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**RETIREMENT AGE AND PRERETIREMENT IN  
GERMAN ADMINISTRATIVE DATA**

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# Retirement Age and Preretirement in German Administrative Data

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## Abstract

The present paper investigates individual determinants of retirement entry age using administrative data on individuals' retirement entries in 2003 published by the German Pension Insurance (*SUF Versichertenrentenzugang 2003*). As preretirement is an important issue in Germany, special interest is attached to the identification of individuals that preretire: 40 percent of all men and women in the sample preretire. On average they stay 2.4 years in preretirement before taking one of the official retirement plans. Differences between individual determinants for those choosing preretirement programs as opposed to regular public pension plans are discussed. A reduced form econometric approach is employed in order to explore these questions. Noticeable differences arise with respect to rehabilitation claims before retirement, income before retirement and pension payments. Overall, the paper puts a great emphasis on discussing sample properties, variable definitions, and data limitations of administrative data that are especially useful for follow-up studies.

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# 1 Introduction

Early retirement and preretirement<sup>1</sup> are costly achievements that aggravate the already tight financial situation of the German pay-as-you-go pension system due to population aging. Since 1992, pension and labor-market reforms have been adopted and they greatly restrain publicly subsidized early retirement and preretirement possibilities. Because of these reforms, the distribution of retirement age of older workers is expected to be changing. These changes can be exploited to investigate the impact of policy reforms on retirement entry behavior.

So far, there is hardly any research on the impact of pension reforms on preretirement in Germany. The difficulty consists in observing preretirement in the data and in providing for a sufficiently long time-series that allows to analyze policy reforms. The only empirical analysis in this area has been undertaken by Wübbecke (2005) who uses a data set based on administrative information of labor-market histories and retirement entries.<sup>2</sup> She investigates the impact of firms' employment and public social security policy on employees' changes from employment into retirement in the period of 1975 to 1995.

Recently, the German Pension Insurance ("Deutsche Rentenversicherung") has started to release administrative data for research purposes. This administrative data is a promising source for investigating the impact of labor and pension reforms on individual retirement behavior, because it includes detailed information about individuals' employment status and pension insurance characteristics. So far, only cross-sectional but no time-series data of individuals' retirement entries and insurance histories are available. The data set used in this study, i.e., the *Scientific Use File (SUF) Versichertenrentenzugang 2003*, is a representative sample of publicly insured persons who retired in 2003. This data is used to learn more about how to describe preretirement which will be useful for future economic analysis of policy reforms based on German administrative

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<sup>1</sup>Preretirement refers to effective retirement before old-age public pension payments can be received from age 60 onwards and includes the option of partial retirement ("Altersteilzeit"). Negotiations between employers and employees, and state subsidies enable preretirement. In contrast, official retirement is defined as receiving public old-age pension payments and, thus, includes early retirement from age 60 onwards. For a more detailed description of early retirement pathways see Berkel and Börsch-Supan (2004).

<sup>2</sup>This data is not publicly available but results from an - until now - unique example of combining data on labor-market histories issued by the Institute for Employment Research ("Institut für Arbeitsmarkt- und Berufsforschung") of the Federal Employment Agency ("Bundesagentur für Arbeit") and data on retirement entries issued by the German Pension Insurance ("Deutsche Rentenversicherung")

data.<sup>3</sup> The present paper discusses differences between individual determinants of retirement for those choosing preretirement programs as opposed to official public pension plans. A reduced form econometric approach is employed in order to explore this question.

Based on the *SUF Versichertenrentenzugang 2003*, the present sample reveals that 40 percent of all men and women preretire, that is they withdraw from the labor market before official pathways into old-age retirement can be taken. On average individuals stay 2.4 years in preretirement before taking one of the official early retirement entries based on the unemployment or partial retirement (“Alters-teilzeit”) pathway or retirement plans for women. Moreover, differences in effects of individual determinants - such as rehabilitation services, income before retirement and pension payments - on retirement age can be observed for preretired persons compared to persons taking official retirement entries.

The paper proceeds as follows: Section 2 summarizes institutional facts and recent changes of early retirement, partial retirement and preretirement in Germany. In Section 3 the data, the sample, and the definition of preretirement are discussed. Characteristics of the retirement age are presented in Section 4 and, finally, Section 5 concludes.

## 2 Early Retirement, Partial Retirement and Preretirement in Germany

Early retirement, preretirement and partial retirement refer to regularly used official and unofficial pathways into retirement before reaching the statutory age of 65. In order to clarify these concepts and in order to motivate institutional changes with respect to the public pension system and unemployment insurance since 1992, they are described in the following.

Early retirement refers to retirement entry before age 65 by one of the official pathways into old-age retirement, which results in an income stream paid by the German public pension system. It has been introduced in Germany with the pension reform in 1972. With the age of 60 women, partial retirees,<sup>4</sup> unemployed or employees, who can not be appropriately employed due to health or labor-

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<sup>3</sup>As discussed in Appendix B the data provided so far by the German Pension Insurance, i.e., the *SUF Versichertenrentenzugang*, does not allow for policy analysis of retirement entry behavior based on option value models.

<sup>4</sup>The term “partial retirees” refers to persons who enter a partial retirement plan (“Alters-teilzeit”).

market reasons, can enter retirement (“Frührente”). All other employees who have been contributing to the public pension system for at least 35 years can retire at the age of 63. These pathways into retirement are not related to any additional adjustment costs. Consequently, strong incentives are set to retire before the age of 65 and individuals react accordingly.

A recent survey reveals that two out of three employees would leave the labor force between age 55 and 60 if this was financially feasible (Pfeiffer and Simons 2004). Preretirement (“Vorruhestand”) meets these preferences and refers to labor force exits that take place before early retirement is possible. This labor force exit can be referred to as preretirement if a person receives income paid by the unemployment insurance or other state subsidies that burden the tax and social security systems and/or income that results from arrangements between employers and employees.

One can distinguish between two different ways of entering preretirement. On the one hand, unemployment compensation is an important way of financing preretirement. If a firm wants to lay off older workers in a restructuring process, employees can receive a negotiable combination of unemployment compensation and a supplement or severance pay. At the age of sixty they enter early retirement via the public pension system, i.e., by taking the unemployment pathway. In the case of preretirement, the date of the labor force exit is very often determined by the maximum duration of unemployment benefit payments. Until 2005 the duration of benefits paid by the unemployment insurance (“Arbeitslosenversicherung”) lasted between 24 and 32 months.<sup>5</sup> Even earlier labor force exits and corresponding retirement entries can be induced by paying the employee the difference between the last salary and unemployment assistance (“Arbeitslosenhilfe”), which, until 2005, lasted for one additional year. Unemployment insurance benefits can amount to 67 percent of the last salary and are especially attractive as the unemployment insurance additionally pays the contributions to the public pension system.

On the other hand, partial retirement (“Altersteilzeit”) is another means of preretirement. This scheme provides for part-time work between the age of 55 or above and early retirement at age 60 or 63 depending on the above mentioned pathways. Effectively, many employees continue to work full time at first and then leave their job earlier (“Blockmodell”). Partial retirement is state-subsidized: The unemployment insurance pays an additional 20 percent of the usual part-time earnings if the employer hires a young employee. This rule also encourages

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<sup>5</sup>The exact duration depended on the duration of compulsory insurance coverage and on the age of the beneficiary.

employers to substitute older by younger employees and meets employees' interest in retiring early.

Figure 1 shows the fraction of different pathways into retirement relative to total retirement for the period of 1978 to 2003. It demonstrates that old-age pensions due to unemployment have become an important pathway into retirement since the early 1990s for men, whereas among women the unemployment pathway is not frequently used. Due to low labor-market participation, women rather take the pathway for women which allows to enter retirement at age 60.

