claiming until age 65, if the age of employment exit is held constant. Depending on individual life expectancy and time preferences, the slope of the curves may be higher and can change its sign, if the adjustment of monthly benefits exceeds the losses induced to the shortening of the receipt period. After age 65, there is no change in monthly benefits due to waiting, but the period of receipt is shortened. Hence, a further delay of benefit claiming after age 65 is always financially unattractive, regardless of time preferences and life expectancy. In the situation without the reform, the curves’ shape before age 65 is the same as after age 65, since no adjustment of monthly benefits takes place. The maximum incentive to pre- or postpone benefit claiming (without changing the employment decision) can be represented by the difference in the net present value of social retirement income for claiming at age 65, and for immediate claiming. The latter legally requires immediate employment exit, and hence the incentive to delay benefit claiming should be measured given that employment exit takes place at the actual age.

Furthermore, we see that social security wealth is monotonically increasing in the date of employment exit until age 65, if the claiming decision is held constant. After age 65, further employment does not influence social security income at all. As a consequence, the maximum change in the net present value of social security income results if employment exit is delayed from immediate exit until age 65. Regular employment is legally impossible after benefit claiming, and hence the incentive to delay employment exit should be measured under the condition that benefit claiming takes place at age 65.

In sum, three different levels of social security wealth have to be taken into account:

\[
SSWA_t = (1 - R(t)) \cdot \sum_{s=5}^{T} \pi(s) \cdot \frac{B_s(t)}{(1 + \delta)^{s-t}}
\]

\[
SSWB_t = \sum_{s=5}^{T} \pi(s) \cdot \frac{B_s(t)}{(1 + \delta)^{s-t}}
\]

\[
SSWC_t = \sum_{s=5}^{T} \pi(s) \cdot \frac{B_s(65)}{(1 + \delta)^{s-t}}
\]

SSWA represents the net present value of retirement income if the individual decides to exit employment and to claim benefits immediately in t. \(\delta\) is the discount rate, \(\pi(s)\) is the probability of surviving until period s and, \(B_s(t)\) are full monthly retirement benefits that are paid in s, if the individual exits employment and claims benefits immediately in t, and \(R(t)\) is the reduction rate on monthly benefits that is applied according to the individuals’ date of birth and the timing of retirement entry.

SSWB represents the net present value of retirement income, if the individual decides to exit employment immediately in t, but draws benefits only at the normal retirement age. Consequently, full monthly benefits \(B_s(t)\) remain unchanged since no further contributions are paid, while the reduction rate \(R(t)\) is decreased to zero.

SSWC represents the net present value of retirement income if the individual draws benefits only at the age of 65, and decides to work and to pay contributions until that age. To forecast \(B_s(65)\), i.e. the monthly benefits that are expected in t given work is continued until 65, I assumed that the individual will pay contributions during t and age 65 according to her last observed contributions.

Three variables are now included in the regression:

1. SSWA
2. INCB = \(\frac{SSWB - SSWA}{SSWB}\)
3. INCC = \(\frac{SSWC - SSWB}{SSWB}\)

SSWA measures the level of social security wealth, related to employment exit and benefit claiming at the actual age. INCB measures the accrual in benefits due to a delay in benefit claiming until entitlement for full benefits (holding the employment decision constant), and therefore captures the incentive to postpone benefit receipt. The propensity of benefit claiming at a given age is expected to be lower the higher the value of INCB. Whether individuals react to this incentive in their claiming decision depends on their unobserved time preferences and life expectancy. Furthermore, INCB can influence

To calculate the net present value of social security income, survival probabilities and discount rates have to be assumed. Of course, individual life expectation and time preferences are unobserved. Therefore, average survival probabilities are drawn from official life table data by gender, region and age. As usual in the literature, I assume a discount rate of 3%. Whether it is optimal for the individuals to delay claiming until age 65 depends effectively on their unobserved, individual time preference. However, the financial incentive to delay claiming should be captured on average.

