The Impact of the Substantial Gainful Activity Cap on Disability Insurance Recipients' Labor Supply[1]

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Abstract

Disability Insurance (DI) beneficiaries in many countries lose benefits if their earnings exceed a specified cap. An earnings cap generates a discontinuous increase in tax liability—a notch—and creates an incentive to keep earnings below the threshold. Exploiting such a notch in Austria, we provide transparent and credible identification of the effect of financial incentives on DI beneficiaries' earnings. Using rich administrative data, we document large and sharp bunching at the earnings cap. However, the elasticity driving these responses is modest. Our estimates suggest that abolishing the cap would increase the labor supply of beneficiaries and reduce fiscal costs.

Keywords: Disability insurance, labor supply, benefit notch, bunching

JEL Classification Numbers: H53, H55, J14, J21

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1. Introduction

Disability Insurance (DI) programs are among the largest social insurance programs. In OECD countries, total expenditures on disability benefits account for approximately 2.5% of GDP on average (OECD, 2010). DI programs are designed to provide income replacement in the case of a permanent loss of earnings capacity due to poor or deteriorating health, but there have been concerns that DI discourages work. A work disincentive that exists in many DI programs is the policy that beneficiaries lose part or all of their benefits if earnings exceed a substantial gainful activity (SGA) amount. The loss of benefits at the SGA cap – often called the "cash cliff" – induces a high implicit tax on work and creates an incentive for beneficiaries to keep their earnings below the SGA level in order to retain benefits.

If "parking" just below the SGA cap is widespread, then policies to encourage work could increase earnings among DI beneficiaries, potentially improving their economic well-being and their autonomy while reducing the dependency on benefits.[2] Yet, these policies could also create unintended costs if more generous earnings rules induce more individuals to apply for and ultimately receive disability benefits. If, instead, few beneficiaries respond to the SGA cap by reducing their earnings, then efforts to lower the implicit tax on work are likely to have small impacts on earnings and benefits, and program entry is likely not very responsive to financial incentives. Despite numerous anecdotes of beneficiaries intentionally keeping their earnings just below the SGA cap, there is very little empirical evidence on the impact of the SGA cap, and financial incentives in general, on earnings of beneficiaries.[3]

This paper helps to fill this gap by investigating whether the SGA cap induces DI recipients to adjust their earnings and by examining how elastic their earnings are to changes in financial incentives. Our approach exploits quasi-experimental variation in the implicit tax on work in the DI program in Austria. Specifically, DI beneficiaries in Austria can earn up to a SGA cap of 440 Euros per month (around \$500 using an exchange rate of \$1.12 per Euro) without

[2] Many countries are considering or have recently implemented policy reforms designed to increase work incentives for DI recipients. For example, the U.S. is currently testing a benefit offset policy that reduces benefits by \$1 for every \$2 of earnings above the SGA cap, rather than fully suspend benefits. Switzerland tested a conditional cash program that offered DI recipients a cash payment if they take up or expand employment and reduce disability benefits (see Bütler et al., 2014, for an evaluation of the program). Other recent examples include the United Kingdom and Norway (see Kostol and Mogstad, 2014).
[3] See, e.g., the article "Disability Insurance: Not Working" in the magazine *the Economist* (issue from January 24, 2015), which provides anecdotal evidence for such behavior in the U.S. Social Security Disability Insurance.

losing benefits. If monthly earnings exceed the SGA cap by one Euro, then DI benefits are reduced by up to 50% in that month. These rules generate a discontinuous increase in the (implicit) tax liability – a notch – at the SGA cap and therefore create a strong incentive for many DI beneficiaries to "bunch" on the low-earnings side of the SGA cap.[4]

As shown by Saez (2010), the amount of bunching can be used to estimate the elasticity of earnings with respect to the net-of-tax rate.

The earnings response to financial incentives might be attenuated by frictions such as adjustment costs or inattention. One advantage of our notch design as opposed to a kink design (see, e.g., Saez, 2010; Chetty et al., 2011; Gelber et al., 2013) is the ability to estimate such frictions. The reason is that a notch creates a region of strictly dominated choices on the high-earnings side of the SGA cap where beneficiaries can increase both total net income and leisure by moving below the SGA cap. In the absence of frictions no individual should locate in the dominated region and we can therefore use the observed density mass in this region to estimate the magnitude of attenuation bias from frictions.

The SGA notch in Austria is an appealing context for studying earnings adjustment to financial incentives for at least three reasons. First, the increase in tax liability at the SGA cap is large in magnitude and very salient to DI beneficiaries. The average DI beneficiary loses around 8.5% of his or her total net income if earnings exceed the SGA cap by one Euro. The large variation in tax liability facilitates the identification of behavioral responses to financial incentives even if they are small.[5] Second, bunching below the SGA cap is often difficult to detect in administrative data, because earnings are typically measured at the annual level while

[4] Recent studies relying on notches in the budget set examine such diverse topics as earnings adjustments to income and payroll taxes (Kleven and Waseem, 2013ö Tazhitdinova, 2015), automaker responses to fuel economy regulations (Sallee and Slemrod, 2012ö Ito and Sallee, 2014]), the impact of transfer taxes on the real estate market (Best and Kleven, 2014; Kopczuk and Munroe, 2014), the effect of tax credits on retirement savings and income (Ramnath, 2013), the labor supply effects of social security (Manoli and Weber, 2011), and firm responses to stricter tax enforcement (Almunia and Lopez Rodriguez, 2014). Our paper contributes to this literature by studying behavioral responses at a notch in the disability benefit schedule.

[5] Detecting behavioral responses would be more difficult in the U.S. DI program because the earnings rules are more complex and therefore less salient. More specifically, DI beneficiaries in the U.S. can earn above SGA for nine months (not necessarily consecutive) over any five-year period. After exhausting the nine months period, beneficiaries enter the extended period of eligibility (EPE). If earnings are above the SGA cap during the EPE, benefits are paid for three additional months, but are suspended in full thereafter during each month that beneficiaries earn above SGA. If earnings are above the SGA three years after entering the EPE, benefits are terminated. Chetty et al., (2009) provide evidence that individuals are not as responsive to less salient policies compared to more salient policies.

the SGA cap is specified at the monthly level. Hence, recipients who bunch at the SGA cap only for some months of the year would not appear to bunch in annual data. We rely on very detailed administrative data from social security and tax registers, allowing us to precisely measure earnings and DI benefits at the monthly level. Third, the amount of bunching at the SGA notch is easily visible in a figure, providing transparent evidence of a behavioral response (or the absence of it).

The insights from our empirical analysis can be summarized by four broad conclusions. First, the earnings distribution of DI beneficiaries exhibits large and sharp excess bunching just below the SGA cap. This suggests that the SGA notch reduces earnings significantly. We estimate that DI beneficiaries who earn just below the SGA cap would increase monthly earnings by up to 342 Euros if the notch at the SGA cap did not exist. This represents a 85% increase relative to the SGA earnings level. Bunching is very persistent over time; almost 60% of those who bunch have done so for at least five years in a row. Second, observed bunching responses are strongly attenuated by frictions. About 55% of beneficiaries in the dominated range are unresponsive to the SGA cap, implying that bunching would be about twice as large without frictions compared to observed bunching. Even though the estimated bunching responses are large, the implied earnings elasticities are quite modest. We find that the earnings elasticity taking into account adjustment frictions is 0.172. Third, there is significant heterogeneity in the earnings response to financial incentives. Specifically, we find that women and younger age groups are more responsive to financial incentives compared to men and older age groups. Fourth, from a policy perspective we find that an abolition of the SGA earnings cap would reduce annual net government expenditures by about 15%. While this estimate does not take into account that such a reform could increase the number of individuals seeking benefits, we show that to overturn this result the elasticity of DI inflow to changes in program generosity would need to be far larger than those reported in previous studies.

To assess the generalizability of our results, we complement our empirical analysis by comparing the estimates of the work capacity of DI beneficiaries in Austria and the U.S. We follow the approach suggested by Bound (1989) who uses the labor force participation rate of rejected DI applicants as an estimate of the labor force participation rate of DI beneficiaries had they not received benefits. Applying this approach to Austria, we obtain estimates that are similar to the OLS estimates reported in Maestas et al. (2013) for the U.S. The similarity of the labor supply estimates suggests that the work capacity of DI recipients in Austria is comparable to that of DI recipients in the U.S. Nevertheless, caution applies when extending our findings to other countries. Our estimation approach exploits variation in earnings of beneficiaries located around the SGA cap. In countries with a different SGA cap than in Austria characteristics of beneficiaries around the SGA cap may differ, which could result in a different elasticity estimate.

Our paper is primarily related to the literature that studies the effects of policy reforms designed to increase work incentives for DI beneficiaries. Hoynes and Moffitt (1999) simulate the financial impacts of a number of potential reforms and conclude that the effects on work effort of some of the reforms are not as strong as expected. Consistent with this view, Schimmel et al. (2011) find that a small increase in the monthly SGA earnings level from $500 to $700 in the U.S. had only a modest impact on earnings of DI beneficiaries. However, more recent evidence suggests that some policies appear to be quite effective in increasing employment. Campolieti and Riddell (2012) find that the introduction of a large earnings disregard of $3,800 per year in Canada lead to a significant increase in disability beneficiaries' propensity to work, but did not have an effect on program inflow or outflow. Weathers and Hemmeter (2011) and Kostol and Mogstad (2014) find that replacing the "cash-cliff" with a gradual reduction in benefits leads to a significant increase in work effort of DI beneficiaries. Our contribution is to provide first empirical evidence of bunching at the SGA earnings cap – a work disincentive that is present in many DI programs – and to document the dynamics of earnings adjustment over time.

Our paper is also related to the literature on the work potential of disability beneficiaries. These studies typically use rejected applicants as a control group to estimate the extent to which DI benefits distort work effort (e.g., Bound, 1989; Chen and van der Klaauw, 2008; von Wachter et al., 2011; Maestas et al., 2013; French and Song, 2014). They therefore provide a good estimate for the employment potential of beneficiaries at the time of applying. Yet, there is much less evidence on the employment potential of beneficiaries who have been on the program for some time. This literature also focuses primarily on the impact of the DI program on labor force participation, while ignoring responses along the intensive margin, which is the focus of this paper.

This paper proceeds as follows. Section 2 describes Austria's DI program. Section 3 outlines the bunching methodology, summarizes the data, and presents descriptive statistics.

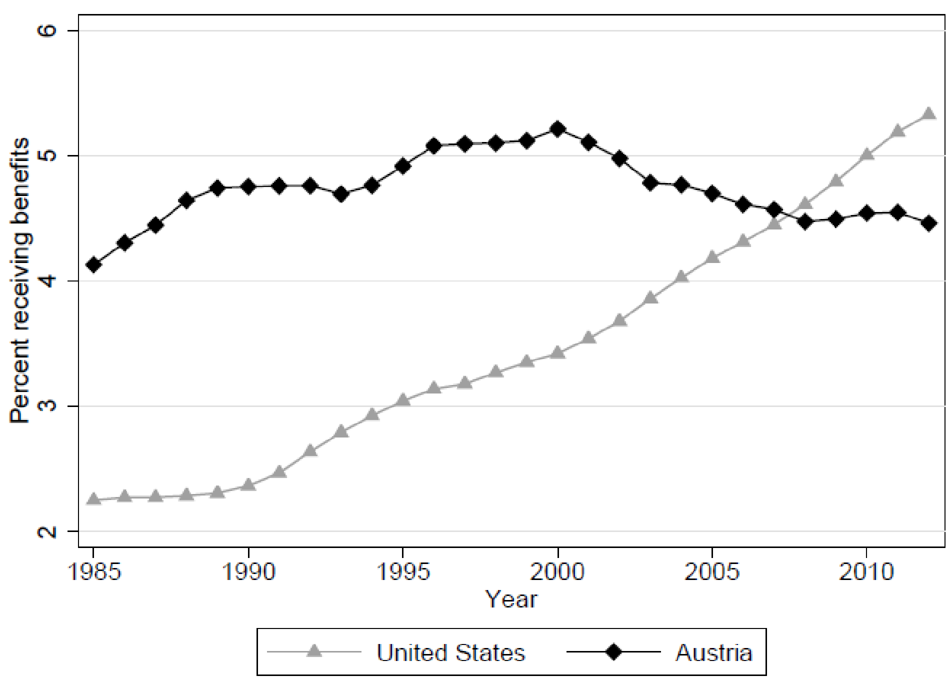
Section 4 shows descriptive evidence for excess bunching at the SGA cap and presents our estimates for the earnings elasticities. Section 5 studies the fiscal and policy implications of an abolition of the SGA cap and Section 6 concludes.