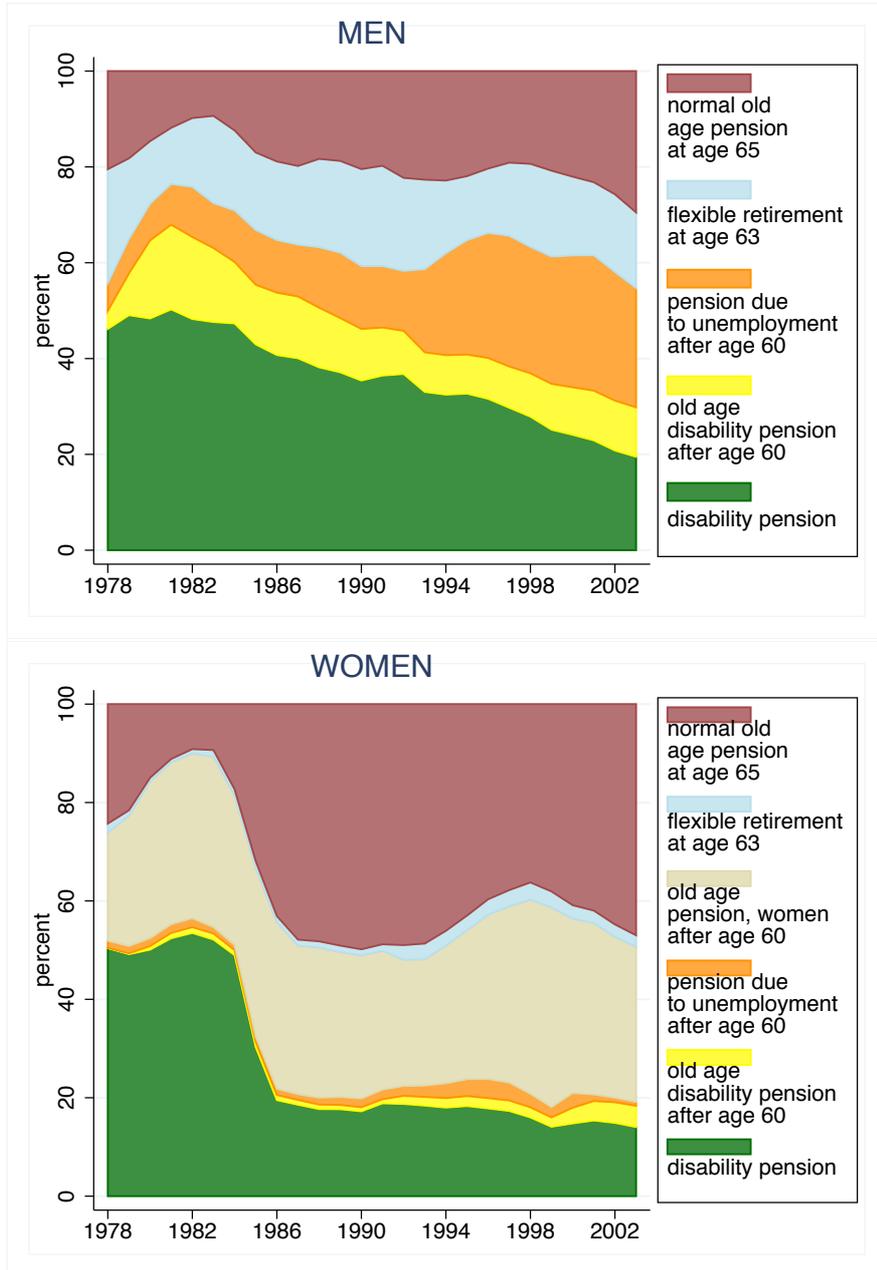
Starting with the pension reforms of 1992 and 1999 and continuing with labor-market reforms in 2003, several changes to these rules have been adopted. These changes constrain generous early retirement and preretirement options. The reforms of 1992 and 1999 introduced an increase of the retirement age limits to age 65 or age 63 for long-term insured. These changes will be fully implemented after a long transitional period in 2015.<sup>6</sup> There will no longer be exceptions for the unemployed, partially retired or women. In Figure 1 a small decrease in the early retirement options of unemployment pensions for men and women old-age pensions can already be observed since the late 1990s. Moreover, the government introduced adjustment costs that reduce pension payments by 0.3 percent for each month of early retirement before age 65. If employers do not want to accept the lower pension benefit, they either need to work longer or have to extend the preretirement period, i.e., the period between labor force exit and retirement payments. From 2005 onwards, unemployment benefits are shortened from a maximum of 32 to 18 months ("Hartz IV"). Unemployment assistance will be paid only if the preconditions for welfare payments are fulfilled ("Arbeitslosengeld II"). Thus, state-promoted preretirement between labor force exit and pension benefit payments is now greatly reduced and limited to 18 months. Transition rules of the pension reforms of 1992 and 1999 already apply to most cohorts retiring in 2003, whereas the new labor-market regulations have not been effective before 2005.

All these reform steps indicate a change in paradigm from promoting early and preretirement towards working longer. These reform steps are backed by the insight that skills of older workers are needed, especially in the course of population aging, and encouraged by governmental initiatives to bring older workers above age 50 back into work ("Initiative 50 plus"). Based on descriptive statistics of recent administrative data of aggregate retirement entries, Reimann (2003) shows that these changes have already had an effect as the retirement entry behavior

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<sup>6</sup>For a more detailed description of the 1992 and 1999 reforms and a graphical description of statutory age limits during the transition period refer to Berkel and Börsch-Supan (2004).

Figure 1: Pathways into retirement



Sources: Own calculations based on VDR (1978-2004).

slowly starts to change. However, the pension reforms in 1992 and 1999 have long transitional periods and are not yet fully phased in. It is of great interest to exploit this policy change in future research in more detail and to investigate the responsiveness of retirement entries, preretirement and old-age unemployment to institutional changes for simulations of future pension and labor-market reform scenarios.

### 3 The Data and Sample

The data employed in this study is based on administrative data of the German public pension insurance that are collected and provided by the German Pension Insurance (“Deutsche Rentenversicherung”). As these data are made virtually anonymous, scientific use files entail only a representative sub-sample of all publicly insured individuals or pensioners of the public pension system. This paper employs the *SUF Versichertenrentenzugang 2003* (SUFRTZN03XVST\_Berk) which is a sample of about 100,000 individuals that started to receive public pensions in 2003. People that are publicly insured but are not yet retired are not part of the sample.

Administrative data are very valuable to analyze questions on retirement entry behavior. They have the following advantages compared to German survey-based data such as the GSOEP: First, samples are large representative draws of the whole population of publicly insured persons. Second, there is no attrition. Third, there are no problems with the interpretation of questions as it is often the case with survey responses. Fourth and most importantly, the sample provides information on individuals’ insurance status before retirement and entails all the relevant information to determine a person’s pension claims, e.g., information on earnings points<sup>7</sup>, on various contribution periods and the type of pension that is received.

But administrative data are also associated with difficulties.<sup>8</sup> One major issue is the measurement of the effective retirement age, which is discussed in detail in the remainder of the paper. Other issues are the measurement of income, wealth and socio-economic variables.<sup>9</sup> Information on these characteristics are

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<sup>7</sup>In Germany the calculation of pension payments is based on earnings points. For each person the number of earnings points depends mainly on the relative earnings position and the number of contributions.

<sup>8</sup>These difficulties differ from problems with German survey data. It would therefore be interesting to compare the GSOEP to the present administrative data in detail. This, however, lies beyond the scope of the present paper.

<sup>9</sup>For a detailed description of the data see also Himmelreicher (2006) and Radl (2005).

available as far as the public pension system retains them for the determination of individual pension claims. Income refers to income subject to social security contributions only and wealth is not recorded at all. Person's health status can be inferred by using a variable that describes whether medical rehabilitation services have been taken in the last 5 years before retirement. Direct information is available, for example, on education, family status, residence and details necessary for the calculation of public pension payments.

For some variables more than pure cross-sectional information is provided, i.e., gross yearly income subject to social security contributions and the status of insurance in the three years before retirement. The latter provides additional information on individuals' situation, i.e., whether they are self-employed or un-employed before retirement.

