Disability Benefit Generosity and Labor Force Withdrawal*

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Abstract

A key component for estimating the optimal size and structure of disability insurance programs is the elasticity of labor force participation with respect to benefit generosity. Yet, in many countries including the United States all workers face identical benefit schedules, which are a function of one's labor market history, making it difficult to separate the effect of the benefit level from the effect of preferences for work on individuals' withdrawal from the labor force. To circumvent this problem, we exploit exogenous variation in disability insurance benefits in Austria arising from several reforms to its disability insurance and old age pension system in the 1990s and 2000s. We use comprehensive administrative social security records data on the universe of Austrian workers to compute benefit levels under six different regimes, allowing us to identify and precisely estimate the elasticity of labor force withdrawal (disability insurance claiming) with respect to benefit generosity.

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1. Introduction

Leaving the work force before the statutory retirement age has become the norm in many industrialized countries. Since the 1960s the labor force participation rate of males aged 55-64 in the OECD countries has decreased from 80 to 65 percent despite considerable improvements in aggregate health. At the same time, disability insurance participation has grown substantially, especially among older workers who are not yet eligible for public pensions. The negative effects of this trend on economic growth and public expenditure are exacerbated by falling fertility rates and significant increases in average life expectancy. While retirement incentives arising explicitly from public old age pension systems (i.e., Social Security) have been well explored (see, e.g., Burtless 1986, Gustman and Steinmeier 1986, Stock and Wise 1990, Berkovec and Stern 1991, Blau 1994, Phelan and Rust 1997, Gruber and Wise 2004, French 2005), the impact of financial incentives arising from alternative retirement channels, most notably disability insurance (DI), still lacks a careful analysis. Although recent studies (e.g., Maestas, Mullen and Strand, 2013) have demonstrated convincingly that substantial work capacity exists among marginal DI program entrants, estimating the effect of DI benefit levels on individuals' labor force participation and claiming decisions has remained elusive due to lack of exogenous variation in DI benefits, which in most countries are determined by a single function of past earnings and work experience.

In this paper employ a novel identification strategy that exploits a series of reforms to the Austrian old age and disability insurance public pension system between 1987 and 2010. We make use of individual administrative data containing detailed information regarding earnings and employment histories and pension claiming, covering all of Austria in the period 1972 to 2007. The combination of detailed administrative data and policy variation from a series of

national pension reforms presents us with a unique opportunity to learn about individuals' labor force withdrawal decisions in ways that are impossible in the U.S. and other settings. Given the similarity in characteristics of the social security system and the aging population structure, and because many of the Austrian reforms mimic policy changes that are currently debated by policymakers around the world, studying their effects can yield important insights to guide social security and disability insurance reforms in other industrialized countries, including the U.S.[1]

We find that generally Austrians in this period are not very sensitive to the level of DI benefits in determining their labor force participation. We estimate an overall elasticity of nonparticipation with respect to DI benefits of approximately 0.03, an order of magnitude smaller than previous estimates using observational data in the U.S. (between 0.2 and 1; see Bound and Burkhauser (1999) for a review of this literature) and even quasi-experimental variation arising from a one-time change in DI benefit levels in Canada exploited by Gruber (1996) (0.3), although strikingly in line with estimates exploiting a different one-time change in Canadian DI benefit levels reported in Campioleti (2004) (0.02-0.04 among workers aged 45 and older, and not statistically different from zero). We are able to precisely estimate such a small effect due to our very large sample. Furthermore, unlike the Gruber and Campioleti studies, we exploit continuous variation in DI benefits as opposed to a one-time flat change.

The large sample also allows us to examine heterogeneity in responsiveness to benefit generosity on several different margins. We find that the effect of benefit level on DI claiming increases with age and decreases with skill level and prior earnings, consistent with the idea that these older, lower skilled and poorer workers tend to have fewer labor market opportunities and higher benefit replacement rates than their younger, higher skilled and wealthier counterparts.

[1] One striking difference between Austria and the U.S., discussed below, is that the DI application process is significantly less strict in terms of labor force participation while awaiting benefits, and therefore less costly to applicants, in Austria compared to the U.S.

Notably, we find that individuals experiencing a current involuntary unemployment spell are much more responsive to DI benefit levels than employed individuals.

Methodologically, our estimates using only variation in benefits within a given year imply that estimates relying on observational data and functional form for identification may accurately reflect responsiveness to benefits in other countries without variation in DI benefit schedules as long as (1) the benefit schedule is sufficiently nonlinear (as it is currently in the U.S.), and (2) sufficient controls are included for past labor market history and other benefit determinants that may be correlated with unobserved tastes for work.

The rest of the paper is structured as follows. In Section 2, we describe the data and institutional background on the Austrian DI system including a detailed description of the policy reforms enacted between 1987 and 2010. Section 3 describes our empirical strategy for isolating the effect of DI benefit level on labor force withdrawal, separating out the effect of unobserved preferences for work that are correlated with both DI benefits. Section 4 presents the results of our estimation models. Finally, Section 5 concludes.

2. Data and Institutional Background

2.1. The Austrian Social Security Database

We use administrative data from the Austrian Social Security Database (ASSD), provided by Hauptverband der Österreichischen Sozialversicherungsträger (the Austrian Social Security Administration). The ASSD covers the universe of workers in Austria and contains detailed information on the labor market and earnings histories of individuals beginning in 1972. Specifically, all employment, unemployment, disability, sick leave and retirement spells are

recorded.[2] Summaries of spells before 1972 (e.g., number of years employed, unemployed, etc.) are available for individuals who have claimed a public pension by the end of 2008. At the individual level, the ASSD contains information on gender, age, work experience, job tenure, blue- or white-collar status and (for any individuals who have ever claimed unemployment insurance) marital status.[3] Although demographic information is limited, the population of Austria is ethnically homogenous; 88% are native Austrians and the largest non-native immigrant groups are from former Yugoslavia (7%), Turkey (2%), Germany (1%), Poland and Hungary (less than 1%). The ASSD also contains some firm-specific information such as geographic region and industry affiliation. See Zweimüller et al. (2009) for a detailed description of the data. A key feature of this data set is that it provides all of the information necessary to compute individuals' hypothetical disability insurance benefits at any given point in time and, with some minor assumptions, individuals' hypothetical disability insurance benefits under *different* policy regimes, which is critical to our identification strategy (see Section 3).[4]

Our main sample includes all male private sectors workers ages 35-64 during the time period 1987-2010 who have not already claimed a (disability or old age) pension. We chose 1987 as the beginning of our sample period in order to observe at least 15 years of earnings for everyone in our sample. We chose age 64 as the upper age limit because the full retirement age (FRA) in Austria is age 65. In practice, more than 95% of the sample is younger than Austria's early retirement age (ERA), age 60.[5] We limit the sample to private sector employees who are

[2] Note that individuals do not have to be receiving unemployment insurance benefits to be registered unemployed. Individuals who have exhausted their UI benefits may still register as unemployed and receive General Assistance.
[3] Unfortunately, it is not possible to link individuals' and their spouses' earnings records.
[4] Although we can confidently say that we are able to calculate potential DI benefits for men with little or no error, we are not confident that this is the case for women since maternity leave spells are known to be observed with error in the ASSD data. Women also have different early and full retirement ages (55 and 60, respectively, for most of the sample period) although they will be equal to those of men by 2033. Therefore, we focus our analysis on men only.
[5] This is also important because any individual who satisfies the eligibility requirements for early retirement (not only age but also insurance/contribution years) is not eligible for a disability pension.

covered by the same pension system and hence face the same eligibility restrictions and financial incentives. That is, we exclude self-employed and civil service workers who are covered by a different pension system. Our sample covers more than three quarters of all active labor market participants in Austria. We construct the sample by defining a reference date, January 1, and obtaining individuals' information on factors that might affect DI application as of that date for each year they are in the labor market (i.e., previous earnings, and demographic characteristics such as employed or registered unemployed). The outcome of interest is whether they were observed to receive disability insurance benefits within a year (i.e., by December 31).