2. Institutional Background

2.1. The Austrian DI Program

The Austrian DI program is part of the larger Social Security system that is financed by a payroll tax on earned income. The program provides partial earnings replacement to workers below the full retirement age who are unable to engage in substantial gainful activity because of a medically determinable health impairment that has lasted for at least six months. As Figure 1 shows, the percentage of the working age population receiving DI benefits in Austria has been relatively constant at 4.3% to 5.2% from 1985 to 2012, while the rate of DI receipt in the U.S. increased from 2.2% to 5.3% over the same time period.

Figure 1: Disability Insurance Recipiency per Adult Ages 25-64



Source for Austria: STATISTIK AUSTRIA population data; statistical supplement published by "Hauptverband der österreichischen Sozialversicherungsträger". Source for the United States: Social Security Bulletin: Annual Statistical Supplement; Bureau of the Census, Census Population Estimates, available at http://www.census.gov/popest/estimates.html.

To apply for DI benefits, an individual must submit an application to the DI office in their state of residence (there are nine states in Austria). Employees at the DI office first check the non-medical eligibility criteria for DI benefits. Only individuals who have contributed to the program for at least 5 years in the past 10 years and are not yet eligible for retirement benefits can apply for DI benefits. Unlike the U.S., DI eligibility in Austria is not conditioned on earnings, so individuals can continue to work while they apply for and receive benefits. If an applicant meets the nonmedical criteria, a team of disability examiners and physicians assesses the applicant's overall ability to work and the medical severity of the applicant's disability. A disability award is made if the medical examination finds that a medically determinable impairment causes more than 50% of a reduction in ability to work relative to that of a healthy person with comparable education.[6] If the health impairment is expected to be temporary, DI benefits are granted for a limited time period of typically two years. DI benefits are awarded for an indefinite time period in case of permanent health impairments. Applicants who disagree with the decision of the DI office can appeal within three months.

Once DI benefits are awarded, there are three main pathways out of the program. First, DI claimants may no longer meet the medical or non-medical eligibility criteria for disability benefits. For example, the health status may improve such that the DI recipient is no longer disabled. In 2012, medical improvements and return to work accounted for 88.4% of program exits. Second, DI claimants may reach the full retirement age, at which point they can ask to be transferred to the old-age pension program. However, few beneficiaries do so because in most cases the corresponding old-age pension would be lower than the disability pension. In 2012, 8.7% of those who left the DI program were shifted to the old-age pension program. Third, the DI recipient may die. Death accounted for 2.9% of program exits in 2012. In 2012, the DI exit rate stood at 1.6% which is around four times smaller than the exit rate in the U.S. Social Security Disability Insurance (Moore, 2014).

DI benefits are fairly generous and replace about 60% of pre-disability earnings up to a maximum of approximately 2,800 Euros per month (around $3,150). Benefits are subject to income tax and mandatory health insurance contributions. For comparison, the median replacement rate in the U.S. DI program is about 50% (Muller, 2008). The level of benefits

[6] Medical criteria for disability classification are relaxed starting at age 57. See Staubli (2011) for the impact of this relaxation on labor force participation of older workers.

depends on an assessment basis and a pension coefficient. The assessment basis corresponds to the average earnings over the best 20 years after applying a cap to earnings in each year. The pension coefficient is the percentage of the assessment basis that is received in the pension. The pension coefficient increases with the number of contribution years up to a maximum of 80% (roughly 45 contribution years). Applicants under age 60 qualify for a special increment if their pension coefficient is below 60%.

2.2. The Substantial Gainful Activity Cap

Like in the United States and other countries, DI beneficiaries in Austria can earn up to a Substantial Gainful Activity (SGA) cap without losing any benefits. All earnings are subject to regular income tax. In 2012, the monthly SGA cap in Austria was 439 Euros (around $500), which is about half of the SGA cap for non-blind DI recipients in the U.S. ($1,010 in 2012). However, DI recipients lose a fraction of their benefits in each month in which earnings exceed the SGA cap. The loss in benefits if a beneficiary earns above the SGA cap in a given month depends on the sum of benefits and earnings in that month and is calculated as follows:

$$\triangle s = \begin{cases} 0 & \text{if } s + z \leq K_1 \\ 0.3(s + z - K_1) & \text{if } K_1 < s + z \leq K_2 \\ 0.3(K_2 - K_1) + 0.4(s + z - K_2) & \text{if } K_2 < s + z \leq K_3 \\ 0.3(K_2 - K_1) + 0.4(K_3 - K_2) + 0.5(s + z - K_3) & \text{if } s + z > K_3, \end{cases} \tag{1}$$

where *s* denotes monthly before-tax DI benefits and z are monthly before-tax earnings. The values K_1, K_2, and K_3 are adjusted each year to account for inflation; in 2012 the corresponding values were 1,258, 1,887, and 2,515 Euros. Equation (1) illustrates that the reduction in benefits Δs increasing in *s* and *z*. However, the maximum reduction is capped at 50% of the full DI benefits; thus DI recipients are always allowed to keep 0.5*s* independent of how much they earn. The SGA cap coincides with the earnings threshold above which workers are automatically insured by the public pension system. DI recipients with earnings above the SGA cap are therefore required to pay social security contributions on *all* earnings. The social security tax is 18% for workers and 21% for employers. The social security contributions are credited towards an old-age pension.

Together, these rules change the implicit tax on work at the SGA threshold in two ways. First, there is a discrete jump in the overall tax liability – a notch – because beneficiaries lose a fraction of their benefits and their earnings on the first Euro of earnings above the SGA cap. The average beneficiary loses about 100 Euros, or 8.5% of total after-tax income, of which 70% are due to the benefit loss and 30% are due to social security contributions. Second, there is a discrete change in the implicit marginal tax – a kink – because for each Euro of earnings above the SGA cap beneficiaries lose between 30-50 cents in benefits, as illustrated in equation (1), and they have to pay 18 cents in social security taxes.

Both the notch and the kink create a strong incentive for DI recipients to bunch just below the SGA cap in order to avoid the high implicit tax on work and retain their full benefits. In the next section, we will describe our methodology how we combine the amount of bunching with the change in the implicit tax at the SGA cap to estimate an elasticity of earnings with respect to the implicit net-of-tax rate.

3. Methodology and Data

3.1. Theoretical Framework

Identification of behavioral responses from kinks and notches has gained a lot of interest in the economics literature that attempts to estimate income elasticities of taxpayers (Saez, 2010; Chetty et al., 2011; Kleven and Waseem, 2013). Our bunching approach follows Kleven and Waseem (2013) and Tazhitdinova (2015) with the difference that we focus on a notch in disability insurance and not in the income tax schedule. The approach relies on the fact that kinks and notches create excess mass on the low-earnings side of the cut-off. The notch also creates a region of strictly dominated choices on the high-earnings side of the cut-off in which DI recipients can increase both total income and leisure by moving to the notch.[7] In the absence of optimization frictions, the earnings distribution should feature a hole in the dominated range for any preferences. The amount of excess and missing mass can is directly proportional to the long-run earnings elasticity with respect to the net-of-tax rate.

To fix ideas, suppose that individual preferences are described by a quasi-linear and iso-elastic utility function of the form

[7] The width of the dominated range z^D is defined such that the earnings level $z^* + z^D$ ensures the same after-tax income as the notch point z^*.

$$u(z) = z - T(s,z) - \frac{n}{1+1/e}\left(\frac{z}{n}\right)^{1+1/e} \tag{2}$$

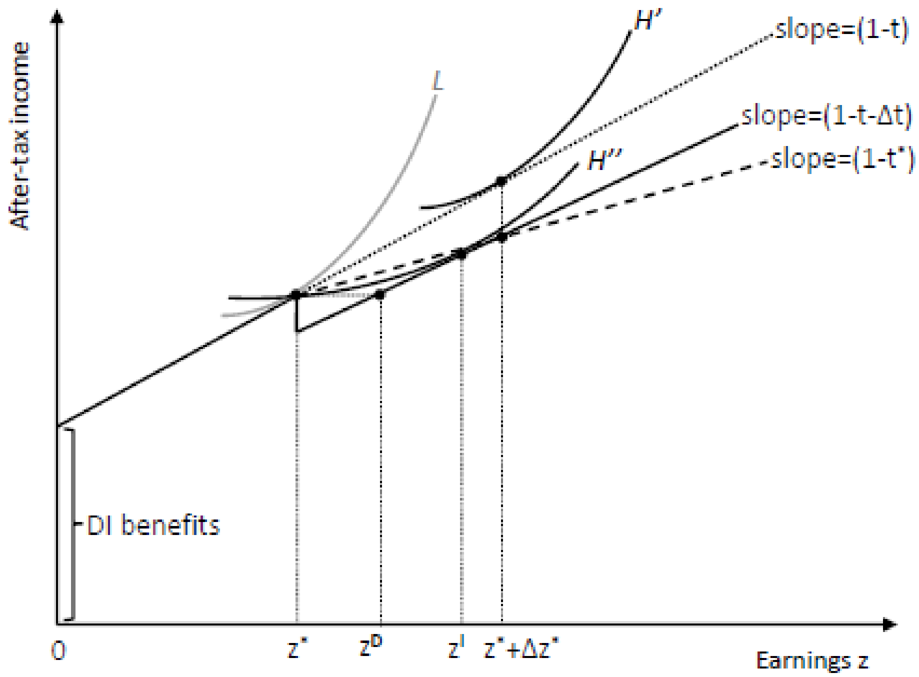
where *T(s,z)* is the tax liability, n is an ability parameter, and e is the elasticity of earnings with respect to the marginal net-of-tax rate 1-t . This specification rules out income effects and below we also present a reduced-form approach, which does not rely on the assumption of no income effects. In the case of a linear tax system *T(s,z)=-s+t·(s+z)* , maximization of (2) with respect to earnings yields

$$z = n(1-t)^e. \tag{3}$$

With zero tax rates, we have z=n and n can therefore be interpreted as potential earnings. Positive tax rates reduce z below n where the elasticity e determines the magnitude of the reduction. Consider a smooth distribution of ability captured by a density function *f(n)* and a cumulative distribution function *F(n)*. Provided that the tax system is linear, the smooth ability distribution translates into a smooth earnings distribution. More specifically, let $H_0(z)$ and $h_0(z)$ be the cumulative distribution and density functions of earnings when the tax system is linear. Equation (3) implies that $H_0(z) = F\left(\frac{z}{(1-t)^e}\right)$ and therefore $h_0(z) = H_0'(z)f\left(\frac{z}{(1-t)^e}\right)/(1-t)^e$.

Suppose that a notch is introduced at an earnings threshold z^*, defined as a discrete change in the average implicit tax rate on earnings. The tax schedule with the notch can be written as $T(s,z) = -s + t \cdot (s+z) + [\Delta t \cdot (s+z) \cdot \mathbf{1}(z > z^*)$ where Δt is the change in the average implicit tax rate at the notch and $\mathbf{1}(z > z^*)$ is an indicator for being above the notch. In our application the notch is generated by two forces: (i) DI recipients lose part of their DI benefits and (ii) DI recipients start paying social security payroll taxes on all earnings. As Figure 2 shows, the introduction of the notch in the budget set induces all DI recipients who had earnings in an interval $(z^*, z^* + \Delta z^*)$ before the introduction of the notch to instead "bunch" at z^*. The width of the bunching segment Δz^* is determined by the change in the implicit average tax rate Δt and the elasticity *e*. More specifically, the bunching segment Δz^* will be wider, the greater the change in the average implicit tax rate Δt and the higher the elasticity *e*. Hence, given an estimate of Δz^* and knowing Δt, it is possible to uncover an estimate for *e*. The figure also illustrates that no DI beneficiary is willing to locate between z^* and z^I, implying that the post-notch earnings density distribution should feature a hole.

Figure 2: Budget sets and preferences



Notes: The figure shows after-tax monthly income as a function of monthly gross earnings; z^* denotes the SGA cap; z^D denotes the earnings level at which the after-tax income is equal to the after-tax income at the SGA cap.