For the subsequent analysis the sample is limited to individuals between age 54 and 72 that receive an old-age or disability pension for the first time in 2003. Individuals with partial pensions are excluded from the sample as these persons are likely to be still partially employed. Observations with pension payments that are significantly determined by inter- or supranational legislation are not considered, because these are determined by factors that are out of reach in this study. Problematic for the analysis are also pensions paid on the basis of the "Fremdrentengesetz" (FRG) which include mainly East-Germans that took refuge from Eastern to Western Germany and resettlers ("Aussiedler" and "Spätaussiedler"). As suggested by Mika (2005), these observations are excluded from the sample as their pension payments and corresponding information in the data are based on fictive contributions. The adjustment of pension payments in East Germany to West German levels has almost been completed in 2003. Therefore, differences affecting the retirement entry age should be minimal and observations from both East and West Germany are included in the sample.

### **3.1 Retirement Age in German Administrative Data**

Administrative data provide detailed and reliable information on individual pension claims that are necessary for meaningful analyses of individual retirement entries and labor force exits. The retirement age in administrative data is defined as the age at which a pension is received from the German public pension insurance for the first time. This retirement age is referred to in the following as the official retirement age. Thus preretirement is not considered. There are three main motivations for taking account of preretirement and for considering the effective instead of the official retirement age in economic analyses of retirement

entries: First, recent pension and labor-market reforms, among other things, aim at limiting preretirement as it aggravates the financial situation of the social security systems. It is of great interest to investigate the impact of these reforms on preretirement using administrative data. Second, it is important to take account of preretirement if overall financial effects of retirement entries on social security systems are of interest instead of financial effects on the public pension system alone as preretirement typically burdens the unemployment insurance. Third, survey-based data show that individuals refer to themselves as retired when they have not yet officially retired but are preretired (Börsch-Supan et al. 2004b). For a consistent estimation of individual retirement entry decisions it is, thus, necessary to use the effective as opposed to the official retirement entry age.

Preretirement cases can be identified in the data as information on individuals' insurance status is available not only for the year before retirement, i.e., for 2002, but also for 2001 and 2000. The insurance status specifies whether a person (i) had an employment that was subject to social security contributions, whether a person was (ii) marginally employed (“geringfügig beschäftigt”),<sup>10</sup> (iii) eligible for a partial pension plan (“Altersteilzeit”), (iv) voluntarily insured,<sup>11</sup> (v) compulsorily insured mainly due to unemployment or sickness,<sup>12</sup> (vi) passively insured or (vii) in some other insurance category.<sup>13</sup> Table 1 summarizes the fraction of each insurance category in the present sample. Half of the individuals have been passively insured or compulsorily insured due to unemployment or sickness. Passive insurance refers to all persons that have not paid any social insurance contributions in the year before retirement. 50 percent of these individuals have not paid any contributions for more than 20 years. This group inter alia includes civil servants or self-employed that have earned pension claims due to employment subject to social security insurance at some point in time, typically very early in their career. A third group is made up of individuals that gave up employment early which are mostly housewives.

As summarized in Section 2 individuals are considered to be preretired if they were unemployed, partially retired, marginally employed or passively insured. In order to rule out cases that have been passively insured for a very long period,

<sup>10</sup>A person is considered marginally employed if he or she does not earn more than 400 Euros per month. Special rules with respect to social security insurance apply to these persons.

<sup>11</sup>These are mainly self-employed persons or housewives who have no income subject to social security insurance but voluntarily take part in the German public pension system.

<sup>12</sup>For exact definitions refer to the German Social Security Code (“Sozialgesetzbuch”), SGB III and § 3 Nr. 3 SGB VI.

<sup>13</sup>This category includes for example persons that were eligible to insurance credits (“Anrechnungszeiten”) or other compulsory insurances that are not part of (v).

Table 1: Insurance status before official retirement

insurance status	percent*
employment s.t. social insurance contributions	20.64
marginally employed	4.14
compulsorily insured (unemployment, sickness)	23.92
partial retirement plan	12.46
voluntarily insured	3.31
passively insured	25.60
others	9.93

*Source:* Own calculations based on *SUF Versichertenrentenzugang 2003* (SUFRTZN03XVST\_Berk).

\*) Percentages relative to all individuals in the sample that officially retired in 2003.

(e.g. housewives, self-employed or civil servants) only those are included that have paid contributions to the public pension insurance at least once during the last 10 years before official retirement in 2003. At the same time, persons that return to an employment status subject to social security contributions or to voluntary insurance are not included in this pool of preretired persons.<sup>14</sup> This classification of preretirement is taken from Pfeiffer and Simons (2004) who investigate preretirement in Germany using various data sources. With this definition, 47 percent of men and 37 percent of women preretired in the present sample, i.e., effectively retired before 2003.<sup>15</sup>

The sample also includes disability pensions. Note that preretirement in this study covers part of the disability cases. Persons retiring due to disability amount to 10 percent in the present sample. Half of them receive a disability pension directly after leaving the labor force, another 30 percent after a period of un-

<sup>14</sup>Also, persons that enter preretirement at age 63 or later are not considered as preretired. These are only a few cases.

<sup>15</sup>Due to a censoring problem for the year 2000 it is not possible to determine whether individuals who are effectively retired in 2000 entered retirement in 2000 or before. For the determination of the effective retirement age this is, however, necessary. All individuals preretired before 2001 are assumed to have entered preretirement in 2000. Compared to the alternative of excluding these observations from the sample, this assumption is justified: The resulting average of duration in preretirement in the present sample amounts to 2.4 years and is only slightly lower than the average duration of preretirement in the GSOEP data which is 2.5 years (Pfeiffer and Simons 2004).

employment. According to the above mentioned definition, the latter case may fall into the preretirement category, whereas the first does not. Declaring part of the disability cases as preretired is reasonable, because obtaining a disability pension due to labor-market reasons is still possible for cohorts retiring in 2003. However, it has become much more difficult over time.<sup>16</sup>

Figure 2 displays retirement entry probabilities in 2003 for men and women aged 54 to 72 that take official pathways into retirement. Preretirement is not accounted for in the data underlying this figure. The distributions for men and women are characterized by two large spikes at age 60 and 65. There is also a third spike for men at age 63. For women the spikes at age 60 and 65 are more pronounced than for men. These differences can be explained by differences in employment histories and different retirement pathways for men and women. 27 percent of all women retire at age 60. This high value is due to a pension pathway that allows women under certain conditions to enter retirement at age 60. This pathway still exists in 2003, however, adjustment costs have to be taken into account. Another 41 percent of all women retire at age 65. Due to interrupted employment histories, women often have not contributed a sufficiently long time period into the public pension system such that they are not eligible to choose this or any other pathway to retire before age 65.

The distribution of retirement age between age 54 and 72 is smoother for men: 20 percent retire at age 60, 18 percent at age 63 and 25 percent at age 65. From age 60 onwards men can retire via the unemployment or partial retirement pathway. From age 63, they are eligible for retirement if they are long-term insured. In 2003 adjustment costs apply to almost all cohorts that choose one of these retirement pathways.