---

12 As described in Section 2, employment after age 65 is not subject to the public retirement insurance. No contributions are paid after that age, benefits remain constant, and can be received regardless of the employment status.
13 This means that the individuals’ wage growth equals the average wage growth among the insured population.
14 This holds regardless of the employment status during the period of delay, since employment after age 65 is not subject to the public retirement insurance (see Section 2).
the employment decision for two opposing reasons: first, a higher value of INCB implies a higher wealth (conditional on SSWA) and should lower labor supply, given leisure is a normal good. But second, postponing the receipt of benefits offers the opportunity to delay employment exit as well. Continued work is legally impossible, if an individual receives benefits prior to the age of 65. Hence, individuals with a high value of INCB who face an incentive not to receive benefits prior to age 65, are more likely to have the option to work left, which should increase their probability to actually work. The total effect of INCB on the employment decision is ambiguous.

INCB now measures the accrual in benefits if this option to work is indeed taken, and the individual continues to work and to pay contributions, thereby raising monthly benefits during the retirement period. Whether individuals react to this incentive depends on their unobserved preferences for leisure and expected wages. Again, since benefit receipt is legally impossible while the individual continues to work, we would expect that INCB influences both, the claiming decision as well as the retirement decision, in the same direction: the propensity to retire and the propensity to collect benefits should be lower for individuals with high values of INCB, i.e. for individuals who can gain a lot from continued work. However, it is expected that the effect of INCB is lower than the effect of INCC: while INCC describes the change in social security wealth that can be realized by working, which is connected with a loss in utility from leisure, INCB describes the change in social security wealth that can be realized by waiting, which does not influence leisure.

One might argue that a change of both, employment and claiming decision at the same time, may lead to higher gains in retirement income, than changing only one of them while holding the other constant. This would not be reflected by the mentioned incentive measures. Connecting points D–H and SSWC in Fig. 4 gives the social security wealth by date of retirement under, under the condition that both events are changed contemporaneously. If there is an inner solution to maximize this curve, the Peak Value as considered by Coile/Gruber will result, and it could be used as a third incentive measure. However, this is unlikely to happen given the pension formula as described above, where non-monotonicities do not occur. The function is increasing in the beginning and decreasing later on, if and only if additional benefit entitlements resulting from an additional period of work (i) at least outweighs the implied loss from waiting at relatively young ages, and (ii) falls behind the loss from waiting at higher ages. In the presence of increasing mortality over the lifetime, the expected loss from waiting decreases with age. At the same time, workers typically face increasing wages, which implies that additional periods of work imply higher additional benefit entitlements over the lifetime. Reconsidering Fig. 2, we see that the distribution of claiming ages indeed follows a bimodal distribution and retirement entry at ages 61 to 64 are of very little importance. This finding supports the appropriateness of the used incentive measures.

Since the pension reform is a kind of natural experiment and the rates of payment reductions at a given age are exogenous – only determined by the birth cohort of an individual – the variation in INCB is fully exogenous. The marginal effect on the transition rate \( \theta(\cdot) \) can be interpreted as a causal effect. Nevertheless, a necessary assumption for identification is that there are no non-ignorable factors determining the retirement behavior that coincide with the reform process. In other words, (i) factors possibly affecting the retirement decision that may differ between neighboring birth cohorts have to be controlled for, and (ii) one has to assume that the effect of these factors remains constant over the reform process.

If there is any variable which is changing between neighboring birth cohorts that is important for the retirement decision but cannot be controlled for in the model, the effect of the reform would not be identified. The model therefore controls for personal characteristics and the labor market situation, which could possibly affect the retirement decision, such as the amount of benefits, unemployment, or health problems. They are presented in detail in Section 5, where the data are described.

Furthermore, one has to assume that the effects of the controlled variables, i.e. the parameters of the model, remain constant over the observed birth cohorts. If they were changing over cohorts, the causal effect of payment reductions would not be identified. However, the relevant observed birth cohorts are 1935 to 1942 (see Section 5), which is a rather short period. There is no obvious reason to assume that the coefficients of the model should vary among them.

For a deeper insight in the sensitivity of different population groups to the reform, the estimation is implemented also for different sub-samples. A higher effect of payment reductions in a population group then indicates a higher sensitivity to the reform. I compare the behavior of men and women, as well as the behavior of men in the East and the West. In a last step, the sample of West German men is subdivided by quintiles of full benefit claims calculated for an assumed entry into benefit receipt at age 60. The separate estimation for quintiles of benefit amounts now allows us to examine whether the effect of income levels and accruals differs across the wealth distribution.