We use the amount of bunching at the SGA cap to estimate the earnings response Δz^*. Denoting excess bunching at the notch by B, we can write

$$B = \int_{z^*}^{z^*+\Delta z^*} h_0(z)dz \approx \Delta z^* h_0(z^*). \quad (4)$$

Equation (4) implies that the earnings response can be estimated as $\Delta z^* = \frac{B}{h_0}$. We describe in the next section our approach to estimate excess bunching B and the counterfactual earnings density $h_0(z)$. The amount of bunching in equation (4) may be attenuated if individuals face optimization frictions such as adjustment costs and inattention. If responding to the notch is associated with adjustment costs, only those DI recipients will adjust whose gain from moving to the notch exceeds adjustment costs. Assume that there is a fixed fraction of DI recipients with sufficiently high adjustment costs that they are unresponsive to the notch. Denoting the fraction of constrained DI recipients by *f*, we can write an expression for excess bunching that accounts for frictions:

$$B = \int_{z^*}^{z^*+\Delta z_s^*} (1-f)h_0(z)dz \approx (1-f)\Delta z^* h_0(z^*). \tag{5}$$

Equation (5) shows that with frictions we can distinguish two earnings responses: $(1-f)\Delta z^*$ is the earnings response attenuated by frictions while Δz^* is the (structural) response not affected by frictions. With an estimate for *f* it is possible to separately identify these two responses. More specifically, the structural earnings response can be estimated using $\Delta z^* = \frac{B}{(1-f)h_0(z)}$ where $\frac{1}{(1-f)}$ is a re-scaling factor to account for the fact that only a fraction $(1-f)$ can bunch at the threshold. To estimate the share of constrained individuals *f*, we exploit the fact that notches create a region of strictly dominated choices (z^*, z^D) in which DI recipients can increase both total income and leisure by moving to the notch. In a world without frictions, no DI beneficiary should choose an earnings level in the dominated range and any mass in the dominated range must therefore be the result of frictions. This insight implies that we can estimate frictions as follows

$$f = \int_{z^*}^{z^*+\Delta z^D} h(z)dz \Big/ \int_{z^*}^{z^*+\Delta z^D} h_0(z)dz, \tag{6}$$

where $h(z)$ denotes the observed post-notch earnings density.

To uncover the earnings elasticity *e*, we exploit the fact that the marginal bunching DI beneficiary is indifferent between the SGA cap z^* and the interior point z^I, as shown in Figure 2. The utility level at the SGA cap z^* is given by

$$u(z^*) = (1-t)(s+z^*) - \frac{n^*+\Delta n^*}{1+1/e}\left(\frac{z^*}{n^*+\Delta n^*}\right)^{1+1/e}, \tag{7}$$

where $(n^* + \Delta n^*)$ is the ability level of the marginal DI beneficiary. Since equation (3) implies that $z^I = (n^* + \Delta n^*)(1 - t - \Delta t)^e$, we can write the utility at the interior point z^I as follows

$$u(z^I) = (1 - t - \Delta t)s + \left(\frac{1}{1+e}\right)(1 - t - \Delta t)^{1+e}(n^* + \Delta n^*). \quad (8)$$

Setting $u(z^I) = u(z^*)$ and using the condition $(n^* + \Delta n^*) = \frac{z^*+\Delta z^*}{(1-t)^e}$, we obtain an expression that defines the elasticity e as an implicit function of the percentage change in the average net-of-tax rate and the percentage earnings response:

$$\frac{1}{1+\Delta z^*/z^*}\left(1 + \frac{\Delta t s/z^*}{1-t}\right) - \frac{1}{1+1/e}\left(\frac{1}{1+\Delta z^*/z^*}\right)^{1+1/e} - \frac{1}{1+e}\left(1 - \frac{\Delta t}{1-t}\right)^{1+e} = 0, \quad (9)$$

Equation (9) cannot be solved explicitly for the elasticity e, but provided an estimate of Δz^* and given knowledge of the other parameters it can be solved numerically.

One drawback of the above approach is that it relies on an explicit functional form for utility. To relax this assumption, we also implement a reduced-form approach used by Kleven and Waseem (2013) that does not depend on the structure of the underlying utility. The idea of the approach is to relate the change in earnings to the change in the implicit marginal tax rate between z^* and $z^* + \Delta z^*$ to back out the implied labor supply elasticity. More specifically, the marginal implicit tax rate between z^* and $z^* + \Delta z^*$ is defined as

$$t^* = \frac{T(s, z^* + \Delta z^*) - T(s, z^*)}{\Delta z^*}. \quad (10)$$

The formula effectively treats the discontinuity at the SGA cap as a kink, as shown by the dashed line in Figure 2. The elasticity of earnings with respect to the implicit marginal net-of-tax rate is then defined as

$$e = \frac{\Delta z^*/z^*}{\Delta t^*/(1-t)}. \quad (11)$$

This reduced-form elasticity provides an upper bound for the true elasticity. The intuition why this is true is evident from Figure 2: faced with the kink Δt, the DI beneficiary who is indifferent between z^* and $z^* + \Delta z^*$ under the notched tax schedule would be better off by locating somewhere between z^* and $z^* + \Delta z^*$ instead of bunching at z^*. The earnings response Δz^* therefore overestimates the earnings reponse that would be generated by the kink Δt^*.

3.2. Empirical Implementation

Our goal is to estimate the impact of financial incentives on DI recipients' earnings by exploiting the discontinuity in the budget set at the SGA cap. As shown in the preceding section, to uncover a structural earnings elasticity we need estimates for the counterfactual earnings density $h_0(z)$, excess bunching B, and the share of unresponsive individuals *f*. To estimate the counterfactual earnings density in the absence of the SGA notch, we fit a flexible polynomial to the empirical earnings density, excluding observations in a range $[z^L, z^U]$ around the notch z^*. The excluded range $[z^L, z^U]$ corresponds to the area that is affected by the notch either because of excess bunching or missing mass. We group DI recipients into earnings bins of 10 Euros indexed by *j* and run the following regression:

$$c_j = \sum_{i=0}^{p} \beta_i (z_j)^i + \sum_{k=z^L}^{z^U} \gamma_k \mathbf{1}(z_j = k) + \varepsilon_j, \tag{12}$$

where c_j is the number of individuals in bin *j* , z_j is the earnings level in bin *j*, and *p* is the order of the polynomial. We choose a sixth-order polynomial for our main specification but our results are not very sensitive with respect to the choice of *p*. Because we include indicator variables for each bin in the excluded range, the polynomial is estimated without considering data from the excluded range. An initial estimate for the counterfactual earnings distribution is calculated as the predicted values from equation (12), omitting the contribution of the dummies in the excluded range ($\hat{c}_j = \sum_{i=0}^{p} \hat{\beta}_j (z_j)^i$). Excess mass is the difference between the observed and counterfactual earnings distribution in the range $[z^L, z^*]$, i.e. $\hat{B} = \sum_{j=z^L}^{z^*} (c_j - \hat{c}_j)$. Similarly, missing mass is the difference between the observed and counterfactual earnings distribution in the range $(z^*, z^U]$, i.e. $\widehat{M} = \sum_{j>z^*}^{z^U} (\hat{c}_j - c_j)$.

The estimation of the counterfactual earnings density hinges on a credible identification of the excluded range $[z^L, z^U]$. Following previous literature, we determine the lower bound z^L by visual inspection. This approach is reasonable given that bunching below the SGA cap is very sharp. A similar approach is not feasible for the upper bound z^U because missing mass is fuzzier and cannot be easily determined visually. Instead, we exploit the fact that the missing mass must be equal to the bunching mass. More specifically, we start with a very low upper bound $z^U \approx z^*$ such that the initial estimate of the counterfactual density underestimates (overestimates) missing mass (bunching mass). We then increase the upper bound in small increments and re-estimate equation (12) until we have $\widehat{M} = \widehat{B}$.

The share of individuals in the dominated range (z^*, z^D) who are constrained by frictions is estimated as $\hat{f} = \sum_{j>z^*}^{z^*+z^D} c_j \,/\, \sum_{j>z^*}^{z^*+z^D} \hat{c}_j$. One difficulty is the determination of the dominated range because z^D varies across DI beneficiaries and is increasing in the level of DI benefits. However, since DI recipients have to start paying payroll taxes on all earnings if earnings exceed the SGA cap, there is a minimum dominated range of 90 Euros for all DI beneficiaries. We therefore set $z^D = 90$ in the empirical implementation. This approach is likely to provide a lower bound for frictions. The reason is that the utility gain from moving to the notch decreases with Δz^* and hence the size of the minimum adjustment cost that prevents moving to the notch decreases as well. This mechanism implies that f is increasing over the interval $(z^*, z^* + \Delta z^*)$, provided that the distribution of adjustment costs is smooth. Following Kleven and Waseem (2013), we also apply an alternative approach that provides an upper bound for frictions and the earnings response. More specifically, we use the point of convergence between the observed and counterfactual distribution, captured by z^U, as an estimate for the earnings response Δz^*.

Given estimates for the counterfactual density, excess bunching, and frictions, we can estimate the notch-induced earnings response from equation (5). By plugging the estimate for the earnings response into equation (11), we can uncover the structural elasticity. We calculate standard errors for all estimated parameters using a bootstrap procedure, as in Chetty et al. (2011). We generate a large number of earnings distributions (and associated estimates of each variable) by random resampling with replacement from the population. We define the standard errors of a variable as the standard deviation of the variable's distribution of estimates.

Since notches introduce a discrete jump in tax liability, they may generate labor supply responses along the extensive margin. Our estimation approach is not able to uncover extensive margin responses, but, as discussed in Kleven and Waseem (2013), such responses should not affect the earnings elasticity substantially. The reason this is true is that the approach to estimate bunching and frictions relies on excess mass and missing mass in a narrow range around the SGA cap, whereas extensive responses do not occur locally around the notch. However, the upper bound approach, which uses the point of convergence between the observed and counterfactual distribution, relies on the characteristics of the density distribution over a larger range and might be sensitive to extensive responses.

In the above analysis, we consider a static framework for estimating elasticities and adjustment costs and a natural question is whether the preceding analysis extends to a dynamic setting. One potential concern is that the static approach may overestimate the implicit tax liability above the notch because it ignores that beneficiaries who work above the SGA cap could be compensated for current benefits lost with higher future old-age benefits. However, this dynamic channel is unlikely to be important in our context. Only few beneficiaries are transferred to the old-age pension program because in most cases the corresponding old-age pension would be lower than the disability pension.[8]

3.3. Data and Sample Selection

We combine register data from two different sources. First, the Austrian Social Security Database (ASSD) contains very detailed longitudinal information for all private sector workers in Austria between 1972 and 2012. At the individual level the data include gender, nationality, month and year of birth, blue-collar or white-collar status, and labor market history. Labor market histories are summarized in spells. Specifically, the start and end date of all employment, unemployment, disability, sick leave, and retirement spells are recorded. The data contain several firm-specific variables: geographical location, industry affiliation, and firm identifiers that allow us to link both individuals and firms. Second, we use income tax reports that firms and the social security administration are required to submit to the tax office at the end of each year. These reports contain detailed information on benefits from the various social insurance programs, earnings, social security contributions, and income tax withholdings for the tax office. We have access to the tax records for the years 1994 to 2012 which can be linked with the ASSD via an identifier variable.

To investigate the effect of the SGA cap on earnings, we consider all DI spells that were initiated between 2001 and 2012 by individuals younger than age 57 at the time of entry into the program. We observe individuals in the sample at a monthly frequency while they receive DI benefits and for up to eight years before entering into and after exiting from the DI program. We exclude spells that started prior to 2001 because earnings restrictions were not uniformly

[8] Moreover, it is not clear how earnings above the SGA cap affect future old-age benefits as there are two forces at play: the additional contributions increase are benefit-enhancing as they increase the pension coefficient but low earnings are benefit-reducing as they lower the assessment basis.

regulated for these spells. We focus on DI recipients who are younger than age 57 because individuals who start claiming benefits after age 57 face stricter earnings restrictions. More specifically, these individuals lose all DI benefits if earnings exceed the SGA cap and they are not allowed to work in the same occupation as before the onset of the disability.

Table 1 provides summary statistics for our analysis samples. Column 1 shows summary statistics for all DI recipients in our sample, columns 2 shows summary statistics for those DI recipients who work at least once during the observation period, and column 3 shows summary statistics for the subset of DI recipients who are working just below the SGA notch. DI recipients are on average 48.2 years old at program entry and 59% suffer from a musculoskeletal disease or a mental disorder which are typically difficult to verify. The numbers are quite similar in the U.S. Social Security DI program: the average age of DI recipients at program entry is 47.4 years and the fraction of recipients suffering from mental illness and musculoskeletal disease is 57.4%.[9]

A comparison of columns 1 and 2 shows that only about 15% of DI beneficiaries are working while receiving benefits. DI recipients who are working are younger, had a lower wage in their last job, have lower DI benefits, have more labor market experience, and suffer less from difficult-to-verify disorders compared to the full population of DI recipients. A comparison of columns 2 and 3 shows that over 25% of working DI beneficiaries are located just below the SGA cap. DI recipients who are working at the SGA cap tend to earn less compared to the full population of working DI recipients, which is not surprising given that the SGA threshold is relatively low. They also are more likely to be female, tend to have lower wages on the last job, are less likely to be classified as blue-collar workers, tend to have higher DI benefits, and are more likely to suffer from a mental illness.

4. Empirical Analysis

4.1. Empirical Evidence on Behavioral Responses at the SGA Notch

We start our analysis by examining graphically whether there is evidence for bunching at the SGA cap. To do so, we pool all available years of data and calculate the difference between earnings and the SGA cap in a given year, given that the SGA cap increases from year to year by about 10 Euros to account for inflation and wage growth. We then group individuals into 10

[9] The U.S. statistics are taken from Maestas et al. (2013).