The average official retirement entry age<sup>17</sup> for men and women as reported in the present sample amounts to 62.3 and 62.5 years respectively. Once preretirement is considered, the average effective retirement age is about one year lower: 61.3 years for men and 61.6 years for women. In the present sample men and women preretire on average at age 59.3 and 59.2 respectively and officially retire after 2.4 years.<sup>18</sup>

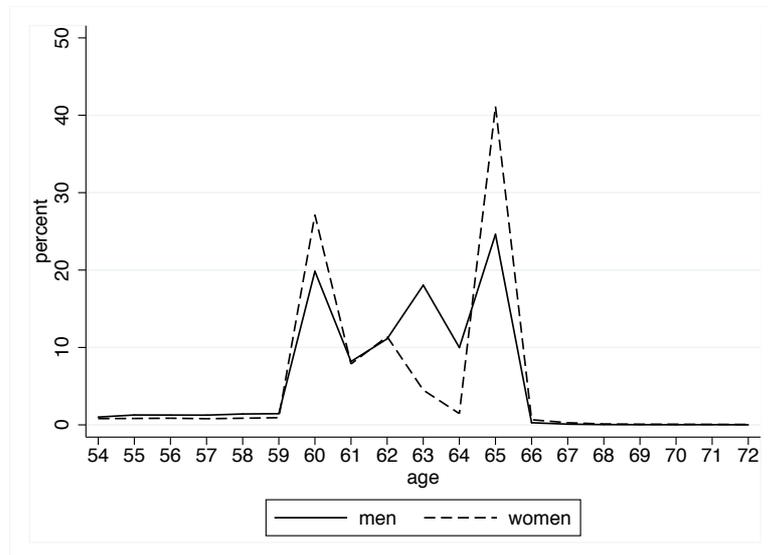
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<sup>16</sup>Note the reduction in disability pensions since 1978 in Figure 1.

<sup>17</sup>“Official” refers to the fact that these individuals enter retirement through one of the official pathways (old-age or disability pensions) and receive pension payments from the German Pension Insurance. The numbers refer to average values in the present sample and, therefore, do not exactly match statistics issued by the German Pension Insurance.

<sup>18</sup>These average values are only approximately correct. Note that the group of preretired persons in this sample refers to persons preretiring in 2000 to 2002 and officially retiring in 2003. In order for this group to be representative for preretirement cases in 2003, one has to

Figure 2: Distribution of retirement entry age in 2003



Source: Own calculations based on *SUF Versichertenrentenzugang 2003* (SUFRTZN03XVST\_Berk), German Pension Insurance (“Deutsche Rentenversicherung”).

## 3.2 Other Variables

In order to characterize retirement entry age the data set provides several variables for the subsequent regression analysis: income before retirement, pension payments, socio-demographic characteristics such as highest educational degree, status of sickness, marital status, and times of child-caring.

Income in administrative data refers to income subject to social security contributions. It does not mirror a person’s complete income position. Therefore, income of passively or voluntarily insured individuals is missing. These individuals mainly obtain income from other sources, e.g., self-employed or civil servants who have had an employment subject to social security contributions only at the beginning of their career. Also housewives belong to this group. In case of housewives but also more generally in the case of couples, especially with children, it would be desirable to use a couple’s income. However, the data does not allow to match couples.

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assume that preretirement cases in 2000 to 2002 are representative for preretirement cases in 2003 that officially retire in 2004 to 2006, i.e., one has to assume that no cohort and time effects exist for the years 2000 to 2006. As retirement entry rules are changing due to long transitional periods of the reforms of 1992 and 1999, time effects can not fully be ruled out.

As the idea of the following econometric analysis is to provide a picture of the characteristics of retirement entry age as provided by the administrative data at hand, observations with missing income values are not dropped, but explicitly controlled for. An income dummy is constructed that is equal to one if the income value is missing, *income\_mis*. 26 percent of all men and 44 percent of all women have reported missing incomes values. Almost 70 percent of these men and women are passively insured.<sup>19</sup>

Another shortcoming of the income variable is the censoring of yearly income values greater than 55,000 Euros. In order to circumvent the censoring problem at the top end of the income distribution, dummies for income quintiles are constructed for men and women with reported income values.<sup>20</sup>

Pension payments are directly obtained from the data. The corresponding variable refers to public pensions only. As pension payments are censored at values greater than 1800 Euros per month, again dummies for pension payment quintiles are constructed.<sup>21</sup>

Information on education is classified by the highest individual educational degree: secondary school (“Hauptschule” and “Mittlere Reife”), high school (“Abitur”), technical college (“Fachhochschule”) or university. The categories secondary and high school are subdivided into cases with and without vocational training (“Berufsausbildung”). Dummy variables equal to one for the highest educational degree are constructed and included in the regression analysis. Furthermore, there is one category referring to unknown education levels and another category referring to missing values. The latter category includes about one-third of all observations. These are mostly individuals that entered retirement not directly after employment: 57 percent are passively insured and 20 percent are unemployed in the year before retirement. Thus, no information on the educational degree was provided by a former employer.<sup>22</sup> The category of missing educational degrees is clearly non-random and related to the insurance status before retirement and is, therefore, separately included in the regression. The distribution of observations with unknown educational degree across income classifications is also likely to be non-random and enters as an additional dummy

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<sup>19</sup>Because of missing income values one could alternatively consider to drop all passively insured persons who have not contributed to the public pension system within the last 10 years and all voluntarily insured persons. Another way to deal with the problem would be to impute income and wealth by using the GSOEP.

<sup>20</sup>For exact quintile ranges see Table 5, Appendix A.

<sup>21</sup>For the exact range of quintiles see Table 5, Appendix A.

<sup>22</sup>For further background information on the education variable refer to Fitzenberger, Osikominu and Völter (2005).

variable.<sup>23</sup>

The health status can be proxied by two different variables: An indicator variable that denotes whether a person has claimed rehabilitation services during the last 5 years previous to retirement<sup>24</sup> and a variable that comprises months of insurance credits due to sickness or rehabilitation.

Information on a person's marital status and on the number of months dedicated to child-caring are provided. It is important to mention that this number refers only to cases in which times of child-caring are credited and lead to higher pension benefits. This variable, therefore, does not directly measure the number of children.

Finally, information on individuals insurance status is categorized. The following dummy variables are included in the regression analysis: employment subject to social insurance contributions; partial retirement; compulsory insurance due to unemployment, sickness or rehabilitation; marginal employment; voluntary employment; passive insurance and others.

Tables 5 and 6 in Appendix A provide definitions and summary statistics of all variables that are of interest in the subsequent regression analysis.

## 4 Characteristics of the Official and Effective Retirement Age

As all people in the sample officially retire in 2003 or effectively retire during the short window between 2000 and 2003, the main sample variation results from the differences in retirement age across individuals. The determinants of this variation are investigated using standard OLS regressions with heteroscedasticity robust standard errors. Estimations are undertaken separately for men and women as retirement entry behavior and the corresponding retirement age are likely to be affected by systematic differences in employment histories. In a first step, retirement age is defined as a person's age in 2003, which is the official retirement age. In a second step, retirement entry age refers to a person's age when effectively retiring. Therefore, individuals who preretire are identified and their official retirement age is adjusted to their effective retirement age.

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<sup>23</sup>In this group 33 percent of individuals are employed subject to social security contributions, 21 percent are unemployed and 25 percent are marginally employed, the rest splits up into all other categories.

<sup>24</sup>Persons that receive a disability pension have often taken rehabilitation services before retiring. However, this is no precondition for obtaining a disability pension in Germany.

## 4.1 The Official Retirement Age

Two different specifications are estimated: The first one includes variables for income, pension, education, health status, marital status and child-caring (Table 2), whereas the second specification additionally includes dummies for insurance categories as described in the previous section (Table 2). Variables referring to income subject to social security contributions in the year before retirement and retirement income paid by the public pension insurance in 2003 are defined as dummy variables of income or pension income classes: A dummy for missing income values, *income\_mis*, as well as dummies for income and pension payment quintiles are constructed: *income\_1<sup>st</sup>*, ..., *income\_5<sup>th</sup>*, *pension\_1<sup>st</sup>*, ..., *pension\_5<sup>th</sup>*. This classification does not allow to interpret the absolute effects but effects relative to the reference category, which is the third quintile for both income and pension payments respectively, *income\_3<sup>rd</sup>* and *pension\_3<sup>rd</sup>*.

The results show that men and women with missing income values, that are mainly passively and voluntarily insured individuals, retire later compared to all other income classes. On the one hand, this could be explained by the fact that passively insured individuals are often not eligible to retirement pathways that allow for retirement before age 65. On the other hand, voluntarily insured individuals are often self-employed and typically retire at higher ages than employees.