Table 1 presents descriptive statistics, overall and grouped by observation period roughly corresponding to the different policy regimes (see Section 2.2 for more details). During the twenty-three year sample period between 1987 and 2010, we observe just over 1.5 million individuals each for an average of 10 years between ages 35 and 64. At any given point in time, the average individual in our sample is 45 years old. Approximately 10 percent of working age individuals are unemployed on any given January 1 and 54 percent are blue collar workers. Thirteen percent claimed sick leave at some point in the last two years and the average sick leave spell among claimants was 52 days (beyond the first 6-12 weeks, which are covered by the individuals' health insurance plan and not recorded in the ASSD). The average worker was employed 13 out of the last 15 years.

On average workers in our sample have accumulated 28.4 "insurance years," which include both contribution years (i.e., periods of employment, including sick leave) and periods of secondary education, military service and unemployment, over their working lives. The average number of insurance years accumulated increased over the sample period, from 28 in 1987 to 29 in 2010. The average annual earnings in the year prior to observation is 33,364 Euros (in 2010

Euros), or $42,502, and increasing in real terms over the sample period. Since wages in Austria are generally monotonically increasing over time, last year's wage generally exceeds average previous earnings calculated over the best 15 years of one's career. We calculated individuals' hypothetical disability insurance (DI) benefits if they were to claim disability in that year; the average disability pension would be 18,467 Euros, or about 55 percent of the last year's wage. The inflow rate into DI from employment is 0.9 percent on average throughout our sample period, starting at 1.35 percent in the mid-80s to mid-90s and declining by more than 75% to 0.3 percent by the late-2000s. The inflow rate into DI from unemployment is considerably larger, 4.6 percent on average over the sample period, and correlates positively with national unemployment levels. However, inflow rate from unemployment may be overstated since it will tend to include individuals experiencing longer unemployment durations by construction.

To examine DI inflow rates among unemployed applicants, we constructed a second sample of all involuntary UI spells occurring between 1987 and 2010.[6] We identify involuntary spells by limiting the sample to UI claims occurring within 28 days of the end date of the prior employment spell since voluntary quitters must wait at least 28 days to start drawing UI benefits. The last column of Table 1 presents descriptive statistics for the UI sample. Compared to the overall population, the average individual experiencing a UI spell in our sample period is much more likely to be a blue collar worker (80.5%), much more likely to have drawn from sick leave in the past two years (40%), and has on average two fewer years of work experience and insurance years. His prior year's earnings are about 30% lower than the average over the entire population and his replacement rate for UI benefits is about 18% higher.

[6] Unfortunately we are unable to examine duration from UI to DI benefit spell because successful DI applications are backdated to the start of the UI benefit spell.

2.2. The Austrian Disability Insurance Program

Like the United States and other countries, the Austrian disability insurance (DI) program is part of a larger Old Age, Survivors and Disability Insurance system that is financed by a payroll tax on earned income and provides pension benefits to qualifying workers who have accumulated enough labor market experience (insurance years). Generally, a disabled worker in Austria must have accumulated at least 5 insurance years within the last 10 years to be eligible for DI benefits; the insurance years requirement increases month for month after age 50 up to a maximum of 15 insurance years.[7] Disability pensions are paid to individuals whose earnings capacity, due to a physical or mental health impairment, has been reduced to less than half of the earnings capacity of a healthy person with comparable education and work experience. The standard is relaxed at age 57 by changing the comparison from a healthy worker performing *any type of work* in the economy to a healthy worker *in a similar occupation*.[8]

Unlike DI applicants in the U.S., DI applicants in Austria are not required to reduce their earnings below a given threshold (or separate from their employers) in order to apply for benefits.[9] Like many European countries, employed individuals may draw sickness benefits from their employers—up to 52 weeks (assuming they have worked at least 6 months in the previous 12 months before onset) —while applying for DI (Social Security Administration, 2012). In addition, individuals who are or become disabled while unemployed can apply for DI benefits while continuing to receive unemployment insurance (UI) benefits. Applying for DI benefits

[7] Note the work history requirement in the U.S. is similar to that in Austria: 20 covered quarters (or 5 years) earned in the last 10 years, with fewer credits required before age 31 and more required after age 42 up to a maximum of 40 quarters (or 10 years).

[8] Prior to 1997, the age at which disability screening is relaxed was 55 for both men and women (see Staubli, 2011). In 2000, the age was raised to 57 for women as well as men. Practically, access to disability insurance in the U.S. is also relaxed at older ages (50 and 55, depending on impairment severity) for workers with limited education and skill level; see Chen and van der Klaauw (2008).

[9] However, it is the case that DI beneficiaries earning more than 380 Euros per month (approx. $484) would lose up to 50 percent of their benefits, depending on their earnings. (In the U.S. DI beneficiaries earning more than approx. $1,000 per month would lose their entire benefit.)

while unemployed does not stop the clock on individuals' maximum UI benefit durations but it does suspend the requirement that individuals must actively search for work and accept any "reasonable" job offered.[10,11] The acceptance rate for DI applications in 2011 was just over two-thirds of applicants, according to official statistics. Once receiving DI benefits, very few claimants (less than 4 percent) ever leave the DI rolls.

The formula for computing DI benefits is the same one used to compute old age (Social Security) pensions. Generally it consists of a *pension coefficient* (PC), which varies by age and insurance years, multiplied by an *assessment basis* (AB), which is average indexed capped earnings over a given period of time (e.g., the last 10 years in 1987 at the beginning of our observation period). Younger DI beneficiaries with limited work experience are eligible for a "special increment" to supplement their accumulated insurance years up to a certain amount to compensate for their limited ability to establish long work histories. For example, in 1987, individuals younger than age 50 who had accumulated less than 26.3 insurance years could add one additional "insurance year" for each year less than age 50 up to a maximum of 26.3 total insurance years (i.e., up to a maximum pension coefficient of 50). The rules governing eligibility and calculation of benefits are publicly available at www.sozdok.at, and prior to 2004 were published (with examples) in a series of books called "Pensionsberechnung Leicht Gemacht," or "Pension Calculation Made Easy" (Marek, 1987-2003). In calculating DI benefits we rely primarily on the website, which allows us to trace changes in detail over time.

[10] UI maximum durations start at 20 (30) weeks for individuals with less (more) than 3 contribution years in the last 5 years and increase to 39 weeks for those older than 40 with more than 6 contribution years in the last 10 years, and to 52 weeks for those older than 50 with more than 9 contribution years in the last 15 years. Empirically, likelihood of DI receipt does not change before or after any of these thresholds.

[11] This requirement is fairly strict. Since 2004, reasonable jobs are all jobs paying at least 75 percent what the individual's previous job paid. After 100 days, a job is still considered reasonable even if it is unrelated to the individual's previous occupation. See OECD (2005).

2.3. Policy Reforms

To identify the effect of benefit levels on DI pension claiming, we exploit exogenous variation in DI benefits between 1987 and 2010 stemming from a number of changes to the DI benefit formula in 1988, 1993, 1996, 2000 and 2004. Starting in 1988, Austria enacted a series of reforms designed to decrease pension levels and introduce bonuses (penalties) for delayed (early) claiming. The reforms were immediately implemented (or in some cases phased in) without grandfathering any cohorts into the previous regime. With the exception of the 1993 and 1996 reforms, which were implemented in July and September respectively, the new DI benefit rules went into effect on January 1.