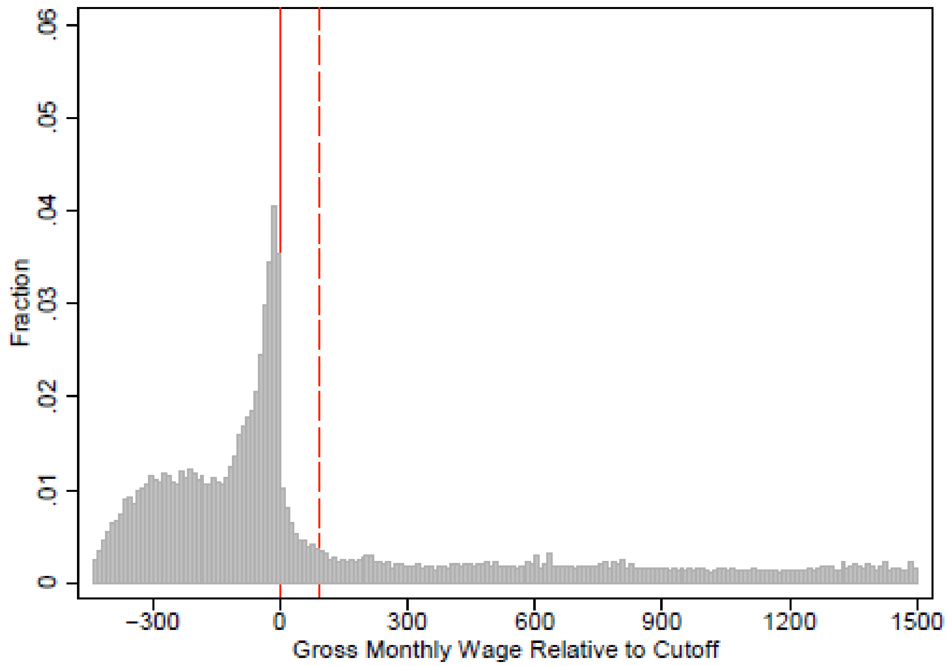
Euro bins and plot the number of individuals per bin in the bins around the SGA cap. Figure 3 shows the normalized earnings distributions around the SGA cap. The vertical solid line denotes the SGA cap and the vertical dashed line denotes the upper bound of the dominated region. Several things can be observed from the figure. First, there is large and sharp bunching at the SGA cap. Second, the earnings distribution exhibits significant missing mass given that the density falls discretely above the notch. Third, there are no visible holes in the earnings distribution as the distribution of earnings is relatively flat above the notch, suggesting that optimization frictions might be important.

Table 1: Summary statistics

	All DI recipients	Working DI recipients	
		All	At notch
	(1)	(2)	(3)
Female (%)	45	45	48
Age at DI entry (years)	48.2 (8.0)	46.6 (9.0)	45.3 (9.1)
Blue-collar (%)	67	68	62
UI duration last 15 years	1.12 (1.31)	0.93 (1.19)	1.14 (1.21)
Experience last 15 years	9.67 (4.71)	11.1 (4.00)	10.3 (4.00)
Sick leave last 15 years	0.71 (0.79)	0.60 (0.71)	0.69 (0.75)
Monthly DI benefits (Euros)			
Full DI benefits	974 (498)	920 (472)	1,040 (490)
Partial DI benefits	964 (507)	688 (584)	1,040 (490)
Monthly gross earnings (Euros)			
Last job before DI	3,009 (5,674)	2,411 (3,766)	1,992 (3,916)
While claiming DI	54 (533)	1,179 (2,227)	375 (43)
Health impairment			
Mental disorders (%)	40	38	44
Musculoskeletal system (%)	19	16	16
Cardiovascular system (%)	10	10	8
Other (%)	31	36	31
No. of individuals	183,168	27,054	7,084
No. of observations	7,562,737	334,461	84,787

Notes: UI duration last 15 years, experience last 15 years and sick leave last 15 years are measured prior to DI entry. Sample standard deviations for continuous variables in parentheses. Monthly DI benefits and monthly gross earnings are measured during DI. Health impairment is only observed for DI spells that start in 2004 or after.

Figure 3: Earnings distribution around the SGA cap, full sample



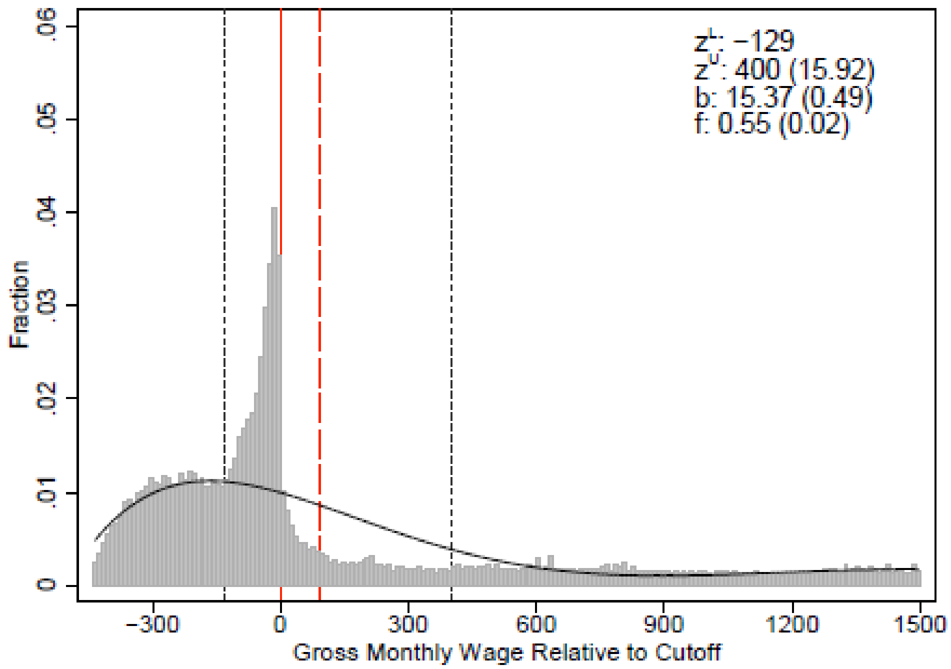
Notes: The figure shows the earnings distribution of monthly gross earnings around the SGA cap (marked by the vertical solid line) for DI beneficiaries between 2001 and 2012. The upper bound of the dominated range is marked by the vertical dashed line. The histogram bins are monthly gross earnings relative to the SGA cap in the relevant year. The bin width is 10 Euros.

To quantify the magnitude of excess mass and missing mass, we estimate a sixth-degree polynomial to the empirical earnings distribution using equation (12). Figure 4 shows the predicted counterfactual earnings distribution (solid back line) that is obtained from the estimated coefficients.[10] The vertical dotted lines denote the excluded ranges $[z^L, z^U]$. We measure excess bunching relative to the counterfactual density at the SGA cap $\hat{b} = \frac{\hat{B}}{\widehat{h_0}(z^*)}$. The figure shows that proportional bunching b is 15.37 and precisely estimated, implying that the observed distribution has 15.37 times more observations at the SGA cap than the counterfactual distribution. This estimate might be attenuated if DI recipients face adjustment frictions. To examine whether frictions are important, we exploit the second theoretical prediction that no DI beneficiaries should locate in the dominated range. Figure 4 illustrates that the mass of DI recipients in the dominated range is sizeable, suggesting that frictions are an important factor that prevent DI recipients from adjusting their earnings. The share of DI beneficiaries in the dominated region who are unresponsive is 55%. This means that the amount of bunching absent friction $b/(1-f)$ is about twice as large relative to observed bunching b. The point of

[10] Figure C.1 in Appendix C plots the counterfactual earnings distribution for lower and higher polynomial degrees, showing that the results are not very sensitive to the choice of the degree of polynomial.

convergence z^U where missing mass equals bunching mass is 400 Euros or just about the size of the SGA cap, suggesting that without the notch DI beneficiaries who bunch would earn up to 100% more.

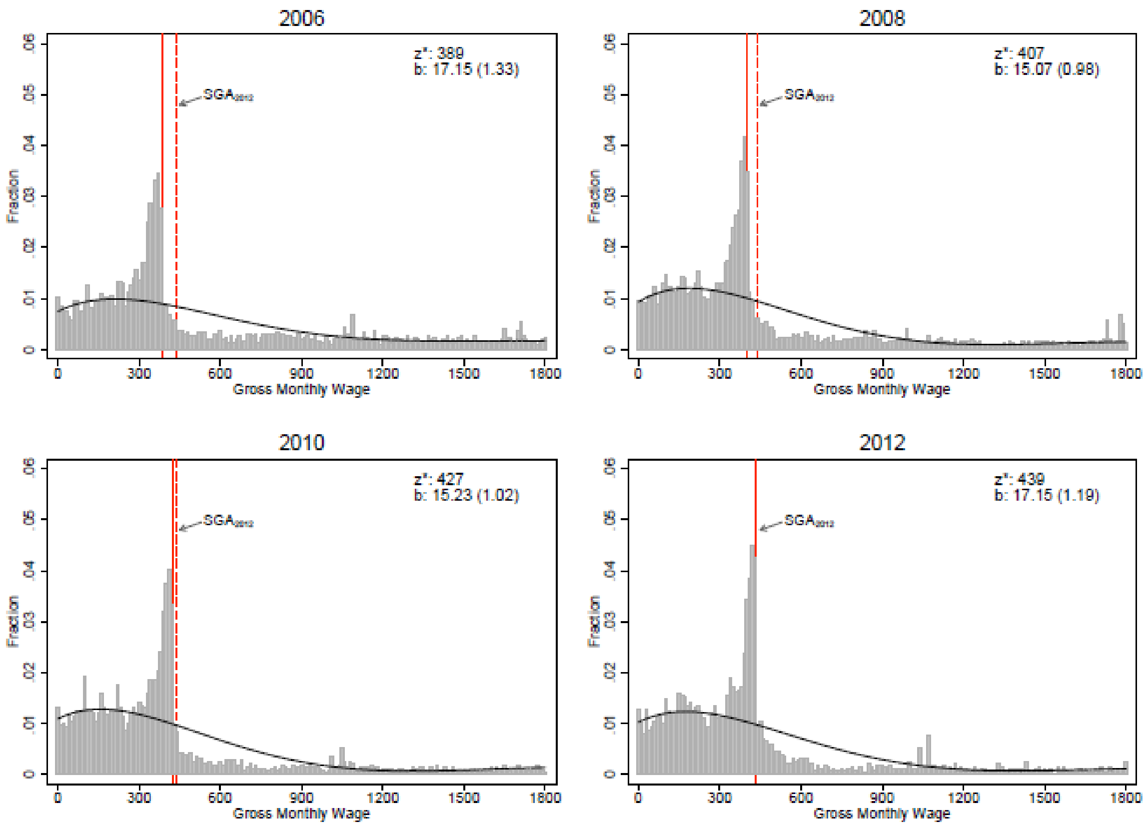
Figure 4: Earnings distribution around the SGA threshold, all years



Notes: The figure shows the earnings distribution of monthly gross earnings around the SGA cap (marked by the vertical solid line) for DI beneficiaries between 2001 and 2012. The upper bound of the dominated range is marked by the vertical dashed line and excluded ranges $[z^L, z^U]$ are marked by vertical dotted lines. The histogram bins are monthly gross earnings relative to the SGA cap in the relevant year. The bin width is 10 Euros. The solid line beneath the empirical distribution is a sixth-degree polynomial fitted to the empirical distribution using equation (12). Proportional bunching *b* is excess mass in the excluded range below the notch relative to the counterfactual density at the notch, *f* is the share of DI recipients in the dominated range who are constrained by frictions, and z^U has been estimated such that missing mass equals bunching mass. Bootstrapped standard errors are shown in parentheses.

The identification assumption underlying our estimates for excess bunching and missing mass in the above analysis is that the earnings distribution would be smooth if there was no jump in the implicit average tax rates at the location of the SGA cap. We can shed light on this identification assumption by exploiting the movement of the SGA cap across years. Figure 5 displays the distribution of earnings around the SGA cap for the years 2006, 2008, 2010, and 2012. We restrict the sample to DI recipients who entered the program in the five year window before the observation year, so that the number of observations is roughly constant across different years. The vertical line denotes the corresponding SGA cap in a given year, while the vertical dashed line denotes the SGA cap in 2012. Clearly, the excess mass follows the movement of the SGA threshold very closely.