5. The data

The data are provided by the German public retirement insurance. For the analysis, the so-called “Versicherungskostenstichprobe 2002” (sample of social insurance accounts) is used.16 The benefit entitlements of all individuals who ever held a job subject to compulsory retirement insurance and who are still alive are administered by public insurers using a personal account. The data set is a random sample of all accounts existing in 2002.17 It contains the complete employment and earnings history (as relevant for benefit claims) for 46,538 individuals and therefore the potential social security entitlements since the age of 14 until 2002, on a monthly basis. Furthermore, some socioeconomic characteristics are available in the data set (see below). The main advantages of these administrative data are:

- There is no panel attrition,
- there is no recall bias in the employment and earnings history, and
- there are only few missing values.

Since exit from employment due to old age and entry into retirement prior to the regular minimum age of 65 is estimated, for this analysis only persons are considered who

- were employed for at least 1 month at age 55 or afterwards, and
- meet the necessary conditions concerning their employment history to claim a pension before the age of 65 (and were therefore affected by the reform).18

16 The Research Data center of the Retirement Insurance (Forschungsdatenzentrum der Rentenversicherung, FDZ-RV) kindly provided the data for on-site use during a research visit.
17 The data are collected for administrative purposes and the editing for research needs is in progress. Samples of subsequent years were therefore not available at the time of the analysis.
18 Persons who had the possibility to claim a pension before the age of 65 were: (i) women aged 60 years and above, with more than 15 years of compulsory contributions after the age of 40 (they can apply for “women’s old-age pension”), (ii) individuals aged 63 and above, with more than 35 insurance years (they can apply for “pension for the long-term insured”) and (iii) unemployed workers who are at least 60 years old, with at least fifteen insurance years, and who contributed to the retirement insurance for more than eight out of the last 10 years (they can apply for “pension for the unemployed”). Of course, the sub-sample of unemployed individuals is not a random sample of all insured individuals. In order to avoid endogenous sample selection, the analysis is therefore (deviating from the legal definition) not constrained to the actually unemployed: every person is considered to be eligible for a “pension for the unemployed” who meets the necessary employment history requirements, regardless of whether he or she is unemployed or not. It is possible that the reaction to the reform is therefore underestimated, since some workers are included in the analysis sample who are in fact not affected by the reform and cannot respond. This however is not problematic inasmuch as the results below can be interpreted as a lower bound of the underlying effects.
This holds for 26,739 individuals. This sample of individuals is used for the estimation of the duration until benefit claiming as well as until employment exit. For the latter, all observations from age 55 onwards are used. They are censored after the final employment exit (for the exact definition see below). The final sample comprises 1,444,846 person–month observations out of which 23,136 exits from employment were observed in the period from 1995 until 2002. For the estimation of the duration until benefit receipt all observations from the first month of eligibility onwards were used and they are censored after claiming benefits (see below). In the end, 304,877 person–month observations are available for this part of the analysis, and 21,536 entries into benefit claiming are observed.

For both parts of the analysis, the dependent variable is derived from the current employment status of an individual at a given point in time. For the estimation of the hazard rates of a transition into benefit claiming, a dummy variable is constructed indicating whether a person receives an old-age pension in a given month or not. Other possible definitions of retirement such as a self-reported employment status or an indicator using the number of hours worked are not reasonable, since the main focus of this analysis is the reform’s effects for the retirement insurance. The dependent variable, indicating benefit claiming, takes the value one in the first month when benefit receipt was observed and zero otherwise. For the second part of the analysis I use a dummy variable indicating whether an individual is employed or not. Again, employment is defined in the legal sense since this is the definition of interest from the insurer’s point of view. Therefore, employment that is not subject to compulsory social security contributions is not taken into account. Since individuals can exit and reenter employment, one has to define whether an employment exit is considered to be permanent or not. The most common approach is to define the first exit after a given age. For example, the age of 55 might be useful, because there is no reentry observed afterwards for a considerable amount of exits. Yet, mainly between age 55 and age 60, also a considerable number of reentries occur. Consequently, it implies a large measurement error to estimate the transition rate into employment using the first exit after age 55, and a large loss of information to estimate the transition rate into employment exit only after age 60. An employment exit is therefore considered to be the final one, if a) it is the first exit that occurs after age 60, or b) the exit occurs before the age of 60, but no reentry is observed until the age of 60. The dependent variable takes the value one in the month of employment exit and zero otherwise.