Relative to the third income quintile, low incomes (first and second quintile) are associated with lower retirement ages among men whereas very high incomes (fifth quintile) are associated with higher retirement ages. Except for the first quintile the effect for women looks similar. This category tends to retire later: Women with very low incomes have typically very unstable employment histories and insurance periods due to child-caring. Therefore, they often might not be eligible to early retirement, i.e., retirement before age 65.

The lower pension payments, the higher are - relative to the third quintile - retirement entry ages (refer to the coefficients on *pension\_1<sup>st</sup>* and *pension\_2<sup>nd</sup>*). This result is in line with the following consideration: Many people who retire late, i.e., with the age of 65, are not eligible to one of the pathways into early retirement. These are mostly passively and voluntarily insured people that typically receive low pension payments. This way into retirement applies to the typical housewife and is, therefore, more common among women compared to men. In line with this consideration, there is a much larger effect for women compared to men.

Income and pension payments are of course strongly correlated. Note, however, that in the present data this correlation is actually weaker than one might

Table 2: Characteristics of the official retirement age I

	men	women		men	women
<i>income_mis</i>	1.728*** [0.087]	1.039*** [0.067]	<i>high_school</i>	-0.547** [0.269]	0.271 [0.316]
<i>income_1<sup>st</sup></i>	-0.336*** [0.067]	0.065 [0.051]	<i>high_school_VT</i>	-0.538*** [0.120]	-0.029 [0.145]
<i>income_2<sup>nd</sup></i>	-0.354*** [0.042]	-0.444*** [0.032]	<i>sec_sch</i>	-0.936*** [0.071]	-0.365*** [0.099]
<i>income_4<sup>th</sup></i>	-0.081** [0.033]	-0.301*** [0.044]	<i>sec_sch_VT</i>	-0.955*** [0.056]	-0.437*** [0.095]
<i>income_5<sup>th</sup></i>	0.365*** [0.076]	0.472*** [0.064]	<i>edu_unknown</i>	-0.643*** [0.069]	-0.054 [0.100]
<i>pension_1<sup>st</sup></i>	1.598*** [0.050]	2.814*** [0.032]	<i>edu_missing</i>	-1.350*** [0.063]	-0.179* [0.097]
<i>pension_2<sup>nd</sup></i>	0.607*** [0.053]	1.188*** [0.030]	<i>reha</i>	-3.279*** [0.066]	-3.576*** [0.070]
<i>pension_4<sup>th</sup></i>	-0.360*** [0.029]	0.136*** [0.031]	<i>sickness</i>	-0.034*** [0.004]	-0.020*** [0.005]
<i>pension_5<sup>th</sup></i>	-0.219*** [0.072]	-0.677*** [0.034]	<i>childcare</i>	0.013*** [0.003]	0.014*** [0.001]
<i>tech_col</i>	-0.722*** [0.083]	-0.571*** [0.151]	<i>married</i>	0.178*** [0.031]	-0.288*** [0.022]
<i>No. of obs.</i>	33917	38285			
<i>R</i> <sup>2</sup>	0.3	0.51			

*Notes:* The dependent variable is the retirement entry age in 2003, *age*; OLS estimations with White-heteroscedasticity robust standard errors.

expect at first:<sup>25</sup> For several cases income values are not reported (see previous section) or employment histories are rather instable before retirement such that income measured in the year before retirement is no perfect proxy for individuals' relative income positions over the life cycle.

Compared to persons with lower educational degrees, men with a university degree, *uni*, have a higher retirement age.<sup>26</sup> This finding is in line with the general notion that people with higher education are more attached to their jobs and, therefore, tend to work longer. Moreover, they are typically less physi-

<sup>25</sup>The actual correlation coefficient amounts to 0.71.

<sup>26</sup>The reference category are men or women with a university degree.

cally strained and are able to work longer. Men with a technical college degree, *tech\_col*, or secondary schooling degree, *sec\_sch* or *sec\_sch\_VT*, have comparatively low retirement ages, i.e., they retire on average between 8 to 11 month earlier. Men with high school degrees, *high\_sch* and *high\_sch\_VT*, lie in between these two extremes. Results for women are similar, though smaller in size and less significant. The fact that the association between education and retirement age is much weaker for women could again be explained by interrupted employment histories. Due to child bearing and caring, many women have not followed a career that is suggested by their educational degree.

Both health measures, *reha* and *sickness*, reveal that a higher degree of health is associated with a higher retirement entry age for men and women which is a well documented phenomenon.<sup>27</sup> The number of months credited by the public pension insurance due to sickness or rehabilitation has only a very small quantitative effect on the retirement age.<sup>28</sup> If men or women have claimed rehabilitation services due to sickness, they retire on average more than three years earlier. The present data show that these are mostly cases that take the disability pathway into retirement. However, rehabilitation is no necessary precondition for receiving a disability pension in Germany.

The number of months dedicated to child-caring as measured by the public pension insurance, *childcare*, on average leads to a higher retirement age for both men and women, though the effect is low in size. This result is well in line with Hank (2004) who investigates in great detail the relationship between women's retirement behavior and fertility biographies.

Married women retire on average three to four months earlier than singles or widows. This finding could be explained by the fact that wives are generally younger than husbands and often try to retire at approximately the same age as their husbands. For men the effect is mirror-inverted: Married men retire about two months later on average. The result is in line with the consideration that in the generation of interest married men are mostly responsible for the main family income source and, thus, work longer in order to afford retirement for the couple and possibly education for the children.

In a second specification, additional dummy variables for individuals with partial retirement, *part\_ret*, compulsory insurance due to unemployment, sickness or rehabilitation, *comp\_ins*, marginal employment, *marg\_emp*, voluntary insurance, *vol\_ins*, passive insurance, *pas\_ins*, and other insurance status, *others*, before re-

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<sup>27</sup>Refer to e.g. Larsen and Gupta (2004) who provide for a large literature on this topic.

<sup>28</sup>An exact quantitative interpretation is not very reliable as the measure is censored at 48 months of credited insurance contributions due to sickness.

irement in 2003 are added (Table 3). The reference category is employment subject to social social security contributions.

Men and women with partial retirement or compulsory insurance due to unemployment have a lower retirement age. Both groups are able to retire early due to a special retirement pathway for unemployment and partial retirement that still applies to cohorts in the present sample, though adjustment costs have already phased in. The effect is smaller for women. This corresponds well with the possibility of women to enter retirement under the same conditions and as early as unemployed persons or as individuals subject to a partial retirement plan. Marginally employed, voluntarily and passively insured persons on average retire much later. Most of the individuals in these three categories are not eligible for retirement before age 65, probably because of too short insurance and contribution periods. Effects for men and women are qualitatively the same and just slightly differ in size.<sup>29</sup>

Naturally, correlations between individual characteristics and the retirement age are largely driven by the institutional framework such as insurance categories or rehabilitation services and to a smaller extent by socio-economic characteristics such as education, child-caring or marriage. The level of income subject to social security contributions and pension payments are also but to a smaller extent important determinants. The results in Tables 2 and 3 underline the importance of employing incentive variables that bundle the institutional framework as well as individuals' employment histories and future expected pension payments when determining individuals' retirement entry ages, as e.g. undertaken in Berkel and Börsch-Supan (2004).

## 4.2 The Effective Retirement Age

Due to generous preretirement possibilities, about 40 percent of individuals in the sample effectively retire before their official retirement date. These cases are identified and their effective retirement age is defined as described in Section 3.1. The present section investigates whether individuals' characteristics are significantly different with respect to retirement age for preretired individuals as opposed to individuals taking official pension plans. The regressions documented

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<sup>29</sup>Note that in this specification the estimated coefficients of the income and pension payment dummies differ. The change is due to a correlation of income and insurance categories. Only in the case of the missing income category, *income\_mis*, there is a substantial qualitative change in the estimated coefficient. As this category is strongly correlated with the insurance categories of passively and voluntarily insured persons, the positive effect is now captured by these dummies, *passive* and *vol\_ins*.