While initially the reforms aimed to encourage delayed retirement/claiming of old age pensions, they also affected DI pensions since the programs were connected through the shared benefit formula. Later reforms broke apart this relationship and added penalties specific to claiming DI pensions. However, not all reforms were detrimental to potential DI recipients; in particular a 1993 change to the "special increment" formula had the effect of *increasing* DI pensions for a sizable group of relatively younger individuals with limited labor market experience. As a result, we observe both increases and decreases in DI pension levels during our sample period that are independent of changes in work histories and preferences over time.

Table 2 summarizes the rules used to compute DI pensions between 1987 and 2010. The first two columns describe changes to the pension coefficient (PC) and assessment basis (AB) respectively and the third column describes other important background information such as the age of relaxed screening for DI benefits or changes to the old age pension program, which could affect DI participation for older individuals on the margin of claiming DI and waiting until eligible for (early) retirement benefits. Figures 1 and 2 illustrate visually what happened to the

length of the assessment basis and the pension coefficient for several hypothetical cases, respectively, with each reform. Figures 3 and 4 illustrate the effect of the reforms on the average level of the assessment basis and average pension coefficient by age group and observation year for three different fixed cohorts of individuals (those observed in 1990, 2000 and 2010). For example, panel A tracks on the y-axis the assessment basis (pension coefficient) calculated under different pension rules (x-axis) for a fixed cohort of individuals observed in 1990. Note that the increase in assessment basis across panels is due to real earnings growth over time. Furthermore, Figure 5 shows the distribution of year-to-year changes in the overall DI pension immediately following each reform and Figure 6 shows the distribution of the maximum difference in DI pension across all the reforms. Figures 5-6 are calculated for a fixed (1993) cohort to isolate changes due to the benefit formula only.

As Figure 1 shows, the length of the assessment basis increased gradually from 10 years in 1987 to 15 years by 1993 (when it changed to from last to best 15 years) and remained at 15 years until the 2004 reform at which point it again increased gradually to 22 years by 2010. (The length of the assessment basis is still increasing year for year until 2028 after which it will hold fixed at 40 years.) Because earnings are generally monotonically increasing in Austria, these changes had the effect of *decreasing* benefit levels (with the exception of the 1993 change from last to best, which could only increase benefit levels). As can be seen in Figure 3, except for 1992 to 1993, the average level of the assessment basis falls for all age groups as the length of the assessment basis increases. Figure 5 supports the fact that the 1988-1992 reform to the assessment basis had a detrimental or negligible effect on DI benefits for more than 90% of potential claimants, although it did increase benefits slightly for some.

While the assessment basis was changing over time, the pension coefficient also experienced changes. Figure 2 presents the pension coefficient for an individual aged 35 (panel A), 45 (panel B) and 55 (panel C) for different levels of insurance years (10, 20 and 30). Prior to 1993, the pension coefficient increased by 1.9 percentage points for each insurance year up to 30 and by 1.5 percentage points for each year thereafter. As mentioned above, insurance years were supplemented on the basis of age for individuals younger than age 50 with pension coefficients under 50. Thus, individuals aged 55 would not be eligible for the special increment and would receive a pension coefficient of 19, 38 or 57 assuming they had accumulated 10, 20 or 30 insurance years, respectively (panel C). Individuals aged 45 would be able to add up to 5 "special increment" years to their insurance years if their baseline pension coefficient is less than 50. Thus, a 45 year-old with 10 or 20 insurance years would be able to increase his pension to 28.5 or 47.5, respectively, whereas a 45 year-old with 30 insurance years would receive his baseline pension coefficient of 57 (same as the 55 year-old). Finally, a 35 year-old could add up to 15 "special increment" years to his insurance years; even with only 10 insurance years his pension coefficient of 47.5 is fairly close to the maximum of 50. (Despite the fact that we illustrate such a case in the figure, obviously a 35 year-old is unlikely to have accumulated more than 20 insurance years.)

The 1993 reform made DI benefits more generous by increasing the age before which the special increment applied, from 50 to 57, and at the same time increasing the maximum supplemented pension coefficient from 50 to 60. As a result, a 35 year-old claimant would now be able to add up to 22 "special increment" years, resulting practically in a minimum pension coefficient of 60. Similarly, a 45-year old would be able to add up to 12 "special increment" years and a 55 year-old would now be able to add up to 2 years. Note that for many relatively

younger individuals the effective minimum pension coefficient set by the "special increment" rules was binding both before and after the 1993 change; as a result the reform increased DI pensions by 20% almost exactly for approximately one-quarter of the sample (see Figure 5). Figure 4 illustrates the effect of the reforms on the pension coefficient by age group and observation year. As can be seen in the figure, the 1993 reform leads to a large increase in the pension coefficient for all age groups, with the largest increase (from 50 to 60) coming from the youngest individuals. The 1993 change in special increment rules for the pension coefficient, combined with the change in the assessment basis from "last" to "best" 15 years, resulted in large increases in benefits for many potential claimants – more than 20 percent greater than the 1992 benefit for more than half of all individuals (see Figures 5).

The 1996 and 2000 reforms changed the calculation of the pension coefficient slightly and decreased pension coefficients by around 2 percent per year through 2004. The 1996 change also introduced a small penalty for claiming before the early retirement age (age 60 before 2000 and increasing to age 61.5 between 2000 and 2004). Notably, the 1996 reform also changed the age of relaxed screening for DI benefits from 55 to 57 for men, which led to large reductions in DI claimants among older men (Staubli, 2011). The 2000 reform also broke the connection between the DI and old age pension formulas, except for DI pension recipients with baseline pension coefficients above 60 (i.e., with more than 33.33 to 50 insurance years, depending on the claiming year).

Finally, the 2004 reform reversed some of the changes of the 2000 reform. The reform reunified the DI and old age pension formulas (resetting the baseline pension coefficient for many DI beneficiaries to a higher level). However, it accelerated the rate of decrease in the baseline pension coefficient, (re)applied a steeper penalty for early claiming, and raised the early

retirement age to 62 for men (and 60 for women). At the same time, the reform made DI relatively more generous for some by increasing the special increment age from 57 to 60. For the most part, though, the reform resulted in a large scale curtailment of benefits (especially for old age pension claimants) which was met with intense public criticism. Responding to the backlash, the Austrian government passed legislation in 2005 that reduced the maximum penalty for early retirement from 15 percent to 5-6.5 percent of the projected pension from the 2000 reform (which higher penalties phased in over time) and enlarged the group of people who were not affected by the raise in the early retirement age. Thus, the effect of the 2004/05 reform was to increase pension levels for some (mostly older workers) and decrease pension levels for others. (Note that Figure 4 shows the pension coefficient *before* the cap on the penalty is applied.)

Figure 6 illustrates the cumulative effect of the five reforms on variation in DI benefits between 1987 and 2010 driven *only* by changes in how benefits were calculated in a given year. This variation is sizeable and comparable to the variation used by Gruber (2000) in his difference-in-differences study of a 1987 Canadian disability insurance reform. Ninety percent of our sample experienced at least a 10 percent difference between their maximum and minimum potential DI benefit, and more than half the sample experienced at least a 20 percent difference in potential benefits. Next we explain how our identification strategy exploits these exogenous changes in DI benefit levels to identify the effect of DI benefit levels on DI claiming.

Finally, Figure 7 gives us a first look at how the reforms affected DI inflow rates (panel B) as DI replacement rates (panel A) rose and fell over the same time period. While we see some evidence that changes in DI inflows generally track changes in replacement rates the time series are generally noisy and seem to indicate that other factors may have largely influenced overall patterns in DI inflows over time. In the next section we discuss our strategy to isolate changes in

DI inflows stemming from changes in benefit levels due to the policy reforms vs. changes in other factors that may have influenced DI receipt over time.