As discussed in Section 4, the level of benefits in case of immediate retirement and the accrual in benefits in case of postponement of employment exit and benefit claiming are included in the model. Furthermore, factors determining the retirement behavior that coincide with the reform process have to be controlled for to ensure identification of the effect of benefit levels and accruals. Fig. 2 buttresses the assumption that there is no general trend corresponding to the reform, since no trend can be seen prior to the reform. However, in order to ensure identification, controlling for other factors is desirable. It stands to reason to include time-dummies, representing all possible changes in employment determinants. Unfortunately, it is not possible to control a general time-trend. Within each benefit type (pension for the unemployed, women’s pension and pension for the long-term insured) the accrual in Social Security Wealth due to a postponement of benefit claiming (INCB) changes almost linearly with the birth year. Fig. 5 shows the average accrual in Social Security Wealth (INCB) due to a postponement of retirement entry until age 65 by age and birth year for women and men. Assuming a discount rate of 3%, the pension formula is not actuarially fair even after the reform. Consequently, average pension accruals are negative for all birth cohorts at every age. However, this negative incentive clearly decreases for affected birth cohorts. At age 60, the first affected birth cohort are individuals born in 1940 for the female sample, and individuals born in 1937 for the male sample. At age 61, women born in 1941 and men born in 1938 are subject to the reform, and so on. As can be seen, the negative incentive does not only decrease with birth year, but it decreases almost linearly. Besides the incentive measure INCB, age is included in the analysis. Adding the actual point in time now, very high multicollinearity will arise because the effects of age, date of birth and point in time are not clearly distinguishable. Therefore, variables which may cause a time-trend are controlled for, instead of using a general time-trend itself.

The vector of control variables contains information about the overall labor market situation, and some taste shifters. Another determinant of labor market behavior might be spouse’s income. Unfortunately, information on spouse’s earnings is not provided for the sake of data privacy. But since women’s labor force participation increases over time, a growing fraction of men is married to a working wife, which might affect the employment decision. Therefore I used another micro data source (German Socioeconomic Panel, GSOEP) and aggregate administrative data, to substitute information about spouse’s income on an individual basis with information about birth cohorts. From the GSOEP I draw the distribution of birth years of the women sample, and individuals born in 1937 for the male sample. At age 60, the negative incentive clearly decreases for affected birth cohorts. At age 61, women born in 1941 and men born in 1938 are subject to the reform, and so on. As can be seen, the negative incentive does not only decrease with birth year, but it decreases almost linearly. Besides the incentive measure INCB, age is included in the analysis. Adding the actual point in time now, very high multicollinearity will arise because the effects of age, date of birth and point in time are not clearly distinguishable. Therefore, variables which may cause a time-trend are controlled for, instead of using a general time-trend itself.

![Fig. 5. INCB: accrual in social security wealth if benefit claiming is delayed by gender, year of birth and age.](image-url)
time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.

Moreover, some taste shifter variables are included in the model. These are namely age, gender, education, occupation, children, and nationality, whether a person faces health problems, and the overall economic situation, the annual unemployment rate by time. Furthermore, the retirement decision might be affected through the amount of assets held. Unfortunately, the retirement insurers do not collect information on assets. As a proxy for assets I used the probability of owning a house by birth cohort and gender, which is again drawn from the GSOEP.
rate by 5%. However, as pointed out in Section 4, the incentive measure INCB represents the increase in Social Security Wealth that can be realized by waiting. As expected, the opportunity to increase one’s net present value of benefits by working, i.e. through further contributions (INCC), causes smaller behavioral reactions since it is connected with a loss in utility from leisure. The marginal effect of INCC amounts to about one third of the effect of INCB.

The behavioral adjustments regarding exit from employment, rather than claiming benefits, is much more modest. The marginal effect of the level of Social Security Wealth on the transition rates out of employment is statistically insignificant and of negligible magnitude. However, the anticipated accrual in Security Wealth if benefit claiming is delayed until age 65 has a significant effect on employment exit. As discussed in Section 4, the expected effect of INCB is ambiguous: on the one hand, raising INCB (given SSWA) raises one’s wealth, and should cause strong reactions. In sum, there are modest to no reactions on the level of Social Security Wealth, strong reactions to accruals in Social Security Wealth that can be realized by waiting, and no to modest reactions to accruals in Social Security Wealth that can be realized by further contributions. In all cases, there is a stronger connection between the claiming decision and financial incentives than between the employment decision and financial incentives.