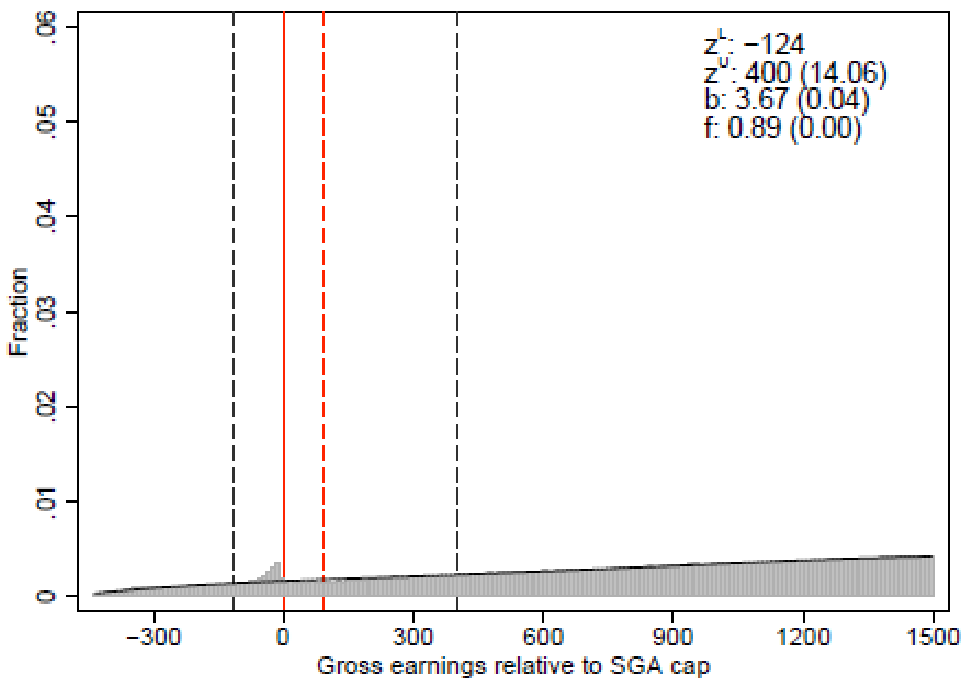
Figure 5: Earnings distribution around the SGA cap in 2006, 2008, 2010, and 2012



Notes: The figures show the earnings distribution of monthly gross earnings around the SGA cap (marked by the vertical solid line) for DI beneficiaries in the years 2006, 2008, 2010, and 2012. The sample in each figure consists of DI beneficiaries who entered the program in the five year window before the observation year. The SGA cap in 2012 is marked by the vertical dashed line. The histogram bins are monthly gross earnings relative to the SGA cap in the relevant year. The bin width is 10 Euros. The solid line beneath the empirical distribution is a sixth-degree polynomial fitted to the empirical distribution using equation (12). Proportional bunching b is excess mass in the excluded range below the notch relative to the counterfactual density at the notch. Bootstrapped standard errors are shown in parentheses.

The change in the implicit tax rate at the SGA notch is not only driven by the reduction in DI benefits but also by the fact that individuals have to start paying social security contributions on all earnings as soon as they earn above the SGA cap. This rule implies that there is also a notch at the SGA cap for individuals who are not receiving DI benefits, as the payroll tax rate jumps from 0% to 18%. It is therefore of interest to examine whether there is bunching among employed individuals who are not on the DI program. Figure 6 shows the earnings distribution around the SGA cap for all employed individuals between 2001 and 2012 who are not on DI. The solid black line is a sixth-degree polynomial fitted to the empirical distribution using equation (12). There is significant excess mass just below the SGA cap; proportional bunching *b* is 3.67 which is about four times lower than for DI beneficiaries. The amount of excess mass may be less because the size of the notch is smaller for individuals who are not on the DI program. Frictions on the other hand are significantly larger compared to DI beneficiaries. We estimate that the fraction of individuals in the dominated region who are unresponsive is 89% compared to 55% for DI recipients. One explanation is that because the size of the notch is smaller the utility gain from moving to the notch is lower and so the minimum adjustment will be lower as well. This effect makes *f* decreasing with the size of the notch, provided that the distribution of adjustment costs is similar for individuals who are not receiving DI compared to individuals who are receiving DI.

Figure 6: Earnings distribution around the SGA cap for workers not receiving DI benefits

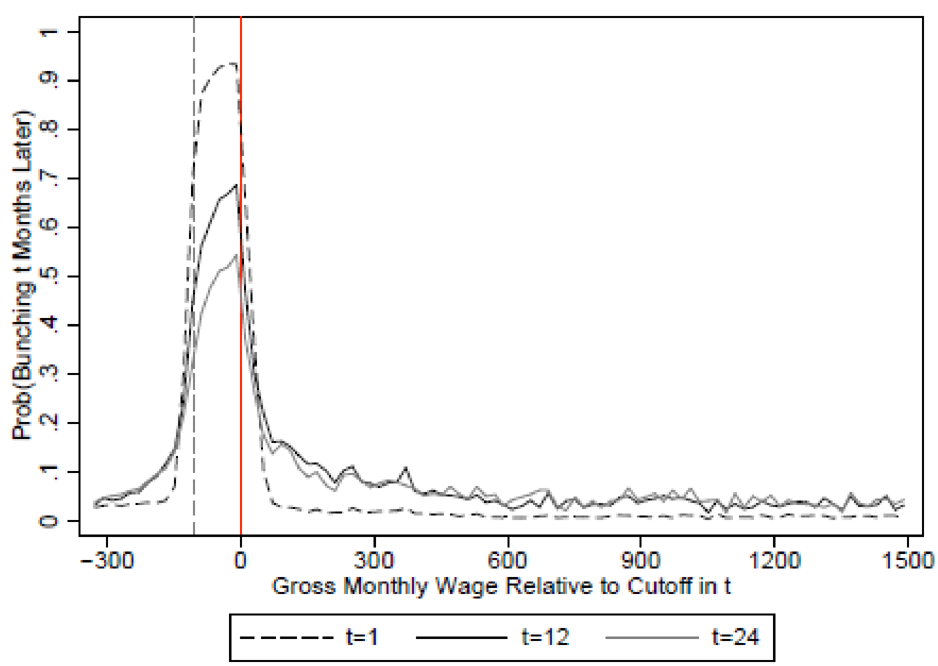


Notes: The figure shows the earnings distribution of monthly gross earnings around the SGA cap (marked by the vertical solid line) for individuals not receiving DI benefits between 2001 and 2012. The upper bound of the dominated range is marked by the vertical dashed line and excluded ranges [z L , z U] are marked by vertical dotted lines. The histogram bins are monthly gross earnings relative to the SGA cap in the relevant year. The bin width is 10 Euros. The solid line beneath the empirical distribution is a sixth-degree polynomial fitted to the empirical distribution using equation (12). Proportional bunching b is excess mass in the excluded range below the notch relative to the counterfactual density at the notch, f is the share of DI recipients in the dominated range who are constrained by frictions, and z U has been estimated such that missing mass equals bunching mass. Bootstrapped standard errors are shown in parentheses.

4.2. Persistency Over Time and Speed of Adjustment

Taking advantage of the longitudinal aspect of our data, we next investigate the dynamics of bunching behavior over time. Figure 7 shows the probability that a DI recipient is bunching one month, 12 months, and 24 months in the future as a function of the gross wage in the current month. Bunchers include all DI beneficiaries locating in the bunching range $[z^L, z^*]$. This figure is informative (1) on whether DI claimants who are located to the right of the SGA cap move to the notch over time and (2) on how persistent bunching is over time. The figure suggests that DI recipients who are currently located to the right of the SGA cap have a clear tendency to start bunching 12 and 24 months in the future. The probability to start bunching in the future is particularly high for those DI recipients who are located just to the right of the SGA notch. These individuals benefit most from moving to the SGA cap since by doing so they can increase both total income and leisure time.

Figure 7: Dynamics of bunching behavior over time



Notes: The figure shows the probability of bunching behavior 1 months, 12 months, and 24 months in the future as a function of the monthly gross wage in month t (equation (12).

The figure also shows that bunching is highly persistent over time. DI beneficiaries who are currently bunching have a probability of around 70% (50%) to be bunching again in 12 (24) months. To further shed light on the persistency of bunching over time, we calculate the fraction of DI beneficiaries who feature bunching behavior in each year as well as the fractions who feature such behavior for two, three, four, and five consecutive years. The results of this analysis are show in Table 2 for the unbalanced panel of those who work at least once during the observation period and the balanced panel of those who work in each year. The table shows that bunching is relatively low in the first year after individuals enter the DI program (28% for the unbalanced panel and 39.1% for the balanced panel), but the fraction of bunchers increases rapidly over time and stabilizes at around 37-42%. Bunching is very persistent over time. For example, in the unbalanced panel around 24% (9/37.8) of those who bunch in the fifth year after DI entry have also been bunching in all the previous years. The corresponding percentage is even higher for the balanced panel (57.6%).

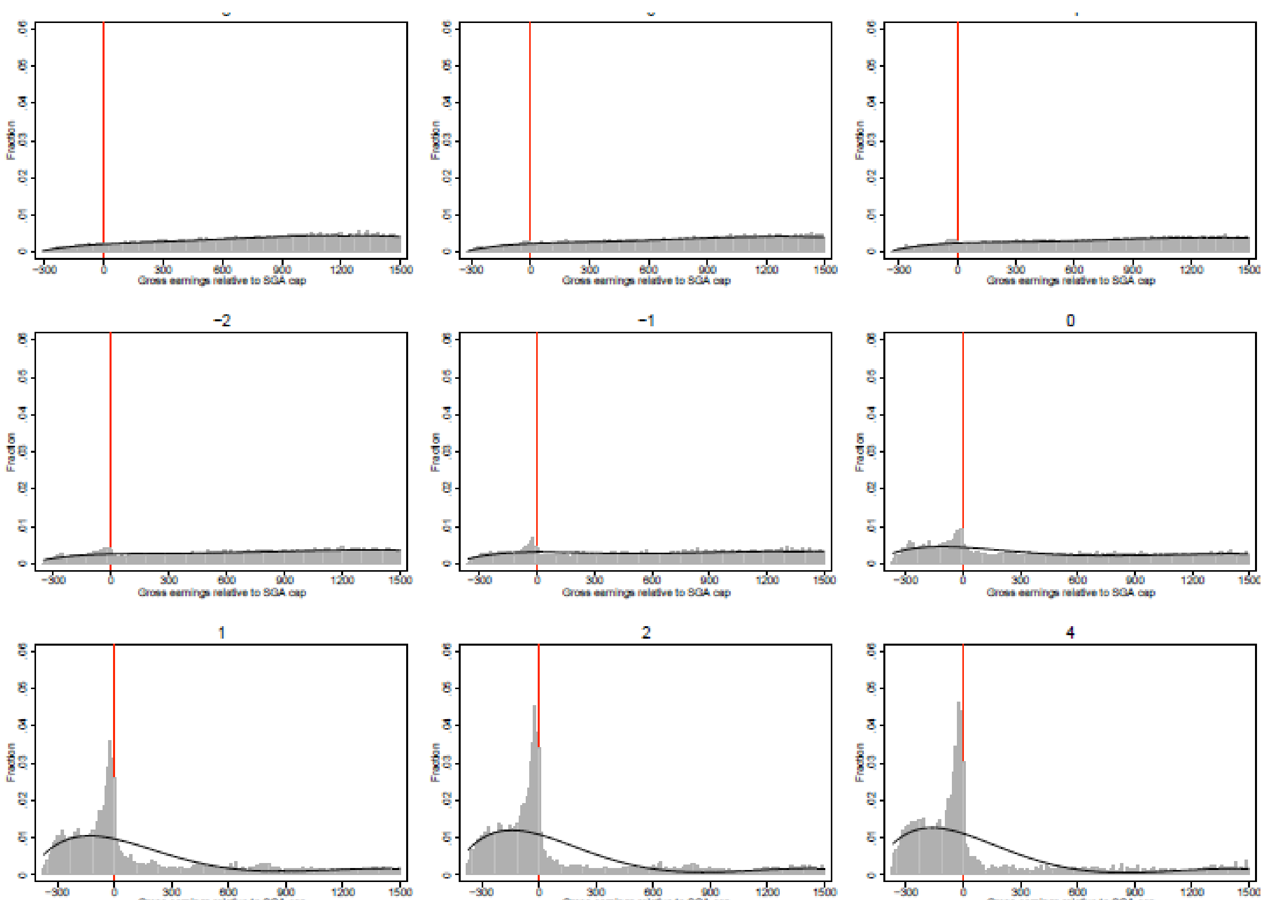
Table 2: Dynamics of Bunching Behavior

Year	#Obs.	Percent Bunching at SGA Cap				
		Total	2-Year	3-Year	4-Year	5-Year
	(1)	(2)	(3)	(4)	(5)	(6)
A. Unbalanced Panel						
1st year after inflow	13,499	28.0				
		(0.4)				
2nd year after inflow	9,601	37.0	21.0			
		(0.5)	(0.4)			
3rd year after inflow	8,668	38.2	24.6	15.5		
		(0.5)	(0.5)	(0.4)		
4th year after inflow	8,139	37.7	25.0	17.8	11.8	
		(0.5)	(0.5)	(0.4)	(0.4)	
5th year after inflow	7,780	37.8	24.9	18.2	13.4	9.0
		(0.6)	(0.5)	(0.4)	(0.4)	(0.3)
B. Balanced Panel						
1st year after inflow	3,259	39.1				
		(0.9)				
2nd year after inflow	3,259	42.2	32.3			
		(0.9)	(0.8)			
3rd year after inflow	3,259	41.0	35.5	28.7		
		(0.9)	(0.8)	(0.8)		
4th year after inflow	3,259	39.3	34.3	30.9	25.2	
		(0.9)	(0.8)	(0.8)	(0.8)	
5th year after inflow	3,259	37.5	32.1	29.3	26.6	21.6
		(0.9)	(0.8)	(0.8)	(0.8)	(0.7)

Notes: The table shows the percent of DI recipients that are clustered at the SGA cap in total and in two, three, four, and five consecutive years. The unbalanced panel consists of DI beneficiaries who work at least once during the observation period; the balanced panel consists of DI beneficiaries who work in each year. Significance levels: ***=1% , **=5% , *=10%.