3. Empirical Strategy

We are interested in estimating regressions of the form:

$$y_{it} = X_{it}\beta + \gamma b_t(Z_{it}) + \delta_a + \phi_t + \varepsilon_{it}, \quad (0)$$

where y_{it} is a labor supply outcome such as DI claiming for individual *i* observed at time *t*, X_{it} is a vector of demographic and labor market characteristics (e.g., socioeconomic status, experience, potential wage), $b_t(Z_{it})$ are potential (log) DI benefits which are a function (potentially varying with *t*) of a subset of labor market characteristics $Z_{it} \in X_{it}$, δ_a and ϕ_t are age and year fixed effects, respectively, and ε_{it} are any unobserved factors affecting DI claiming such as tastes for work. The parameter of interest is γ, the effect of DI benefits. A problem may arise if the benefit formula *b* does not vary across individuals. In this case, if *b* is a linear function of Z_{it} then, even if all of the components of Z_{it} are orthogonal to unobserved tastes ε_{it}, we cannot separately identify the effect of the benefit level from the effects of the individual components of Z_{it}. For example, if benefits are a linear function of past wages, then benefits are perfectly collinear with past wages and we cannot independently vary them. If, on the other hand, *b* is a *non*-linear function of Z_{it} and $E[\varepsilon_{it} \mid Z_{it}] = 0$ then we can independently vary *b* and Z_{it} and identify both γ and β. If $E[\varepsilon_{it} \mid Z_{it}] = kZ_{it}$ (where Z_{it} may contain polynomials or other transformations of one or more of its elements) then we can identify γ if not β even in the case of a single benefit formula that applies to all individuals. In this case, Z_{it} serves as a *control*

function such that, conditional on Z_{it}, b is orthogonal to ε_{it} and the estimated coefficient on b obtained by OLS regression of equation (1) is unbiased.

The problem with this identification strategy is that it relies heavily on functional form. In the example where benefits are a nonlinear function of past wages, where the replacement rate falls as wage rises (as is the case in most countries), a problem could arise if preferences for work also vary with earnings history in a concave fashion that cannot be captured by a polynomial function or other transformation of earnings that could serve as a control function. If a second policy regime (i.e., different benefit formula) were observed, then pooling individuals under both policy regimes would break apart even a nonlinear relationship between benefits and unobserved factors. This assumes that the new benefit regime is not correlated with unobservables, i.e., that unobserved tastes for work do not vary systematically across cohorts.

One way to allow for unobservable differences across cohorts is to implement a control function approach that calculates hypothetical benefits under each policy regime for each individual and includes them as controls in the regression. Conditional on the hypothetical benefit variables, the *actual* benefit is uncorrelated with unobservable factors and an OLS regression of equation (1) gives an unbiased estimate of the effect of DI benefit levels on labor force withdrawal.[12] This approach is conceptually similar to Currie and Gruber's (1996) simulated instruments methodology, which would use simulated benefits under different policy regimes holding constant a fixed (aggregated) cohort to "predict" actual benefits over time and net out any endogenous cohort level differences to isolate exogenous variation in benefits due to the policy environment only. Similarly, our approach isolates exogenous variation in actual benefits by conditioning on hypothetical benefits which "soak up" any variation correlated with

[12] This approach was used by Fevang et al. (2013) to study the effect of temporary disability insurance (TDI) benefit levels on the duration and outcome of TDI spells using policy variation in Norway.

unobservable factors. The intuition behind the approach is the same as the intuition behind including Z_{it} as a control function in the first example above to soak up variation in benefits due to variation in prior earnings that may be correlated with unobserved tastes for work.

We apply each approach discussed above in turn to estimate the effect of DI benefit generosity on labor force withdrawal and DI claiming (i.e., separate regressions by year, pooled regression and pooled regression with hypothetical benefits as controls). Since we analyze decisions over the course of a calendar year, yet two of the changes (1993 and 1996) were implemented at a point other than January 1, we measure benefits as the weighted average of benefits over the year in those cases. (For example, since the 1996 reform was implemented in September, we calculate benefits in 1996 as two-thirds of the 1995 benefit plus one-third of the 1996 benefit.) Similarly, we include a variable indicating eligibility for relaxed screening that weights eligibility over the year (e.g., an individual who turns 57 in September is eligible for relaxed screening one-third of the year). Finally, we assume a one-year lag to learn the new DI benefit level after a policy reform. We experimented with both leads and lag specifications and found that one-year lagged benefits did the best job of predicting labor force withdrawal decisions.

4. Results

In this section we present estimates of the effect of disability insurance (DI) benefit levels on DI pension receipt in Austria. Because, unlike some other systems (e.g., U.S.), Austrian DI applicants are not required to quit their jobs or refrain from receiving unemployment insurance benefits during the disability determination period, this is equivalent to estimating the effect of benefit generosity on labor force withdrawal among disabled workers. First, we estimate separate

regressions of equation (1) for each year 1987-2010. Next, we pool individuals from all years to estimate the same regression with and without hypothetical benefits calculated under each of the policy regimes as a control function. Finally, we examine heterogeneity in the estimated labor supply elasticities for different observable characteristics such as age, blue vs. white collar status, lifetime earnings, marital status and employment status.

Table 3 presents cross sectional estimates separately for each year between 1987 and 2010. The first set of estimates presents models with base controls, which include age dummies, two-year insurance year group dummies and assessment basis variables (i.e., earnings averaged over the last 5, 10, etc. years, respectively). This is equivalent to estimating equation (1) with $X_{it} = Z_{it}$, so that all control variables are variables that affect the DI benefit level directly. The second set of estimates presents models with saturated controls, that is, including in addition to the base controls a number of variables capturing job tenure, prior sick leave, maximum UI benefit duration, industry, region (of the firm), blue collar status, Austrian national status and 4th order polynomials in last year's wage and average wage in the best 15 years ($Z_{it} \in X_{it}$). These variables should not directly affect the estimates on log DI benefits since they do not add any information beyond the base controls, and as such provide a check that we have correctly captured the key factors affecting DI benefit variation (that may be correlated with unobservable factors).

As Table 3 shows, the estimated effects of benefit levels on labor force withdrawal in Austria are extremely small, but precisely estimated given the large sample sizes. Specifically, most of the estimates are between 0.01 and 0.02, implying that a one-percentage increase in benefits is associated with a 0.01-0.02 percentage point increase in DI inflow. Since DI inflow rates are approximately 0.01 over this time period, this implies a labor supply elasticity with

respect to DI benefit generosity of around 0.01-0.02, an *order of magnitude* lower than previous estimates in the literature with the exception of Campioleti's (2004) study of a one-time increase in DI benefits in part of Canada, which are of similar magnitude although not precisely estimated. Generally, the combination of benefit levels and other factors summarizing labor market experience explain very little (very rarely more than 10%) of the variation in DI claiming decisions in Austria over this time period.

As discussed above, the year-by-year estimates are valid in the case that unobservables are either uncorrelated with benefit determinants such as past earnings and work experience (unlikely) or if they are correlated linearly since the benefit formula is nonlinear in insurance years for all years prior to 2004. Note that the estimates become implausibly low and in some cases are estimated to be the wrong sign after 2004, where (subject to a penalty) benefits were largely determined by a pension coefficient that increased by a single fixed amount per insurance year. In other words, the estimation strategy of relying on including benefit determinants as control variables to net out endogenous variation in benefits breaks down when the benefit schedule is essentially linear.

Table 4 presents estimates of the DI benefit elasticity pooling individuals over the entire sample period. Columns 1 and 2 present pooled versions of the models presented in Table 3, respectively, and column 3 presents estimates adding hypothetical benefits calculated under each of the policy regimes in order to control for nonlinear variation in unobservable tastes for work that may also vary across cohorts. As expected, the estimates without the hypothetical benefits center around 0.02, roughly the center of the year-by-year estimates. Including hypothetical benefits to the model increases the estimated elasticity slightly to around 0.03 but the conclusion

remains that DI benefit levels explain very little DI claiming behavior in Austria in the past two decades.