Table 3: Characteristics of the official retirement age II

	men	women		men	women
<i>income_mis</i>	-0.818*** [0.116]	-1.262*** [0.076]	<i>sec_sch_VT</i>	-0.982*** [0.070]	-0.318*** [0.098]
<i>income_1<sup>st</sup></i>	-0.366*** [0.066]	-0.465*** [0.051]	<i>edu_unknown</i>	-0.672*** [0.069]	-0.118 [0.099]
<i>income_2<sup>nd</sup></i>	-0.194*** [0.043]	-0.305*** [0.032]	<i>edu_missing</i>	-1.341*** [0.065]	-0.251*** [0.097]
<i>income_4<sup>th</sup></i>	-0.027 [0.033]	-0.273*** [0.042]	<i>reha</i>	-3.262*** [0.067]	-3.340*** [0.069]
<i>income_5<sup>th</sup></i>	0.284*** [0.075]	0.259*** [0.061]	<i>sickness</i>	-0.034*** [0.004]	-0.017*** [0.004]
<i>pension_1<sup>st</sup></i>	0.871*** [0.054]	2.049*** [0.036]	<i>childcare</i>	0.010*** [0.003]	0.013*** [0.001]
<i>pension_2<sup>nd</sup></i>	0.141*** [0.053]	0.821*** [0.030]	<i>married</i>	0.165*** [0.030]	-0.275*** [0.021]
<i>pension_4<sup>th</sup></i>	-0.304*** [0.028]	0.104*** [0.030]	<i>part_ret</i>	-0.683*** [0.035]	-0.294*** [0.035]
<i>pension_5<sup>th</sup></i>	-0.243*** [0.074]	-0.862*** [0.041]	<i>comp_ins</i>	-0.683*** [0.038]	-0.308*** [0.036]
<i>tech_col</i>	-0.688*** [0.081]	-0.465*** [0.150]	<i>marg_emp</i>	0.951*** [0.119]	1.848*** [0.060]
<i>high_school</i>	-0.539*** [0.119]	0.028 [0.143]	<i>vol_ins</i>	2.520*** [0.110]	2.360*** [0.090]
<i>high_school_VT</i>	-0.629** [0.266]	0.267 [0.328]	<i>pas_ins</i>	3.000*** [0.100]	2.999*** [0.070]
<i>sec_sch</i>	-0.978*** [0.056]	-0.362*** [0.094]	<i>others</i>	0.261*** [0.081]	0.743*** [0.057]
<i>No. of obs.</i>	33917	38285			
<i>R<sup>2</sup></i>	0.35	0.57			

Notes: see Table 2.

in Table 2 are repeated with interaction terms between a preretirement dummy,  $P$ , and each explanatory variable (Table 4).<sup>30</sup>

<sup>30</sup>The estimation of interacted effects for preretired persons is equivalent to a separate regression for this group.

Table 4: Characteristics of the effective retirement age

	men	women		men	women
<i>income_mis</i>	0.32	0.054	<i>income_mis * P</i>	0.349	0.108
	[0.197]	[0.120]		[0.273]	[0.192]
<i>income_1<sup>st</sup></i>	-0.071	-0.058	<i>income_1<sup>st</sup> * P</i>	0.073	-0.228
	[0.143]	[0.097]		[0.201]	[0.143]
<i>income_2<sup>nd</sup></i>	-0.210**	-0.503***	<i>income_2<sup>nd</sup> * P</i>	-0.365***	0.029
	[0.083]	[0.048]		[0.106]	[0.069]
<i>income_4<sup>th</sup></i>	-0.251***	-0.587***	<i>income_4<sup>th</sup> * P</i>	1.342***	1.423***
	[0.053]	[0.064]		[0.064]	[0.073]
<i>income_5<sup>th</sup></i>	0.166	0.059	<i>income_5<sup>th</sup> * P</i>	-0.751***	-0.663***
	[0.168]	[0.122]		[0.242]	[0.182]
<i>pension_1<sup>st</sup></i>	1.481***	2.672***	<i>pension_1<sup>st</sup> * P</i>	0.276*	0.239***
	[0.056]	[0.044]		[0.150]	[0.062]
<i>pension_2<sup>nd</sup></i>	0.761***	1.400***	<i>pension_2<sup>nd</sup> * P</i>	-0.664***	-0.632***
	[0.065]	[0.044]		[0.115]	[0.058]
<i>pension_4<sup>th</sup></i>	-0.560***	0.081*	<i>pension_4<sup>th</sup> * P</i>	0.228***	0.104*
	[0.050]	[0.048]		[0.058]	[0.059]
<i>pension_5<sup>th</sup></i>	-0.207***	-0.680***	<i>pension_5<sup>th</sup> * P</i>	-0.304	-0.085
	[0.067]	[0.043]		[0.283]	[0.060]
<i>tech_col</i>	-0.673***	-0.791***	<i>tech_col * P</i>	0.182	0.363
	[0.118]	[0.231]		[0.155]	[0.279]
<i>high_school</i>	-0.740*	0.631*	<i>high_school * P</i>	0.098	-0.771
	[0.403]	[0.377]		[0.500]	[0.508]
<i>high_school_VT</i>	-0.655***	0.054	<i>high_school_VT * P</i>	0.303	-0.465*
	[0.167]	[0.214]		[0.222]	[0.268]
Note: This table continues on the next page.					
<i>sec_sch</i>	-1.028***	-0.399***	<i>sec_sch * P</i>	0.112	-0.162
	[0.095]	[0.151]		[0.130]	[0.186]
<i>sec_sch_VT</i>	-1.151***	-0.407***	<i>sec_sch_VT * P</i>	0.466***	-0.159
	[0.070]	[0.145]		[0.102]	[0.179]
<i>edu_unknown</i>	-0.578***	0.096	<i>edu_unknown * P</i>	-0.269**	-0.510***
	[0.091]	[0.152]		[0.126]	[0.187]
<i>edu_missing</i>	-0.848***	0.293*	<i>edu_missing * P</i>	0.028	-0.805***
	[0.106]	[0.150]		[0.132]	[0.183]
<i>reha</i>	-4.245***	-4.000***	<i>reha * P</i>	2.533***	1.936***

	[0.089]	[0.093]		[0.124]	[0.132]
<i>sickness</i>	-0.043***	-0.022***	<i>sickness*P</i>	0.008	0.01
	[0.006]	[0.006]		[0.008]	[0.008]
<i>childcare</i>	0.009**	0.012***	<i>childcare*P</i>	0.009	0
	[0.004]	[0.001]		[0.007]	[0.001]
<i>married</i>	0.069	-0.368***	<i>married*P</i>	0.222***	0.215***
	[0.046]	[0.028]		[0.060]	[0.041]
<i>P</i>	-3.317***	-2.664***	No. of obs.	33557	37992
	[0.388]	[0.257]	<i>R</i> <sup>2</sup>	0.54	0.67

*Notes:* The dependent variable is retirement entry age in 2000-2003 which is adjusted for pre-retirement, *age<sub>f</sub>*; *P* is a dummy equal to one if a person preretires as defined in Section 3.1; OLS estimations with White-heteroscedasticity robust standard errors.

Overall, the effects for preretired individuals<sup>31</sup> are qualitatively similar to the reference category, i.e., individuals that take official pension plans. Main differences exist with respect to the size of the effects on rehabilitation, income and pension payments: Most importantly, the negative association between claims of rehabilitation services before retirement, *reha*, and retirement age is much smaller for preretired men and women. If rehabilitation services are taken, the retirement age of persons with regular pension plans is on average almost four years lower whereas preretired men are only about one and a half years and preretired women two years younger compared to persons not claiming any rehabilitation services. This observation can be explained by the fact that the frequency of rehabilitation services in the present data is much higher for persons between age 54 and 60 compared to older persons. At the same time, rehabilitation is strongly correlated with disability pension entries at ages below 60. Therefore, persons who take rehabilitation services seem less likely to take the preretirement pathway but rather the disability pathway.