In addition to the estimation of average marginal effects, the total effect of the reform was simulated. First, for every person at every observed point in time, a transition rate into retirement (and out of employment) was predicted, assuming no reduction in payments for the calculation of SSWA and INCB. Second, the transition rate was predicted given the values of SSWA and INCB after full implementation of the reform. The results by gender are presented in Table 2. Based on separate estimations for men and women. For men the average monthly transition rates into retirement were almost halved from 5.5% before the reform to 2.6% after the reform, and the effect is statistically highly significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the reform, and the effect is statistically significant. The effect is even much stronger for the female population. The monthly transition rates into benefit claiming for women were about 14.7% prior to the reform and 6.7% after the re

Table 2
Total effects of the reform on transition rates by gender.

<table>
<thead>
<tr>
<th>Transitions into retirement</th>
<th>Women</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average predicted transition rates</td>
<td>14.74%</td>
<td>0.31%</td>
<td>5.53%</td>
</tr>
<tr>
<td>Standard error a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transitions out of employment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before reform</td>
<td>1.27%</td>
<td>0.13%</td>
<td>1.48%</td>
</tr>
<tr>
<td>After reform</td>
<td>1.87%</td>
<td>0.1%</td>
<td>1.06%</td>
</tr>
</tbody>
</table>

Notes:
a Standard errors of the difference between the predicted transition rates. The standard errors were bootstrapped with 80 draws from the original sample.
eligibility. Within half a year, less than 50% of the male and less than 25% of the female population are still at risk. After the reform, 75% of the male individuals and 90% of the female individuals are still at risk after half a year, and it takes about 3 years for men and about four and a half years for women until half of the population at risk has claimed benefits.

The reform also causes a postponed exit from employment. About 50% of the male individuals at risk exit employment until the age of 60 (which is 60 months after becoming at risk) when there are no reductions in payments. This share decreases to about 35% after the reform. After age 63 the effect disappears. For the female population there is almost no effect of the reform.

But besides the postponing of retirement and the slight postponing of employment exit, the time lag between exit from employment and entry into benefit claiming is widened considerably. After transposing the average survival probability by spell duration into the average survival probability by age, the distance between (i) the survival until exit from employment and (ii) the survival until benefit receipt shows: by how much the fraction of the population at a given age who are not gainfully employed exceeds the fraction of the population who are receiving benefits. For example, without the reform 37% of the male risk population is expected not to claim benefits until age 61, while 33% should not exit employment until the same age. Consequently, we expect that 4% of the population at risk at age 61 permanently left employment but do not receive benefits. Due to the reform, this share increases to 23%. The effect is even stronger for women: without the reform survival until employment exit nearly perfectly mirrors the survival until retirement entry about half a year after age 60, i.e. the gap between both is near to zero. Almost every woman who exited employment receives benefits, which is plausible since there is no gain through postponement of benefit claiming. Full implementation results in a gap between claiming and retiring. The fraction of the female population who are still in the labor force at age 61 is 33%, while the fraction of the female population who did not claim benefits at age 61 is about 89% at the same age.

Fig. 7 illustrates that point. It shows the difference between the aggregate number of individuals who exited employment by a given age and the aggregate number of individuals who claimed benefits at the same age. By how much exceeds the group of individuals who left the labor force the group of individuals for whom benefit receipt is observed? Without the reform, in the second quarter of age 60 that number amounts to about 320,000 men and 80,000 women, respectively. It decreases to nearly zero until age 63 for men and even before age 61 for women. These numbers rise dramatically with fully implemented reform: at the age of 63, the number of individuals who exited employment exceeds the number of individuals out of employment. Immediately after the age of 65, this

---

29 For the calculation of these aggregate numbers the number of observed individuals in the sample was extrapolated using sampling weights to get an estimate of the aggregate population at risk in the basic population. This aggregate population at risk was then assumed to decrease over time according to the predicted average survival function by age.