To examine heterogeneity in labor supply responses, Table 5 presents estimates of our preferred specification (with hypothetical DI benefits as controls) separately by different groups. Despite the overall low magnitudes, some interesting patterns emerge. Most notably, the elasticity of DI claiming with respect to benefit generosity increases sharply with age. Indeed the estimates for individuals ages 55 and older are an order of magnitude higher than estimates for individuals younger than age 40. This accords with conventional wisdom that older individuals are likely using the DI system as an alternative pathway to early retirement, whereas younger individuals are unlikely to exit the labor force unless they are facing very serious conditions. We also find that blue collar workers are more elastic than white collar workers (who may face stricter barriers to qualifying for DI and also have more labor market opportunities than blue collar workers). Poorer individuals are more elastic than richer individuals (who tend to have lower replacement rates), and single individuals are more elastic than married individuals (who may be able to "self insure" against poor health shocks by pooling risk with their spouses).

Finally, the estimated elasticity for DI claiming is roughly a third higher for individuals currently experiencing an involuntary unemployment spell compared with the overall labor force (largely made up of employed workers). We find that a one percent increase in DI benefits leads to a 0.14 percentage point increase in DI claiming among this group. Since 3% of UI claimants ultimately receive DI (see Table 1), this amounts to a just over a 0.04 percent increase in DI claimants. Thus, laid off workers are more influenced by financial incentives than employed workers when making decisions about withdrawing from vs. remaining in the labor force in the face of a significant health impairment.

5. Conclusion

Many countries have more than one social insurance program that allow older workers to withdraw from the labor market. A popular pathway besides the traditional old age pension (i.e., Social Security) is disability insurance (DI). While DI programs are generally intended to insure against the risk of acquiring a career-ending health impairment, often individuals who would qualify for DI choose to work, at least for a time, instead. Understanding what drives these decisions is important for designing effective pension reforms, which are necessary to guarantee the financial stability of public old age and disability insurance pension systems. For example, if individuals are relatively elastic in their labor supply responses to DI benefit levels, then cutting DI benefits will induce many potential DI entrants to remain in the labor force and significantly decrease program participation. On the other hand, if individuals are relatively inelastic, then cutting DI benefits is only likely to harm current DI beneficiaries who would not otherwise choose to work or try to find work.

Using detailed administrative data and policy variation in DI benefits stemming from a series of national pension reforms in Austria between 1987 and 2010, we find convincing evidence that Austrian workers are *not* particularly responsive to DI benefit levels. Even among those groups that are the most elastic—older, blue collar, poor, single and unemployed workers—we estimate labor force nonparticipation elasticities that are roughly an order of magnitude lower than previous estimates in the literature. One caveat in interpreting our estimates as applicable to other settings is that under Austria's rules DI applicants do not have to withdraw from the labor market in order to *apply* for benefits but only do so if they are *awarded* benefits. It is not clear how this difference would affect the magnitude of the elasticity, since on

the one hand the lower cost of application may encourage more individuals to try their luck but on the other hand rejected applicants do not face significant barriers to work since they do not have to re-enter the labor market after a potentially lengthy absence.

Methodologically, our results suggest that, given sufficient nonlinearity in the DI benefit schedule, observational data on benefit determinants (e.g., past earnings) that may be correlated with unobserved tastes for work are adequate to identify the effect of benefit generosity on labor force withdrawal and DI claiming decisions. Thus, studies exploiting observational variation in DI benefits with sufficiently rich information about past labor market history would be worth pursuing to obtain more current estimates of the elasticity of nonparticipation with respect to DI benefits in other contexts.

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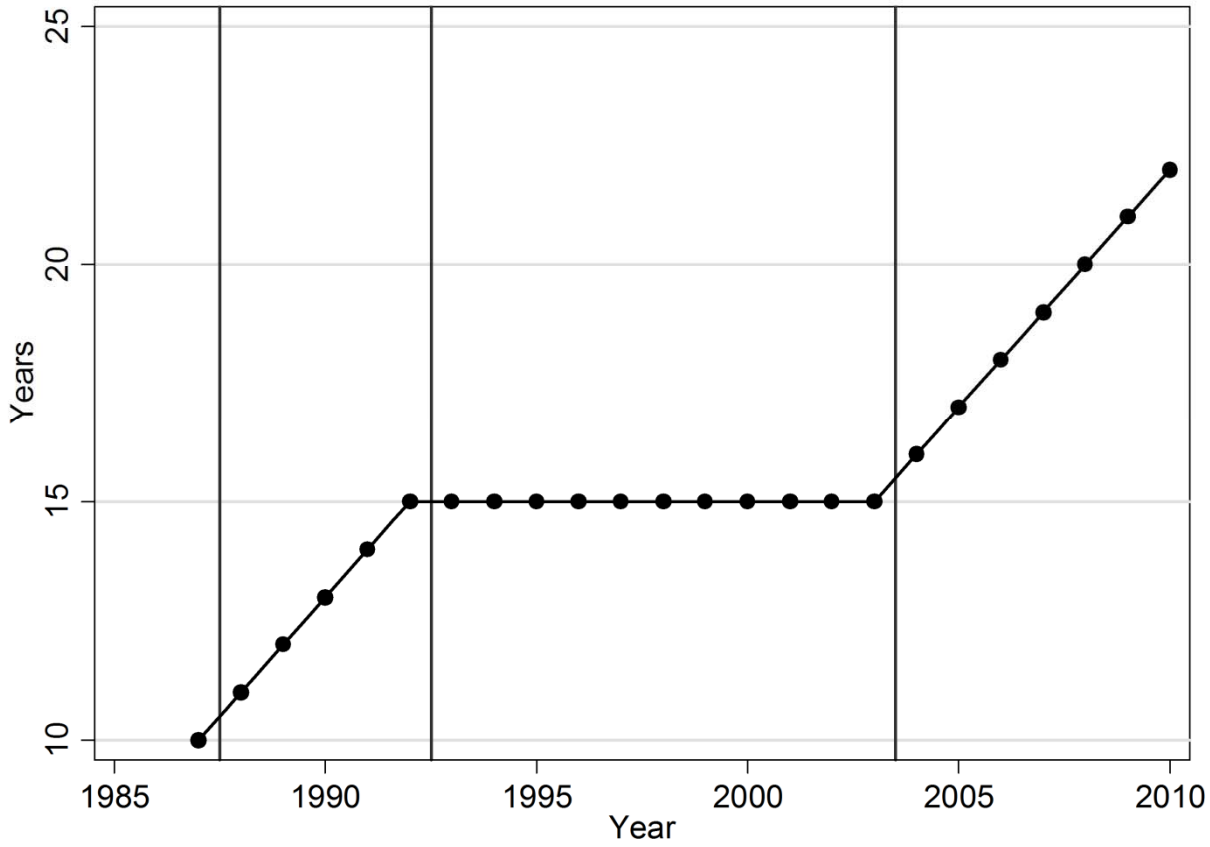
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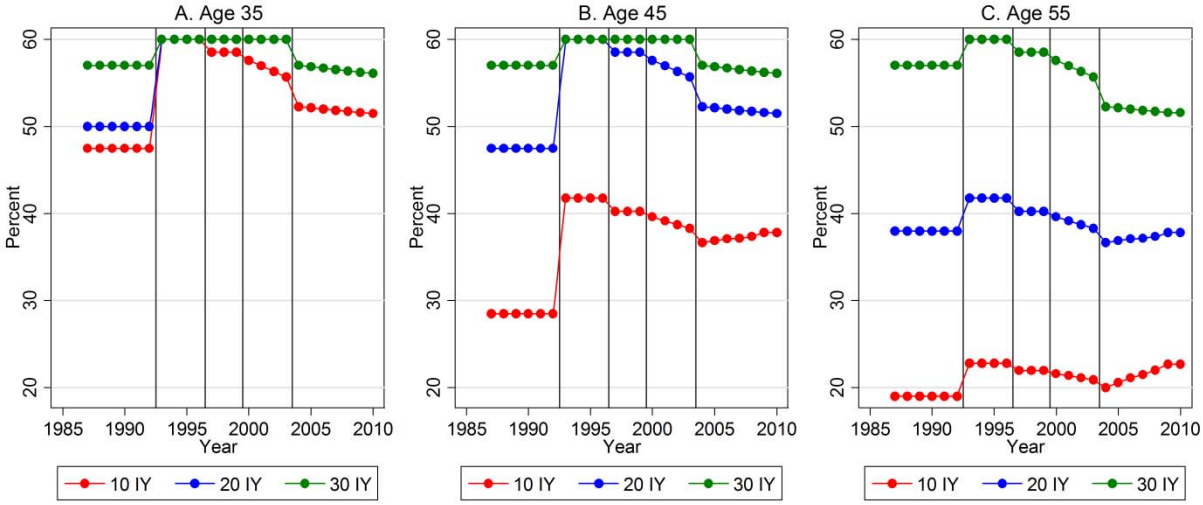
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Figure 1: Impact of Reforms on Assessment Basis