The jump in the implicit tax rate at the SGA cap is much smaller for individuals not receiving DI compared to individuals on the DI program. Those on DI lose a portion of their benefits and must start making social security contributions whereas those not on DI only have to start making social security contributions. As a consequence, we would expect to see bunching materialize only while individuals receive DI benefits but it should not be very strong before individuals enter the program or after they lose benefits due to medical recovery. The availability of data both before individuals enter and after they exit the DI program allows us to examine how bunching adjusts with entry into and after exit from the DI program.

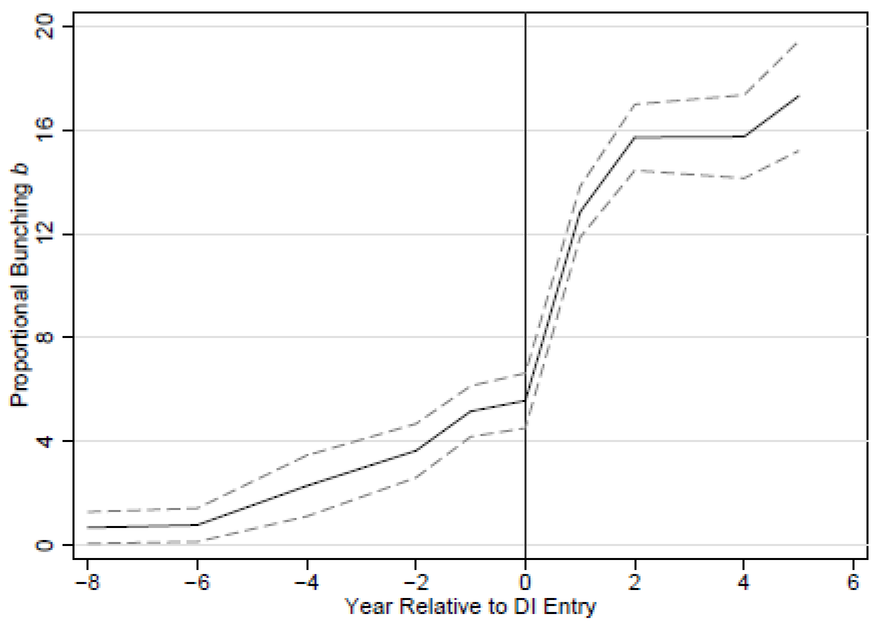
Figure 8: Earnings distribution around the SGA cap before and after DI entry



Notes: The figure shows the earnings distribution of monthly gross earnings around the SGA cap (marked by the vertical solid line) for DI beneficiaries 8, 6, 4, 2, 1 years before DI entry and 0, 1, 2, 4 years after DI entry. The sample consists of DI beneficiaries who are working at least once in the first five years after program entry. The histogram bins are monthly gross earnings relative to the SGA cap in the relevant year. The bin width is 10 Euros. The solid line beneath the empirical distribution is a sixth-degree polynomial fitted to the empirical distribution using equation (12).

Figure 8 displays the earnings distribution around the SGA cap in the years before and after DI entry for DI beneficiaries who work at least once in the first five years on the program. Figure 9 plots the point estimates and 95% confidence interval for proportional bunching in each year. The amount of proportional bunching is close to zero (though statistically significant) eight to six years before program entry and increases steadily to 5.41 in the year of program entry. Proportional bunching jumps to 12.74 in the first year on the program and continues to increase to 18.39 five years after program entry, highlighting the persistency of bunching over time. This pattern suggests that some individuals adjust earnings before DI entry in anticipation that they will be awarded benefits, but most of the adjustment takes place within the first year on the program.

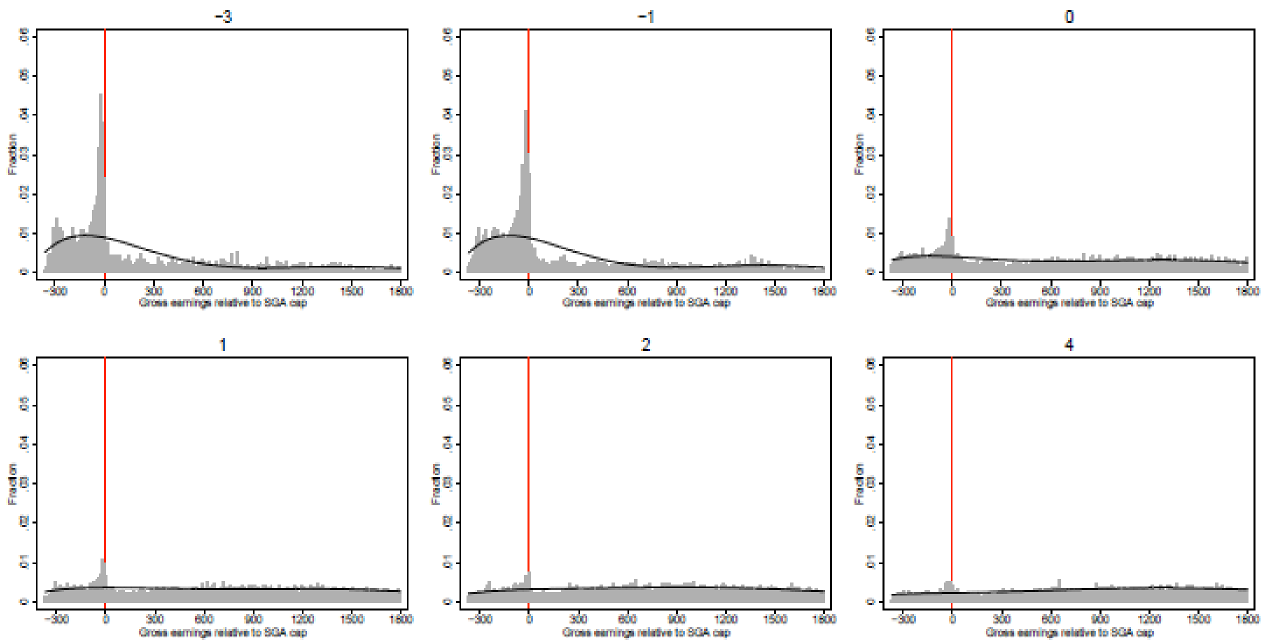
Figure 9: Proportional bunching before and after DI entry



Notes: The figure shows proportional bunching *b* for different years before and after DI entry (vertical solid line). Proportional bunching is calculated as described in the text. The dashed lines denote 95% confidence intervals. The sample consists of DI recipients who are working at least once in the first five years after program entry.

We can perform a similar analysis when individuals exit the DI program by examining whether excess bunching becomes smaller or even disappears as individuals leave the DI rolls. Figure 10 displays the earnings distributions around the SGA cap in the years before and after DI exit for those DI recipients who lose benefits between 2004 and 2007. Figure 12 also shows the amount of proportional bunching estimated by year before and after DI exit, along with 95% confidence intervals. There is a substantial reduction in proportional bunching from 15.81 in the last year on the program to 8 in the first year after program exit. However, the excess mass around the SGA cap is quite persistent after program exit; four years after exiting the program proportional bunching remains relatively large at 6.26, which is almost twice as large compared to individuals who have never been on the DI program (3.67). One potential explanation for the slow earnings adjustments after program exit is that many DI beneficiaries who lose benefits may be speculating that they will return to program in the near future. We find that around 66% of DI recipients who lose benefits appeal the decision and 72% of those who appeal are eventually readmitted to the program.

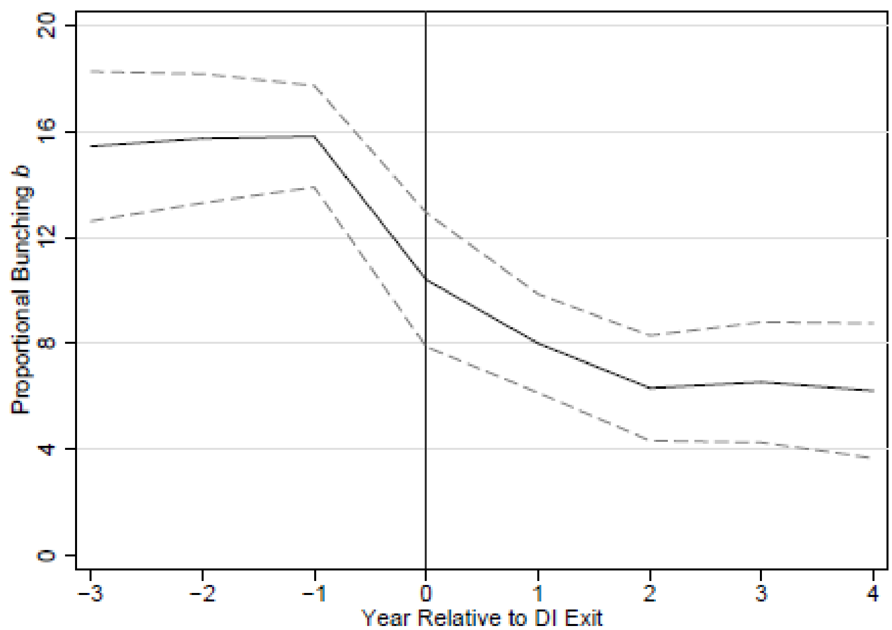
Figure 10: Earnings distribution around the SGA cap before and after DI exit



Notes: The figure shows the earnings distribution of monthly gross earnings around the SGA cap (marked by the vertical solid line) for DI beneficiaries 3, 1 years before exit from the DI program and 0, 1, 2, 4 years after exit from the DI program. The sample consists of DI recipients who exit the DI program between 2004 and 2007; exits into the old-age pensions are excluded. The histogram bins are monthly gross earnings relative to the SGA cap in the relevant year. The bin width is 10 Euros. The solid line beneath the empirical distribution is a sixth-degree polynomial fitted to the empirical distribution using equation (12).

The preceding analysis suggests that most of the earnings adjustment takes place in the first year after individuals enter or exit the DI program. We investigate the earnings response in more detail by examining whether the adjustments primarily occur within the same firm or whether individuals adjust earnings by changing jobs across firms. Figure A.1 in Appendix A shows the fraction of firm-movers and firm-stayers who are bunching in a month relative to the DI-entry month (left panel) and relative to the DI-exit month (right panel). The left panel illustrates that the probability to bunch increases significantly in the first year on the program, but the increase is about twice as large for firm-stayers relative to firm-movers. This pattern suggests that firms are not pivotal in helping to coordinate the employment response. If this were the case, we would expect to see a larger increase in fraction bunching among firm-movers compared to firm-stayers. The right panel shows a decline in the probability to bunch in the year before beneficiaries exit the program, but, consistent with the pattern at DI-entry, the decline is more pronounced among firm-stayers relative to firm-movers.

Figure 11: Proportional bunching before and after DI exit



Notes: The figure shows proportional bunching b for different years before and after exit from the DI program (vertical solid line). Proportional bunching is calculated as described in the text. The dashed lines denote 95% confidence intervals. The sample consists of DI recipients who exit the DI program between 2004 and 2007; exits into the old-age pensions are excluded.

4.3. **Estimates of Earnings Elasticity**

In this section we present estimates of earnings elasticities, by combining the nonparametric evidence presented above with the framework in section 3. These elasticities can be obtained by estimating the earnings response Δz^* and then solving formula (9) numerically for the elasticity *e*. As discussed earlier, we estimate the earnings response in two ways: a lower bound is obtained from observed proportional bunching scaled by the fraction of individuals who are unresponsive $b/(1-f)$. An upper bound is obtained from the point of convergence z^U where missing mass equals bunching mass. The results are presented in Table 3, which displays the amount of frictions in the dominated range in column (2), the lower- and upper-bound for earnings responses in column (3)-(4), and the corresponding lower- and upper-bound of the elasticities in columns (5)-(6).