Differences in effects between preretired individuals and the rest of the sample are large for individuals with middle and high incomes: The estimated effects differ substantially for the fourth and fifth quintile, whereas there is no or only a small difference with respect to the missing values dummy and the first and second income quintile.

There are also significant differences between preretired individuals and those taking official pathways into retirement across all pension payments quintiles, except for the fifth quintile. In spite of the quantitative differences, there is

<sup>31</sup>These effects are obtained by adding the interaction effect and the respective effect for the reference group.

still a similar qualitative pattern for both groups, though: Relative to the third quintile, lower pension payments are associated with a higher retirement age and higher pension payments are associated with a lower retirement age.

To summarize: Claiming rehabilitation services before retirement has a much lower effect on retirement age for preretired individuals compared to the rest of the sample. Also income in the year before retirement and pension payments in 2003 have different effects for preretired persons. However, there is no obvious and easy to interpret pattern of differences in income and pension effects between the two groups. Further minor differences can be observed with respect to marital status and education.<sup>32</sup> Overall, the estimated differences in effects with respect to rehabilitation services, income and pensions as well as the large number of identified preretirement cases underline the relevance of taking account of preretirement in administrative data when individual retirement entry decisions and effects of retirement entries on the overall social security system are of interest.

## 5 Conclusion and Outlook

The present paper employs administrative data of individuals' retirement entries in 2003 (*SUF Versichertenrentenzugang 2003*) provided by the German Pension Insurance. Retirement entry in administrative data is defined as receiving pension payments for the first time. This does, however, not include the possibility of preretirement. The issue of preretirement plays an important role in recent pension and labor-market reforms. s

Preretirement is defined as leaving the labor force and effectively retiring before any official pathways into retirement can be taken. Until official retirement individuals receive financial support through arrangements between the state, employers and employees that typically burden the social security system. These arrangements are often very generous for the employee such that this option has been frequently used: 40 percent of all men and women in the sample preretire. They stay on average 2.4 years in preretirement before taking one of the regular retirement plans. Moreover, the present paper investigates individual determinants of retirement entry age such as income, pension payments, measures for education, health and family status. It is investigated whether individuals' characteristics are significantly different with respect to retirement age for the group of preretired individuals and individuals taking regular pension plans. Noticeable

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<sup>32</sup>There is a difference in estimated effects of *edu\_unknown* and *edu\_missing* which is per definition mainly driven by a larger number of passively insured persons in the preretired sub-sample.

differences arise with respect to rehabilitation claims before retirement, income before retirement and pension payments.

These insights are based on analyzing German administrative data. Such data is very advantageous with respect to detailed and reliable information on individuals pension characteristics and the number of observations. Information is only provided as far as it is relevant for the calculation of pensions. Consequently, income variables are censored, information on wealth is non-existent and retirement entry is defined as obtaining public pension payments. In order to provide useful information for future studies based on German administrative data provided by the German Pension Insurance, the paper discusses those issues.

In light of recent reform initiatives in Germany concerning the labor market (unemployment insurance) or social security legislation (retirement entry rules and adjustment costs) interesting future research questions arise: What is the impact of these reforms on retirement entries, labor force exits and preretirement? How will future pension and labor-market reforms change the distribution of retirement entry age? Such research questions are typically analyzed in option value models of individual retirement entry behavior, e.g., Börsch-Supan (1992), Schmidt (1995), Börsch-Supan and Schmidt (1996), Siddiqui (1997), Börsch-Supan (2000), Berkel and Börsch-Supan (2004), Antolin and Scarpetta (1998). Administrative data that is available so far, i.e., the *SUF Versichertenrentenzugang 2003*, does not yet include sufficient variation in individuals' retirement entry decisions in order to investigate these questions. Appendix B discusses why an option value approach is not feasible with the data at hand and describes the necessary data characteristics for such an undertaking. In particular, it is essential to have data that includes not only observations of retirement entries but also of older workers still in the labor force and not yet retired. It is of great interest to release such administrative data in order to accomplish the estimation of structural models of retirement entry decisions and labor force exits that can be used for policy analysis.

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## 6 Appendix

### 6.1 Appendix A - The Data

Table 5: Variable definitions

Variable	Description
<i>age</i>	retirement entry age in 2003
<i>age<sub>f</sub></i>	retirement entry age in 2000-2003, preretirement is taken into account as described in Section 3.1
<i>income_mis</i>	dummy variable equal to one if income subject to social security contributions is missing in 2002
<i>income_1<sup>st</sup></i>	dummy variable equal to one if income subject to social security ranges between ]0; 428] Euros per month in 2002
<i>income_2<sup>nd</sup></i>	dummy variable equal to one if income subject to social security ranges between ]428; 1141] Euros per month in 2002
<i>income_3<sup>rd</sup></i>	dummy variable equal to one if income subject to social security ranges between ]1141; 1957] Euros per month in 2002
<i>income_4<sup>th</sup></i>	dummy variable equal to one if income subject to social security ranges between ]1957; 2870[ Euros per month in 2002
<i>income_5<sup>th</sup></i>	dummy variable equal to one if income subject to social security is above 2870 Euros per month in 2002
<i>pension_1<sup>st</sup></i>	dummy equal to one if public pension payments range between ]0; 266] Euros per month in 2003
<i>pension_2<sup>nd</sup></i>	dummy equal to one if public pension payments range between ]266; 537] Euros per month in 2003
<i>pension_3<sup>rd</sup></i>	dummy equal to one if public pension payments range between ]537; 794] Euros per month in 2003
<i>pension_4<sup>th</sup></i>	dummy equal to one if public pension payments range between ]794; 1122[ Euros per month in 2003
<i>pension_5<sup>th</sup></i>	dummy equal to one if public pension payments are above 1122 Euros per month in 2003
<i>reha</i>	dummy variable equal to one if rehabilitation services were claimed during the last 5 years before retirement
<i>sickness</i>	number of months with insurance credits due to sickness or rehabilitation
<i>childcare</i>	number of months with insurance credits for child-caring
<i>married</i>	dummy variable equal to one if an individual is married

	or widowed
<i>sec_sch</i>	dummy variable equal to one if the highest educational degree is from secondary school
<i>sec_sch_VT</i>	dummy variable equal to one if the highest educational degree is from secondary school plus vocational training
<i>high_sch</i>	dummy variable equal to one if the highest educational degree is from high school
<i>high_sch_VT</i>	dummy variable equal to one if the highest educational degree is from high school plus vocational training
<i>tech_col</i>	dummy variable equal to one if the highest educational degree is from a technical college
<i>uni</i>	dummy variable equal to one if the highest educational degree is from university
<i>edu_missing</i>	dummy variable equal to one if the highest educational degree is a missing value
<i>edu_unknown</i>	dummy variable equal to one if the highest educational degree is unknown
<i>full_emp</i>	dummy variable equal to one if the individual had an employment subject to social social security contributions in the year before retirement
<i>partial_ret</i>	dummy variable equal to one if the individual was partly retired in the year before retirement
<i>comp_ins</i>	dummy variable equal to one if the individual was compulsorily insured due to unemployment, sickness or rehabilitation <sup>33</sup> in the year before retirement
<i>marg_emp</i>	dummy variable equal to one if the individual was marginally employed in the year before retirement
<i>vol_ins</i>	dummy equal to one if a person was voluntarily insured in the year before retirement
<i>pas_ins</i>	dummy equal to one if a person was passively insured in the year before retirement
<i>others</i>	dummy equal to one for all other individuals that are neither passive, <i>vol_ins</i> , <i>marg_emp</i> , <i>comp_ins</i> , <i>part_ret</i> or <i>full_emp</i> , which includes the following employment categories: credited insurance, other compulsory insurances, other status and unknown status

<sup>33</sup>Refer to SGB III and § 3 Nr. 3 SGB VI.