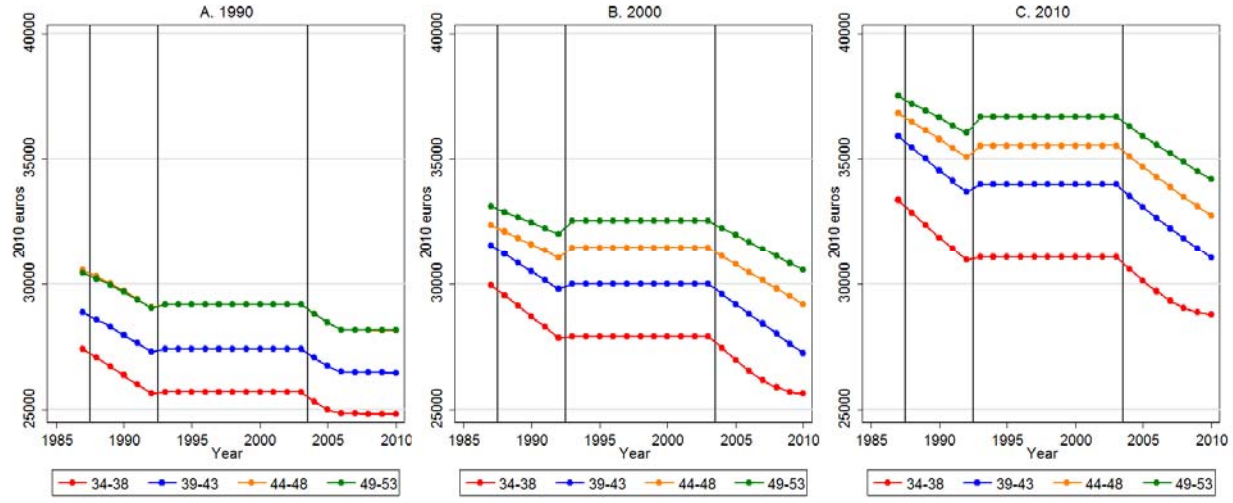
Source: Own calculations

Figure 2: Impact of Reforms on Pension Coefficient



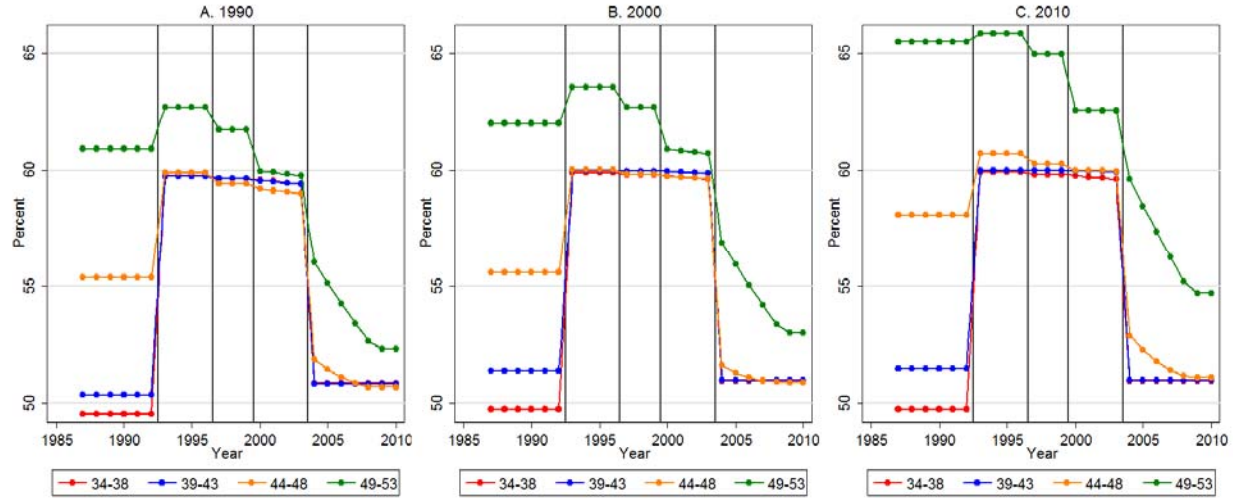
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Figure 3: Assessment basis over time by age group and observation year



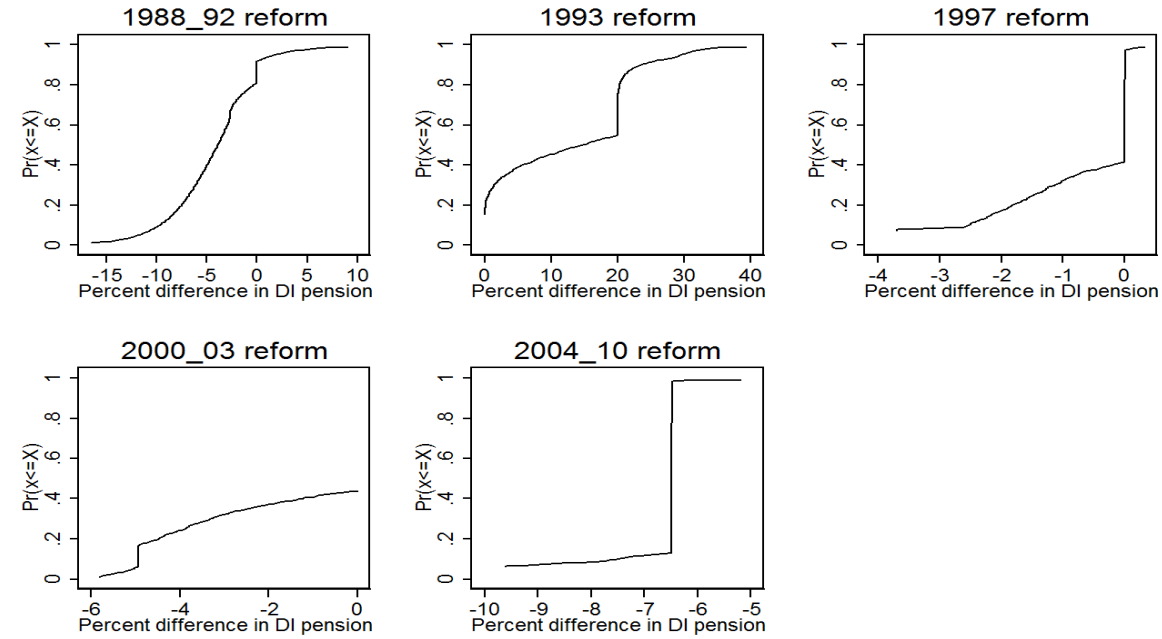
Source: Own calculations, based on Austrian Social Security Data.