30 It slightly increases for men after age 63, because individuals who were not entitled for any pension before can receive “pension for the long-term insured” now. Therefore, a second peak in employment exit and benefit claiming is observed at this age.
number decreases to nearly zero. In sum, Figs. 6 and 7 show: first, entry into benefit receipt is postponed. Second, exit from employment is postponed as well. And third, the reform’s effect on the employment decision is much smaller than the reform’s effect on the claiming decision and consequently a time lag between employment exit and benefit claiming emerges or is widened.

In a next step, the expected value of the average survival function was calculated. Table 3 shows the expected duration until benefit claiming and employment exit in months. The reform rises the expected value of the average survival function by 10 months, so the gap between both events grows by about 4 months due to the reform.32 Thus, the sensitivity to policy-induced incentives for postponement of benefit receipt seems to be especially high in the groups with lower labor market attachment and probably lower chances to stay gainfully employed and vice versa. Apparently, there arises an employability-problem mainly for those individuals who show a strong response to the reduced provision of pension incomes.

7. Conclusions

A recent pension reform in Germany introducing permanent benefit reductions for workers retiring prior to the minimum age was used to examine the effects of pensions on the timing of entry into benefit receipt and on the timing of employment exit. Since the reform was a natural experiment, the results can be interpreted as causal effects under some behavioral assumptions. Administrative data containing the full earnings history of the individuals were used. The main advantage of this data set is that there is no panel attrition and no recall bias. The models are flexible in the specification of duration dependence and all results are robust against changes in distributional assumptions.

We see that individuals react only modestly to changes in the level of social security wealth, but strongly to pension accruals that can be realized by a delay of benefit claiming. Pension accruals due to further contributions influence the retirement decision, but are less important. The reform changed accruals in pension benefits through a delay of claiming, and had indeed a great influence on the employment and claiming decisions of older workers. After the reform, claiming of benefits occurs on average nearly fourteen months later, and at the same time workers are expected to stay in gainful employment about 10 months longer. In some sub-groups the effect is even higher, and benefit receipt is postponed for up to two and a half years, while employment spells expand by less than benefit claims. The reform thus increases the expected duration until claiming by about 14 months. At the same time, exit from employment is postponed as well. However, the expansion of the expected spell duration until employment exit is only about 10 months, so the gap between both events grows by about 4 months due to the reform.31 In Fig. 3 we have seen that the frequency of receiving unemployment benefits or disability pensions at a given age increases for birth cohorts who face accrual rates through a delay in claiming, compared to those cohorts who are not affected by the introduction of accrual rates. Apparently, at least some of the emerging gap between employment exit and pension claiming is filled by application for other public benefits.

Table 3 presents additional results for population sub-groups based on separate estimations. First, we see that women’s reaction concerning the claiming decision is much stronger than the reaction of men. Women postpone their benefit claiming by 27 to 33 months, while the effect for men is only about 12 months. Second, the reaction is somewhat stronger for East German men than for men from West Germany. And third, the results for quintiles of benefit amounts differ substantially: the reaction clearly decreases with growing benefit amounts. Since the amount of benefits is determined by the earnings history, this indicates that men with higher lifetime wages react less to pension accruals than those with lower wages and/or those with a weaker attachment to the labor market.

The opposite is true when we examine the effect on the employment decision. Now, the reaction of men is much stronger than the reaction of women, who do not delay employment exit at all. The large difference in the reaction of men and women concerning benefit claiming and concerning employment exit may result from a decision taken in a household context. Labor force behavior depends on spouse’s income as well as on spouse’s leisure or work time. While incomes of spouses are substitutes to some extent, leisure time of spouses may be either substitutable or complementary goods. If couples prefer shared leisure over leisure time spent alone, a delay of wives’ employment exit may cause a higher disutility, because they are typically younger than their husbands and therefore exit employment later in time. Consequently, it may be optimal to strongly delay men’s employment exit than women’s. If spouses can substitute labor incomes at the same time, this may again support this behavior. For studies which analyze the work behavior of couples, see for example Hurd (1990b), Blau (1998) and Blau and Riphahn (1999). The mentioned studies found that couples value spouses’ leisure time as complementary goods and coordinate their retirement decisions accordingly. The stronger reaction of women regarding benefit claiming could be due to the typical role of wives as a second earner, whose income is not as important as the husbands’ ones. Their typically lower pensions may be dispensable for some period, while the men’s are not.