Table 3: Earnings Elasticities for Full Sample and Subgroups

Group	Frictions	Earnings response Δz^*		Earnings elasticity e	
	f	Lower-bound	Upper-bound	Lower-bound	Upper-bound
		$b/(1-f)$	z^U	$b/(1-f)$	z^U
	(2)	(3)	(4)	(5)	(6)
A. Full sample					
	0.551***	342***	400***	0.172***	0.227***
	(0.021)	(18.97)	(14.35)	(0.019)	(0.013)
B. Age					
< 35	0.465***	291***	690***	0.204***	0.562***
	(0.032)	(37.45)	(200)	(0.043)	(0.128)
$35-49$	0.543***	347***	400***	0.197***	0.249***
	(0.028)	(37.97)	(36.55)	(0.038)	(0.034)
$50-56$	0.568***	346***	380***	0.144***	0.175***
	(0.02)	(19.36)	(14.14)	(0.018)	(0.013)
C. Gender					
Men	0.542***	339***	390***	0.109***	0.153***
	(0.024)	(23.98)	(23.68)	(0.022)	(0.02)
Women	0.553***	333***	390***	0.26***	0.323***
	(0.031)	(36.94)	(34.6)	(0.043)	(0.037)
D. Health impairment					
Mental	0.543***	284***	340***	0.135***	0.192***
	(0.047)	(34.03)	(20.38)	(0.036)	(0.021)
Physical	0.548***	341***	400***	0.141**	0.194***
	(0.069)	(78.31)	(44.69)	(0.069)	(0.039)
Other	0.578***	395***	460***	0.224***	0.282***
	(0.031)	(36.77)	(71.54)	(0.033)	(0.056)
E. Worker status					
Blue-Collar	0.513***	263***	310***	0.096***	0.142***
	(0.02)	(15.76)	(20.6)	(0.016)	(0.02)
White-Collar	0.585***	515***	670***	0.242***	0.344***
	(0.037)	(61.46)	(115)	(0.046)	(0.072)

Notes: Frictions f in column (2) correspond to the share of DI beneficiaries in the dominated range who are unresponsive, a lower bound on the earnings responses Δz^* to the SGA cap is obtained from observed bunching scaled by frictions $b/(1-f)$ (column 3) and an upper bound is obtained from the point of convergence z^U (column 4), lower-bound and upper-bound elasticities in columns 5-6 are obtained by numerically solving equation (9) using the earnings responses from columns 3-4 and the observed tax parameters. Standard errors in parentheses are obtained using a bootstrap procedure where we sample from the population with replacement. The standard deviation of the distribution is shown in brackets. All estimates are based on a sixth-order polynomial fitted to the empirical earnings distribution. Significance levels: ***=1% , **=5% , *=10% .

Panel A of Table 3 shows that the earnings responses are very large and highly significant. The lower-bound estimate suggests that DI beneficiaries who bunch would increase earnings by up to 342 Euros per month or 85% more than the SGA cap, while the upper-bound estimate amounts to 400 Euros. Even though the estimated earnings responses are large, the implied earnings elasticities are relatively modest: the lower-bound elasticity is 0.172 and the upper-bound elasticity is 0.227. These estimates are very close to the estimates presented in Gelber et al. (2013) who study earnings responses to the Social Security Earnings Test among older workers in the U.S. and slightly higher than the estimates presented in studies that exploit nonlinearities in the income tax schedule (Saez, 2010; Chetty et al., 2011; Kleven and Waseem, 2013). For comparison, we also estimate earnings responses for individuals not receiving DI and find a lower-bound elasticity of 0.602 and upper-bound elasticity of 0.772 (not reported).

Since not all beneficiaries have the same work capacities, the impact of the SGA cap on earnings is likely to differ across beneficiaries. For example, those with less severe impairments should have more work capacity than those with more severe impairments. Our estimation strategy can be used to test for heterogeneity in the effect of the SGA cap, provided that the number of observations within each subgroup is sufficiently large to detect excess mass and missing mass. In Panels B-E of Table 3 we present estimates of the impact of the SGA cap for groups defined by age, gender, health impairment, and worker status. There is significant heterogeneity in the responsiveness to the SGA cap. More specifically, Panel B illustrates that proportional bunching and elasticities are larger for DI beneficiaries below age 50 than for DI beneficiaries above age 50, consistent with existing evidence that younger DI beneficiaries exhibit the highest responsiveness to financial work incentives. As Panel C shows, female DI recipients are more responsive to financial incentives than their male counterparts. This finding is in line with previous studies that study the responsiveness of women and men to financial incentives in other contexts. There are also significant differences across impairment types, as illustrated in Panel D. DI recipients with mental and physical disorders are less responsive compared to DI recipients with other impairments. Finally, Panel E shows that white-collar workers are more responsive to financial incentives than blue-collar workers. One likely explanation for this finding is that eligibility criteria for disability benefits are less strict for white-collar workers compared to blue-collar workers.[11] As a consequence, white-collar DI beneficiaries are healthier on average than blue-collar DI beneficiaries, facilitating adjustments in earnings to financial incentives.

Table D.1 in the Appendix presents analogous estimates as in Table 3 using the reduced-form approach in equation (11). The earnings elasticities based on the reduced-form approximation are substantially larger than those based on the exact approach and fall mostly in the interval 1-1.5. This is unsurprising: the reduced-form elasticity provides an upper bound for the true elasticity and Kleven and Waseem (2013) show that the upward bias is increasing in the relative earnings response $z^*/\Delta z^*$ and the change in the implicit tax rate at the notch $\Delta t/(1-t)$ (assuming that true preferences are quasi-linear). In the current context the magnitude of both parameters is large, implying that absolute bias is likely to be sizeable.

We complement our empirical analysis with an estimation of the counterfactual labor force participation rate of DI recipients had they not received DI benefits. This exercise sheds light on the external validity of the earnings elasticity estimates for Austria. We follow the approach by Bound (1989) who uses the labor force participation rate of rejected DI applicants as an estimate of the counterfactual labor force participation rate of DI recipients in the U.S. We extend his approach in two dimensions: first, our data contain information on the receipt of unemployment and sick leave benefits allowing us to examine benefit substitution between DI and related social insurance programs. Second, we also estimate the effects of terminating DI benefits using the labor force participation rate of beneficiaries whose program eligibility ceased due to medical recovery as an upper bound of the labor force participation rate of beneficiaries who continue on the program. This estimate is informative on the effectiveness of return-to-work policies in returning beneficiaries to the labor force. Table B.1 in the Online Appendix presents OLS estimates on the impact of being awarded DI benefits on different outcomes. Panels A-C show that receiving DI leads to a 22.7-27 percentage point drop in employment, a 19.4-22.5 percentage point drop in the probability of earning more than the annual SGA threshold, and a 4,278-4,726 Euros drop in annual earnings. These estimates are very close to the OLS estimates (and somewhat above the IV estimates) reported in Maestas et al. (2013) for the U.S. Moreover, panels D and E show that receiving DI is associated with a significant decrease in UI and sick

[11] More specifically, white-collar workers are classified as disabled if their ability to work is reduced to less than 50% in the last occupation, while blue-collar workers are only eligible if they suffer a reduction in the ability to work of 50% or more relative to a healthy person in any reasonable occupation that the individual is able to carry out.

leave benefit receipt. Table B.2 displays corresponding estimates for the sample of DI recipients whose benefits are terminated. The estimates are quite similar to the results for DI entrants, suggesting that many DI recipients have considerable work capacity. They are in line with the estimates presented in Moore (2015) who studies the labor supply effects of the removal of drug and alcohol addictions as qualifying conditions in the U.S.

Overall, the similarity of the labor supply estimates indicates that the work capacity of DI recipients in Austria is comparable to that of DI recipients in the U.S. However, it is important to keep in mind that our bunching approach to estimate the earnings elasticity relies on excess and missing mass around the SGA cap and therefore provides a good estimate for the work capacity of beneficiaries located around the SGA cap. The earnings elasticity might differ in countries with a different SGA level than in Austria if the elasticity is heterogeneous across subgroups of beneficiaries and if characteristics of beneficiaries around the SGA cap vary with its size. Given that Austria's earnings cap is quite low, it is likely that beneficiaries around the SGA cap have a low work potential. Consistent with this view, Table 1 shows that beneficiaries around the notch had lower earnings in their last job compared to the full population of beneficiaries, suggesting that our earnings elasticity may represent a lower bound.

5. Fiscal Effects and Policy Implications

This section discusses the fiscal effects of the SGA cap for the government and the associated policy implications. More specifically, using data for the year 2012 we investigate the impact of an abolition of the SGA cap on DI benefits paid, payroll taxes received, and government net expenditures. The first row of Table 4 shows that under the status quo the government spends 1,025.5 million Euros on DI benefits per year and receives 15.1 million Euros in payroll taxes. The second row documents the fiscal effects from abolishing the SGA cap associated with intensive labor supply responses. We find that each year there would be additional DI benefit payments of 7.1 million Euros, because DI recipients who earn above the SGA cap would not lose any benefits. However, there would also be an increase in payroll tax revenues of 35.5 million Euros due to increased earnings of DI beneficiaries who bunch under the current rules.

Abolishing the SGA notch will likely generate extensive margin labor supply responses, as the reduction in the implicit average tax rate induces some DI beneficiaries to enter the labor force. Taking rejected DI applicants' earnings two years after the initial decision as a counterfactual for DI beneficiaries' earnings without the SGA cap (Panel C of Table B.1), we estimate that extensive margin labor supply responses would generate additional payroll tax revenues of 121.4 million Euros per year. In sum, we estimate that abolishing the SGA cap would reduce annual net expenditures by 149.8 million Euros or 14.8% of annual net expenditures under the current rules.

Table 4: Annual Fiscal Effect of Abolishing the Notch

	DI benefits (A)	Payroll tax revenues (B)	Net expenses (A-B)
Status quo with notch (million Euros)	1025.5	15.1	1010.4
Δ intensive margin (million Euros)	7.1	35.5	-28.4
Δ extensive margin (million Euros)	0.0	121.4	-121.4
Δ total (million Euros)	7.1	156.9	-149.8
(in % of status quo)	0.7	1039	-14.8

Notes: All money amounts are in 2012 Euros; "Δ intensive margin" refers to individuals that receive DI benefits, are working under the notch, and increase labor supply after the abolishment of the notch; "Δ extensive margin" refers to individuals that are on DI and start working.

These estimates ignore the possibility that abolishing the SGA earnings cap could induce an increase in DI entry by those able to earn above the SGA threshold, ultimately leading to higher DI program costs and net expenditures. Making the earnings rules more generous could also lead to fewer exits from DI by current beneficiaries. However, this effect is likely to be small given that the DI exit rate is already very low under the current rules (around 1.6% per year). Because the SGA cap is identical for all beneficiaries and has not changed during the observation period (except for small inflation adjustments), we are not able to estimate the size of induced entry that may occur if the SGA threshold was increased or abolished entirely. However, we can calculate how elastic DI program inflow would need to be to lead to an increase in government net expenditure. We follow Kostol and Mogstad (2014) and calculate an elasticity of induced entry, defined as the percentage increase in the number of DI beneficiaries relative to the percentage change in disposable income as a DI beneficiary.[12] This approach yields an elasticity of induced entry of 1.12 if we take into account both extensive and intensive labor supply responses. If we assume instead that the abolition of the notch only induces intensive labor supply responses, we obtain an elasticity of 0.73. These elasticity estimates are substantially larger than those reported in previous studies. Exploiting a policy change in Canada, Gruber (2000) estimates an elasticity of induced entry between 0.28 and 0.36. Staubli and Mullen (2015) find even smaller elasticity estimates of 0.02-0.03 using variation in benefit levels in the Austrian DI program. Thus, our calculations suggests that an abolition of the SGA notch would reduce government net expenditure even after accounting for induced entry responses.

6. Conclusion

Many countries specify a substantial gainful activity (SGA) threshold in their DI program and if earnings exceed the SGA threshold for an extended period of time DI beneficiaries lose part or all of their benefits. These rules imply a discontinuous change in the implicit tax rate – a notch – at the SGA cap, creating a strong incentive for many beneficiaries to "park" earnings just below the SGA cap. In this paper, we have examined whether the SGA cap induces many DI recipients to adjust their earnings and have investigated how elastic their earnings are to changes in financial incentives.