Figure 4: Pension coefficient over time by age group and observation year



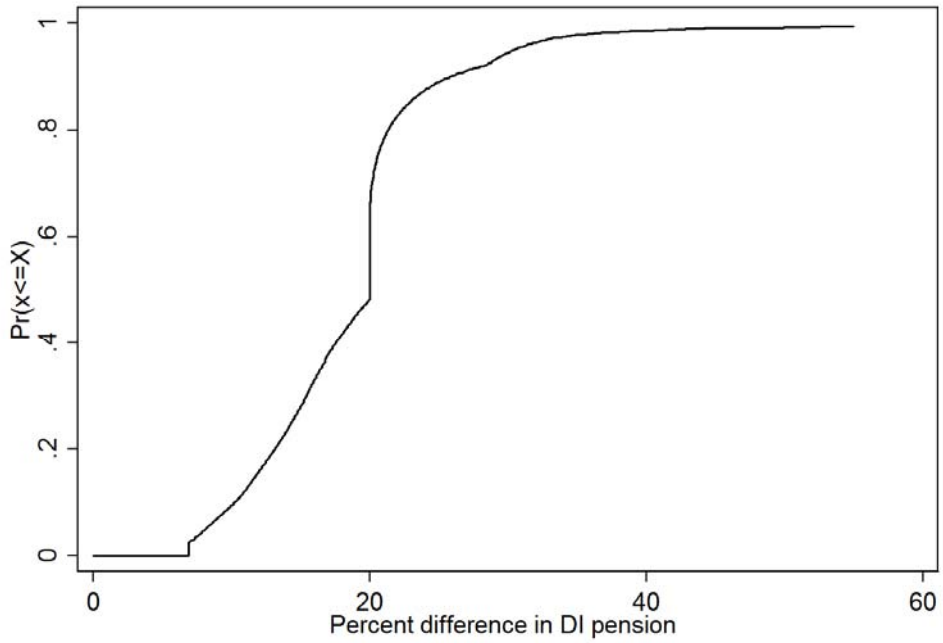
Source: Own calculations, based on Austrian Social Security Data.

Figure 5: Cumulative Distribution Functions of % Change in DI Pension



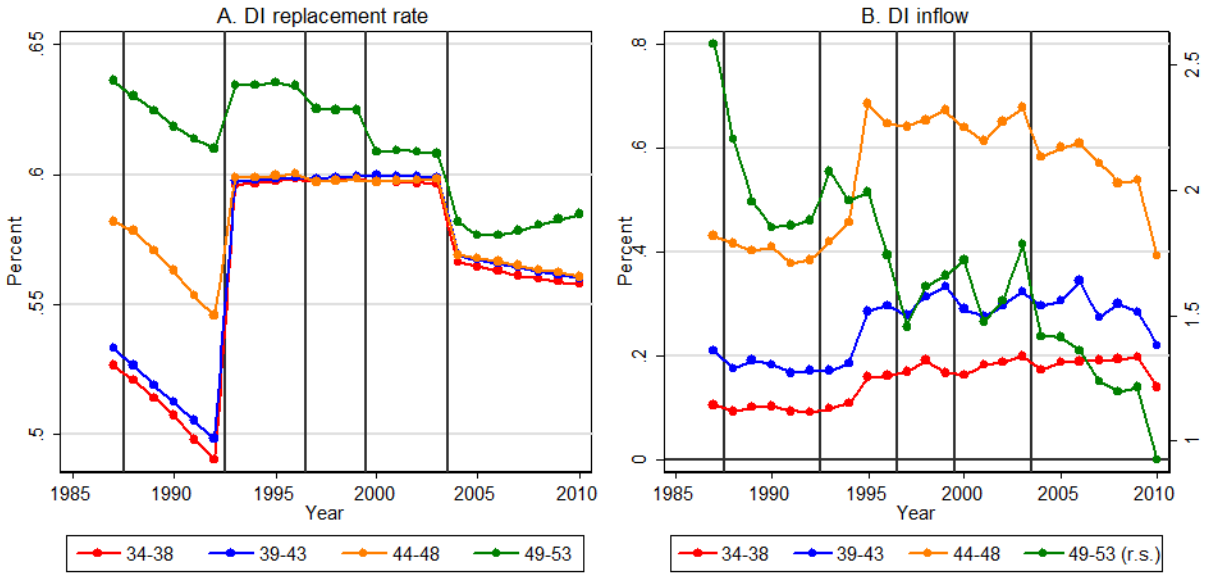
Note: Calculations based on 1993 cohort.

Figure 6: Cumulative Distribution Functions of Maximum % Change in DI Pension



Note: Calculations based on 1993 cohort.

Figure 7: DI replacement rate and DI inflow rate in different age groups



Source: Own calculations, based on Austrian Social Security Data.

Table 1. Summary Statistics

	All	1987-1992	1993-1996	1997-1999	2000-2003	2004-2010	UI Spells
Age	45.3	45.8	45.5	45.3	44.9	45.1	45.0
% unemployed	10.3	9.5	11.7	12.0	10.3	9.5	n/a
% blue collar	53.9	56.1	54.5	53.6	53.6	52.4	80.5
% positive sick leave days last 2 years	13.3	12.7	14.3	13.9	12.7	13.2	40.3
Sick leave days past 2 years (if > 0)	51.3	47.3	53.1	56.7	62.2	45.2	57.8
Experience last 15 years	13.1	13.5	13.0	12.9	12.9	13.1	10.9
Insurance years	28.4	28.0	28.0	28.3	28.3	29.0	26.1
Last wage	33,364	30,310	31,516	32,505	33,741	36,398	23,324
Avg. wage best 15 years	30,894	27,834	29,425	30,438	31,381	33,537	25,926
Disability benefits	18,467	16,214	18,338	18,949	19,245	19,423	15,080
DI infow from employment (in %)	0.894	1.352	1.349	1.06	0.844	0.32	n/a
DI inflow from unemployment (in %)	4.631	3.694	5.21	4.816	5.255	4.458	3.3
No. of observations	16,199,158	3,507,613	2,550,646	2,026,008	2,806,316	5,308,575	1,230,029
No. of individuals	1,548,093	762,470	758,828	764,959	845,650	990,452	591,440

Note: All monetary amounts are in 2010 Euros.