Table 6: Summary statistics

Variable	Men					Women				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
<i>age</i>	33917	62.26	2.48	54	72	38285	62.48	2.61	54	72
<i>age_f</i>	33557	61.28	2.94	54	72	37992	61.63	3.03	54	72
<i>income</i>	33917	16.84	13.47	0	45.15	38285	7.66	9.01	0	45.36
<i>pension</i>	33917	9.70	4.24	0.17	18.97	38285	4.80	3.05	0.05	18.97
<i>uni</i>	33917	0.03	0.18	0	1	38285	0.01	0.10	0	1
<i>tech_col</i>	33917	0.03	0.17	0	1	38285	0.01	0.09	0	1
<i>high_sch_VT</i>	33917	0.01	0.10	0	1	38285	0.01	0.08	0	1
<i>high_sch</i>	33917	0.00	0.05	0	1	38285	0.00	0.04	0	1
<i>sec_sch_VT</i>	33917	0.42	0.49	0	1	38285	0.25	0.43	0	1
<i>sec_sch</i>	33917	0.08	0.27	0	1	38285	0.10	0.30	0	1
<i>edu_unknown</i>	33917	0.09	0.28	0	1	38285	0.11	0.32	0	1
<i>edu_missing</i>	33917	0.34	0.47	0	1	38285	0.51	0.50	0	1
<i>reha</i>	33917	0.06	0.25	0	1	38285	0.04	0.20	0	1
<i>sickness</i>	33917	0.98	3.14	0	48	38285	0.63	2.39	0	48
<i>childcare</i>	33917	0.30	3.03	0	60	38285	23.39	14.65	0	60
<i>married</i>	33917	0.82	0.39	0	1	38285	0.73	0.44	0	1
<i>full_emp</i>	33917	0.28	0.45	0	1	38285	0.22	0.42	0	1
<i>part_ret</i>	33917	0.17	0.37	0	1	38285	0.08	0.27	0	1
<i>comp_ins</i>	33917	0.29	0.45	0	1	38285	0.19	0.39	0	1
<i>marg_emp</i>	33917	0.01	0.11	0	1	38285	0.07	0.25	0	1
<i>vol_ins</i>	33917	0.04	0.19	0	1	38285	0.03	0.16	0	1
<i>pas_ins</i>	33917	0.17	0.37	0	1	38285	0.33	0.47	0	1
<i>others</i>	33917	0.07	0.26	0	1	38285	0.12	0.33	0	1

Source: German Pension Insurance ("Deutsche Rentenversicherung"), *SUF* *Versichertenrentenzugang 2003* (SUFRTZN03XVST.Berk).

Note: *income* and *pension* are summarized in 100 Euros per month.

## 6.2 Appendix B - The Option Value Model and *SUF Versichertenrentenzugang 2003*

The individual retirement decision is a sequential inter-temporal discrete choice problem under uncertainty that depends on socioeconomic as well as present and future institutional and legal determinants. This inter-temporal nature of the decision process is reflected in option value models such as by Stock and Wise (1990).<sup>34</sup> The option value model assumes that individuals compare the present value of all future discounted retirement income when retiring now to all present values of retiring in all possible future points in time. An individual chooses to retire now if the utility from retiring today is higher than utility from retiring at any later point in time.

Due to its structural nature the estimation of an option value model allows policy analyses. More specifically, one can simulate the impacts of pension reforms on individuals retirement entry decisions and, therefore, on the distribution of retirement age in the population. This section discusses, why the option value model can not be applied to the data of the *SUF Versichertenrentenzugang 2003*.

In order to employ an option value model based on Stock and Wise (1990) as estimated e.g. by Berkel and Börsch-Supan (2004), panel data on individuals retiring during the sample period is required. Ideally, the data should be a representative draw from the German population of the elderly. Most importantly, variation in the option value is needed that arises from different characteristics across individuals retiring at different ages and still working, and from differences in pension legislation across years and cohorts. The time series information on each individual has to be sufficiently long in order to observe changes in the option value before retiring.

The data structure of the *SUF Versichertenrentenzugang 2003* does not sufficiently match these requirements. First, the data is cross-sectional as it refers to retirement entries in 2003 only. The mechanism of the option value model can not be revealed in such data as the decision of each single individual has to be followed over time. A very short but insufficient time series can be extracted from the data, though, as one has information on individuals' labor-market and insurance status in 2000 to 2002.

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<sup>34</sup>The model by Stock and Wise (1990) does not provide for a complete solution of the complex inter-temporal optimization problem, but includes all relevant economic incentives. Models solving the full inter-temporal optimization problem can be found e.g. in Rust (1996), Rust and Phelan (1997). Lumsdaine, Stock and Wise (1992) discuss and compare three alternative approaches of estimating an option value model. More general surveys about option value models can be found in Arnds and Bonin (2002) and Lumsdaine and Mitchell (1999).

Second and most importantly, all individuals retire in 2003. The importance of this point becomes clear if one describes the final measure of interest, the probability of retiring at age  $a$  conditional on the option value at age  $b$  in the present sample,  $Pr(RA = a|OV_b)$ , more formally by applying Bayes' Rule:

$$Pr(RA = a|OV_b) = Pr(RA = a) \frac{Pr(OV_b|RA = a)}{Pr(OV_b)},$$

where  $Pr(RA = a)$  is the unconditional probability of retiring at age  $a$ ,  $Pr(OV_b)$  is the unconditional probability of an option value  $OV$  at age  $b$ , and  $Pr(OV_b|RA = a)$  is the probability of observing an option value  $OV$  at age  $b$  if an individual retires with age  $a$ . In the present sample  $a$  refers to retirement age in 2003 and  $b$  takes the values  $b = a$ ,  $b = a - 1$ ,  $b = a - 2$  or  $b = a - 3$ . The unconditional probability of retirement age  $a$ ,  $Pr(RA = a)$ , and the probability of an option value  $OV_b$  conditioned on retirement entry age  $a$ ,  $Pr(OV_b|RA = a)$ , can be obtained from the data sample at hand. If necessary both terms can be weighted by age such that the representative age structure in the population is matched. However, information on  $Pr(OV_b)$  is only available for individuals retiring in 2003 and not for a representative draw from the whole population including also individuals retiring later. If  $Pr(OV_b)$  is significantly different for individuals inside and outside the sample, the sample has too little variation and estimation results will be biased.<sup>35</sup> Additional variation would come from a longer time-series dimension including people that are still working and covering a longer period of institutional changes. Potentially German data of retirement entries between 1997 and 2015 are very useful as during this period adjustment costs of early retirement are phased in and retirement age limits are gradually increased. As no true time-series information is contained in the data at hand, such variation is not sufficiently provided. Crucial information for the model is not existent and econometric models with weighting procedures, such as the "weighted" exogenous sampling Maximum-Likelihood estimator (WESLM)<sup>36</sup>, can not help. As the option value is a complex construction, it can not be easily obtained from other data sources.

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<sup>35</sup>Estimations indeed reveal that there is not sufficient variation concerning the option value in the data. In the model individuals have an incentive to retire if the option value of postponing the retirement entry decision becomes negative. The option value falls the closer an individual gets to its optimal moment of retirement. Therefore, individuals tend to have small option values around the moment of retirement. In order to obtain variation, observations on individuals still being further away from their entries into retirement are essential.

<sup>36</sup>Refer to Manski and McFadden (1981).

Third, the sample is only representative with respect to the population of all retirement entries in 2003 whereas it is not representative for the German population of retired and non-retired individuals. There is a large portion of 60, 63 and 65 years old individuals retiring, as these are popular retirement ages, but there are only few people with age 59, 61 and 64. After constructing an artificial panel from 2000 to 2003 with all individuals retiring in 2003 the sample is not at all representative to the German population. One can solve this problem by weighting observations by age classes. However, weights take very extreme values.

Overall, no robust estimation method can be found to solve the most severe problem of missing information on individuals not retiring during the sample period. Additional data on older individuals not yet retired is needed. Ideally, a random draw of insured persons of age 54 to 72 is needed that covers a period of about 15 years and that includes persons that retire within the sample period and others who are still in the labor force or not yet retired.

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