In contrast to the claiming decision, the difference between East and West Germany regarding the employment decision is smaller. Furthermore, we see a clear pattern regarding the level of benefit claims, i.e. the amount of lifetime earnings: (i) the higher the benefit entitlements, the longer the individuals stay in employment, with or without benefit accruals due to postponement, and (ii) the longer is the further delay of employment exit due to the reform.32 Thus, the sensitivity to policy-induced incentives for postponement of benefit receipt seems to be especially high in the groups with lower labor market attachment and probably lower chances to stay gainfully employed and vice versa. Apparently, there arises an employability-problem mainly for those individuals who show a strong response to the reduced provision of pension incomes.

Table 3 Total effects of the reform on the expected duration until benefit claiming and employment exit.

<table>
<thead>
<tr>
<th>Quintile</th>
<th>Before reform</th>
<th>After reform</th>
<th>Difference</th>
<th>Before reform</th>
<th>After reform</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full sample</td>
<td>13.86</td>
<td>27.27</td>
<td>13.86</td>
<td>53.04</td>
<td>65.51</td>
<td>12.47</td>
</tr>
<tr>
<td>Men</td>
<td>15.60</td>
<td>27.83</td>
<td>12.24</td>
<td>57.72</td>
<td>66.53</td>
<td>8.81</td>
</tr>
<tr>
<td>Women</td>
<td>6.53</td>
<td>33.17</td>
<td>26.65</td>
<td>50.40</td>
<td>49.85</td>
<td>-0.55</td>
</tr>
<tr>
<td>Men (West Germany)</td>
<td>17.38</td>
<td>27.95</td>
<td>10.57</td>
<td>61.36</td>
<td>69.63</td>
<td>8.27</td>
</tr>
<tr>
<td>Men (East Germany)</td>
<td>10.95</td>
<td>25.99</td>
<td>15.04</td>
<td>47.22</td>
<td>58.72</td>
<td>11.50</td>
</tr>
<tr>
<td>Men (West Germany) by quintiles of benefit claims at age 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st quintile</td>
<td>18.93</td>
<td>33.57</td>
<td>14.64</td>
<td>56.48</td>
<td>57.73</td>
<td>1.25</td>
</tr>
<tr>
<td>2nd quintile</td>
<td>15.44</td>
<td>28.45</td>
<td>13.01</td>
<td>59.88</td>
<td>67.62</td>
<td>7.74</td>
</tr>
<tr>
<td>3rd quintile</td>
<td>15.56</td>
<td>26.92</td>
<td>11.36</td>
<td>58.85</td>
<td>74.33</td>
<td>15.48</td>
</tr>
<tr>
<td>4th quintile</td>
<td>16.35</td>
<td>25.03</td>
<td>8.68</td>
<td>58.45</td>
<td>78.59</td>
<td>20.14</td>
</tr>
<tr>
<td>5th quintile</td>
<td>22.04</td>
<td>25.14</td>
<td>3.10</td>
<td>71.03</td>
<td>72.95</td>
<td>1.92</td>
</tr>
</tbody>
</table>

31 Both results are consistent with the simulations of Berkel and Börsch-Supan (2004) and Siddiqui (1997), who both predicted a shift in retirement entry of about 1 year if payment reductions of 0.3%-points per month were introduced.

32 This result does not hold for the uppermost quintile, whose reaction is only very small. Furthermore, the estimated coefficients corresponding to the accrual rate were insignificant for them. But in the remaining quintiles the increase is obvious.
different across population groups. Women, East German men and workers with low benefits display the strongest response with respect to the claiming decision. Unfortunately, the same groups extend employment only a little. Those groups who postpone benefit claiming for an especially long time are also the ones who do not increase their time in employment equivalently. Consequently, the income situation of those individuals with limited employment opportunities appears to deteriorate. Further research is needed to quantify any distributional effects of the reform.

Acknowledgments

I am grateful to Regina Riphahn for valuable advice and continuously insightful guidance and encouragement. I also thank Parvati Trübs-wetter for useful advice and very helpful suggestions, as well as Kevin Lang and two unknown referees. I would like to thank the Research Data Center of the German Retirement Insurance, in particular Michael Stegmann and Frank Röder, for kind provision of and helpful information about the data.

References