Table 2. Summary of Austrian Disability Pension Regimes

Regime	Pension Coefficient (%)	Assessment Basis	Other
Prior to 1988	Baseline PC: 1.9*min(IY,30) +1.5*max(IY-30,0) up to maximum PC of 80	Last 10 years of earnings	Relaxed screening at age 55
	"Special increment": If PC<50 and AGE<50, then add (50-AGE) to IY up to maximum PC of 50		ERA: 60/55 for men/women FRA: 65/60 for men/women
1988-Jun 1993	No change	Phased in change to last 15 years of earnings	
Jul 1993-Aug 1996	Changed special increment: If PC<60 and AGE<57, then add (57-AGE) to IY up to maximum PC of 60	Changed from last 15 years to best 15 years of earnings	Introduced bonus for claiming DI/OA pension after ERA: ~2.1 % per year
Sep 1996-1999	Changed baseline PC: 1.83*min(IY,30) +1.675*max(IY-30,0) up to maximum PC of 80	No change	Changed age of relaxed screening to 57 for men
	Introduced ~0.09% penalty for claiming before ERA if PC>60		Increased bonus for claiming DI/OA pension after ERA: ~3.8 % per year
2000-2003	Phased in new baseline PC for DI pensions only: (1.8-.02*(YR-2000))*IY	No change	Changed age of relaxed screening to 57 for women
	If baseline PC>60 then PC=2*IY and apply penalty for early claiming up to maximum of 10.5 %-pts or 15% of pension		Split DI and OA formulas Phased in increase in ERA to 61.5/56.5 for men/women
2004-2010	Phased in new baseline PC: (1.96-.04*(YR-2004))*IY	Phased in change to best 40 years of earnings (-2028)	Phased in increase in ERA to 62/60 for men/women (-2017)
	Apply penalty for early claiming: 4.2 %-pts per year up to 15% maximum; backlash limited loss to 5-6.5% of projected 2004 pension from 2000 reform		Returned to same formula for OA and DI pensions
	Phased in new age of special increment 57 to 60		

Notes: PC="pension coefficient," IY="insurance years," ERA="early retirement age," FRA="full retirement age," DI="disability insurance," OA="old age." For completeness we include differences in rules for men vs. women even though empirically our analysis only focuses on men.

Table 3. Cross-Sectional Regressions by Year, 1987-2010

			Base controls			Saturated controls		
Year	No. obs.	DI inflow rate	Coeff. on log benefits	Std. error	R^2	Coeff. on log ben.	Std. error	R^2
1987	575,268	0.022	0.0181***	(0.00116)	0.057	0.0145***	(0.00308)	0.076
1988	573,481	0.018	0.0114***	(0.00110)	0.046	0.00840***	(0.00296)	0.064
1989	573,739	0.017	0.0151***	(0.00109)	0.045	0.0161***	(0.00297)	0.065
1990	581,386	0.017	0.0141***	(0.00108)	0.048	0.00719**	(0.00294)	0.070
1991	595,221	0.017	0.0179***	(0.00102)	0.047	0.00477*	(0.00273)	0.069
1992	608,518	0.018	0.0227***	(0.00103)	0.053	0.00848***	(0.00269)	0.073
1993	621,477	0.018	0.0272***	(0.00106)	0.052	0.0133***	(0.00277)	0.074
1994	632,256	0.020	0.0287***	(0.00113)	0.059	0.0161***	(0.00291)	0.083
1995	643,841	0.023	0.0389***	(0.00125)	0.067	0.0234***	(0.00318)	0.093
1996	653,072	0.023	0.0555***	(0.00166)	0.068	0.0275***	(0.00365)	0.092
1997	661,705	0.016	0.0346***	(0.00142)	0.045	0.0245***	(0.00312)	0.064
1998	677,644	0.018	0.0372***	(0.00149)	0.054	0.0268***	(0.00332)	0.079
1999	686,659	0.020	0.0476***	(0.00159)	0.073	0.0390***	(0.00362)	0.102
2000	692,726	0.022	0.0641***	(0.00164)	0.086	0.0690***	(0.00382)	0.118
2001	695,774	0.013	0.0199***	(0.00132)	0.031	0.0189***	(0.00305)	0.056
2002	704,258	0.013	0.0174***	(0.00136)	0.035	0.0153***	(0.00325)	0.065
2003	713,558	0.016	0.0169***	(0.00151)	0.049	0.0244***	(0.00366)	0.084
2004	717,333	0.013	0.00698***	(0.00138)	0.040	0.0161***	(0.00349)	0.070
2005	733,995	0.012	-0.00842***	(0.00137)	0.037	0.0169***	(0.00361)	0.077
2006	749,393	0.013	-0.0179***	(0.00141)	0.036	-0.00208	(0.00394)	0.078
2007	761,833	0.012	-0.0216***	(0.00139)	0.035	-0.0163***	(0.00413)	0.075
2008	775,437	0.012	-0.0178***	(0.00142)	0.031	-0.00564	(0.00465)	0.072
2009	782,355	0.012	-0.000665	(0.00145)	0.030	0.0122**	(0.00517)	0.069
2010	788,229	0.009	0.00734***	(0.00130)	0.024	0.0168***	(0.00516)	0.052

Note: Base controls include age dummies, 2-year insurance year group dummies and assessment basis. Saturated controls include base controls plus dummies for tenure (in 2-year groups), any sick leave, more than a week of sick leave or more than a month of sick leave in last two years, UI benefit duration, industry, region (of firm), blue collar status and Austrian national status, and 4th order polynomials in last year's wage and average wage best 15 years. *** p<0.01, ** p<0.05, * p<0.1

Table 4. Pooled Regressions, 1987-2010

	Base controls	Saturated controls	Full model
Log benefit	0.0198***	0.0243***	0.0323***
	(0.000233)	(0.000460)	(0.000637)
Hypothetical log benefit 1987			-0.0567***
			(0.00851)
Hypothetical log benefit 1988			0.0431**
			(0.0187)
Hypothetical log benefit 1989			-0.0323
			(0.0231)
Hypothetical log benefit 1990			0.0584**
			(0.0261)
Hypothetical log benefit 1991			-0.127***
			(0.0261)
Hypothetical log benefit 1992			0.120***
			(0.0134)
Hypothetical log benefit 1993-1996			-0.0509***
			(0.00816)
Hypothetical log benefit 1997-1999			0.0157
			(0.0108)
Hypothetical log benefit 2000			-0.0555
			(0.0478)
Hypothetical log benefit 2001			-0.0192
			(0.0977)
Hypothetical log benefit 2002			-0.162*
			(0.0909)
Hypothetical log benefit 2003			0.0999**
			(0.0426)
Hypothetical log benefit 2004			0.157***
			(0.0150)
Hypothetical log benefit 2005			0.460***
			(0.0469)
Hypothetical log benefit 2006			-0.582***
			(0.121)
Hypothetical log benefit 2007			0.780***
			(0.212)
Hypothetical log benefit 2008			-0.427***
			(0.163)
Hypothetical log benefit 2009			-0.867***
			(0.193)
Hypothetical log benefit 2010			0.596***
			(0.147)
F-test			140.9
Prob > F			0.000
Observations	16,199,158	16,199,158	16,199,158
R-squared	0.044	0.072	0.072

See text for definitions of base and saturated controls. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5. Heterogeneity

	No. obs.	Coeff. on log benefits	Std. error	F-test	Prob > F	R^2
Age 35-39	4,149,741	0.00524***	(0.00110)	10.99	0.000	0.015
Age 40-44	3,779,899	0.00582***	(0.00103)	12.10	0.000	0.021
Age 45-49	3,419,217	0.0180***	(0.000987)	13.39	0.000	0.031
Age 50-54	2,893,098	0.0313***	(0.00228)	12.85	0.000	0.067
Age 55-59	1,957,203	0.0492***	(0.00807)	17.12	0.000	0.085
White collar	7,466,445	0.0229***	(0.000726)	25.36	0.000	0.056
Blue collar	8,732,713	0.0359***	(0.00101)	86.80	0.000	0.086
Lifetime earnings Q1	4,050,101	0.0457***	(0.00140)	118.6	0.000	0.066
Lifetime earnings Q2	4,049,822	0.0255***	(0.00142)	48.49	0.000	0.083
Lifetime earnings Q3	4,049,228	0.0356***	(0.00139)	73.30	0.000	0.073
Lifetime earnings Q4	4,050,007	0.0279***	(0.00108)	16.13	0.000	0.089
Single	3,075,168	0.0193***	(0.00171)	24.36	0.000	0.065
Married	5,943,705	0.00468***	(0.00114)	26.23	0.000	0.059
UI: DI entry	1,230,029	0.139***	(0.00328)	116.8	0.000	0.119

See text for definitions of base and saturated controls. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1