Using a large and salient notch located at the SGA cap in Austria's DI program, we provide transparent and credible documentation of behavioral earnings responses of DI beneficiaries. We find evidence for large and sharp bunching just below the SGA cap and missing mass just above the SGA cap, suggesting that many DI recipients would earn considerably more in the absence of the notch at the SGA cap. Our estimation approach implies that the excess number of DI recipients at the notch equals the total number that should be observed with earnings up to 342 Euros. This effect represents a substantial 85% increase

[12] Our calculations suggest that abolishing the notch would finance 18 new entrants per 100 beneficiaries without increasing net expenditures. Hence, the elasticity of induced entry can be expressed as $\varepsilon = \frac{0.18}{\Pr(Award=1) \cdot E(\Delta I|Award=1)}$ where $E(\Delta I|Award = 1)$ denotes the percentage change in disposable income due to the abolition of the SGA cap conditional on being award benefits. The award rate $\Pr(Award = 1)$ is relatively constant over the observation period and is equal to 59.4%. The estimated percentage increase in disposable income is 28% if we take into account intensive and extensive labor supply responses and 8% if we only consider intensive labor supply responses.

relative to the SGA earnings level of 405 Euros. The vast majority of beneficiaries' adjustment occurs in the first year on the program and is accompanied by a sharp increase the probability to change jobs across employers, suggesting that firms may help coordinate bunching by offering jobs with earnings at the SGA cap.

While the earnings responses to the SGA cap are large, the elasticities driving those responses are rather modest, even after taking into account that observed earnings responses are attenuated by adjustment frictions. We estimate that the earnings elasticity with respect to the implicit net-of-tax rate is 0.172, suggesting a relatively low responsiveness of earnings to financial incentives. The reason is that notches create extremely large implicit marginal tax rates and thus behavioral responses are large, even when elasticities are quite small. The elasticity estimates are heterogeneous across subgroups of the population, with women and younger age groups being more responsive to financial incentives compared to men and older age groups.

Our framework is useful to shed light on the fiscal effects of policy reforms that intend to reduce the implicit tax on work above the SGA cap. Our calculations suggest that removing the SGA cap reduces annual net expenses in the DI program by around 15%. However, allowing DI recipients to earn more while keeping benefits may increase the incentive to apply for and ultimately receive DI benefits. While we cannot estimate the level of induced entry that would occur if the SGA cap was relaxed, we instead calculate how elastic entry responses would have to be to increase net expenditure. We find that the elasticity of program inflow to changes in benefits needs to be much higher than those reported in previous studies. Thus, policy reforms designed to increase work incentives for DI beneficiaries could potentially increase beneficiaries' earnings without increasing program costs.

Our results are derived in the context of Austria and it is important to exercise caution when applying these conclusions to other countries. The discussion above suggests that the DI program in Austria shares similarities with DI programs in other countries in terms of size and composition of beneficiaries. Moreover, our estimates of the counterfactual labor force participation rate of DI beneficiaries using rejected applicants as control group are similar to those found in recent studies, suggesting that the qualitative lessons from this study may be informative for other settings as well. However, there are also some characteristics that are distinct from other programs, most notably the level of the SGA cap. This difference is important because our elasticity estimate is a local average treatment effect, exploiting variation in earnings around the Austrian SGA cap. The elasticity may vary in countries with a different SGA cap than in Austria if elasticities are heterogeneous across the earnings distribution.

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Appendix:

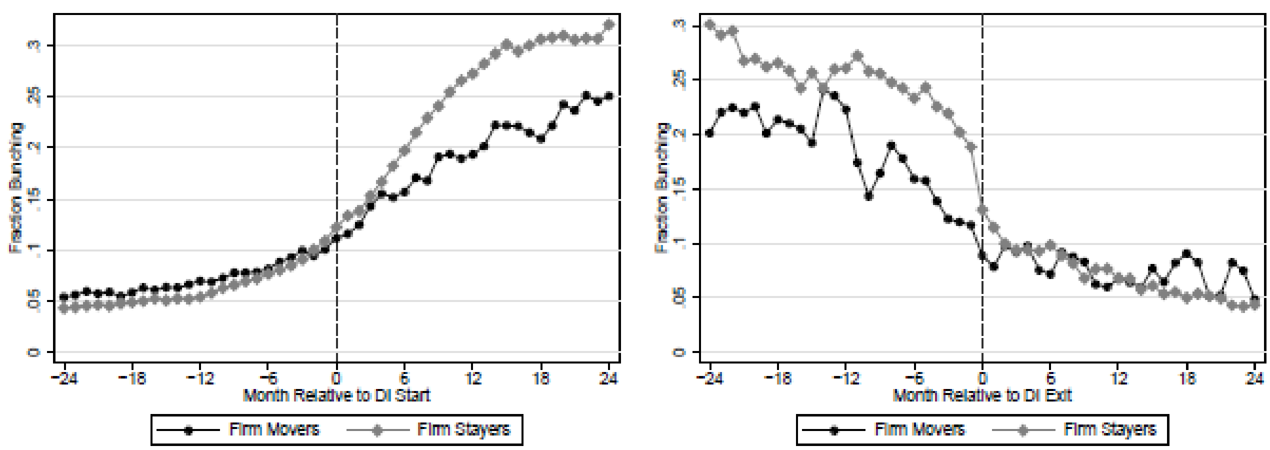
Financial Incentives and Earnings of Disability Insurance Recipients: Evidence from a Notch Design

Philippe Ruh and Stefan Staubli

A. The Role of the Employer in Coordinating Bunching

This section investigates whether the employer helps coordinate bunching by employees. Figure A.1 plots the fraction of movers and stayers who are bunching by month relative to DI entry (left panel) and relative to DI exit (right panel).

Figure 12: Fraction of firm movers and stayers bunching by month relative to DI entry (left panel) and relative to DI exit (right panel)

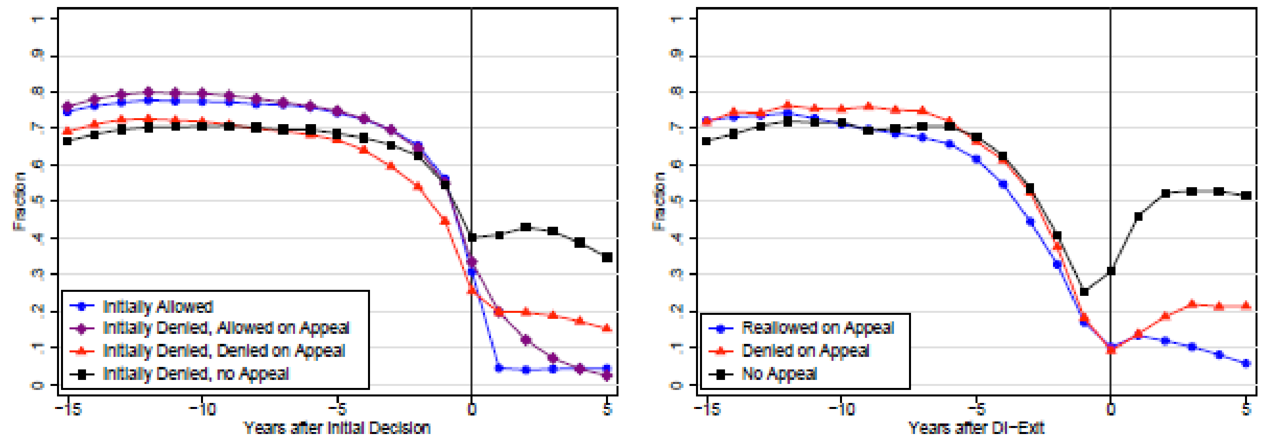


Notes: This figure shows the fraction of firm movers and stayers who bunch in different months before and after DI-entry (vertical solid line in left panel) and DI-exit (vertical solid line in right panel). Firm movers: individuals who change firms between two months and who stayed at least 3 months in the old firm and are staying 3 months in the new firm; firm stayers: individuals who stayed at least 3 months in the same firm and do not change firms between two months.

B. Labor Supply Response Using Bound-Approach

This section presents estimates of the counterfactual labor force participation rate of DI recipients had they not received benefits. We follow the method by Bound (1989) who uses the labor force participation rate of rejected DI applicants in the U.S. as an estimate of the counterfactual labor force participation rate of DI recipients. This approach arguably yields an upper bound because rejected DI applicants are likely to be in better health on average than DI recipients. We extend his approach in two dimensions: first, our data contain information on the receipt of unemployment and sick leave benefits allowing us to examine benefit substitution between DI and related social insurance programs. Second, we also estimate the effects of terminating DI benefits using the labor force participation rate of beneficiaries whose program eligibility ceased due to medical recovery as an upper bound of the labor force participation rate of beneficiaries who continue on the program. This estimate is informative on the effectiveness of return-to-work policies in returning beneficiaries to the labor force.

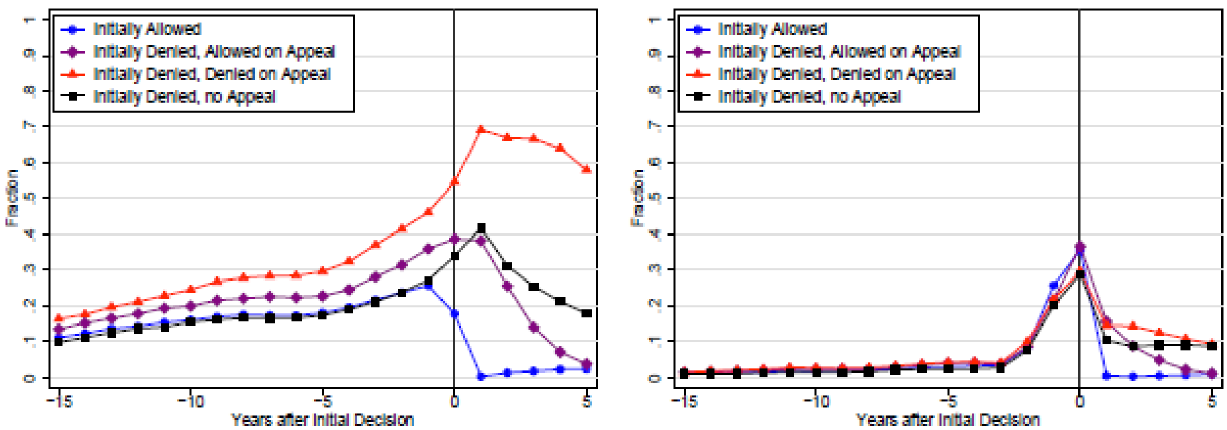
Figure B.1: Employment before and after initial decision (left panel) and DI-exit (right panel)



Notes: The figure shows employment rates relative to the year of the initial decision (left panel) and relative to the year of DI-exit (right panel) for different groups of individuals. Employment is measured as having positive working days in the year in consideration. The sample consists of all initial applicants in the years 2004-2007 (left panel) and all DI recipients who left the DI program in the years 2005-2007 (right panel), except for those who have been transferred to the old-age pension program.

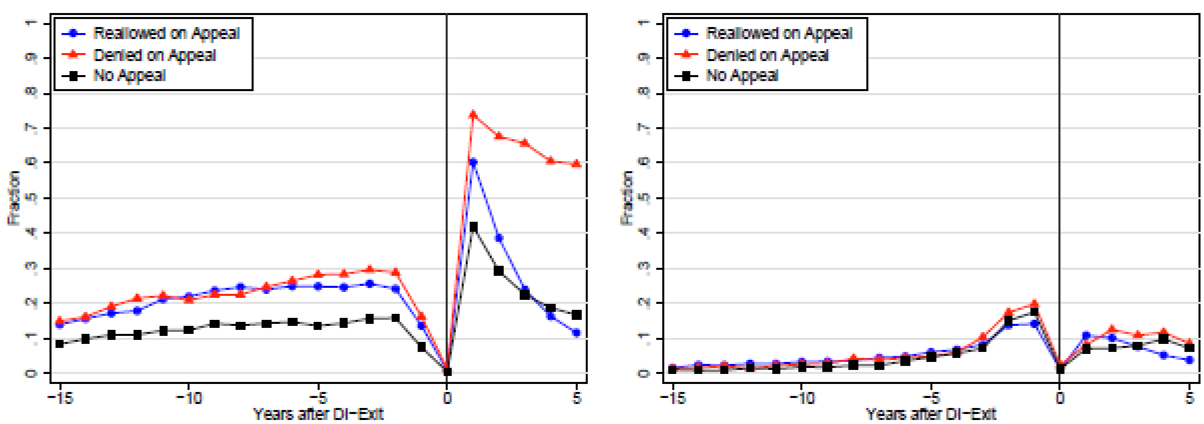
The left panel of Figure B.1 displays the employment rate of 2005-2007 applicants up to fifteen years before and five years after their initial determination. Employment is defined as having positive working days in a given year. Before the initial determination, the employment rate of applicants who were initially allowed is very similar to that of applicants allowed on appeal. There is a sharp drop in employment in the determination year and by three years after the decision employment rates are relatively constant at around 5% for both groups. In contrast, ultimately denied applicants have lower employment rates before the initial determination and significantly higher employment rates after the initial determination. Denied applicants who do not appeal and those who appeal have similar employment rates prior to the initial decision, but employment rates are around twice as large for denied applicants who do not appeal after the initial decision. The right panel of Figure B.1 shows the employment rate of DI recipients who lost their benefits between 2005 and 2007 up to fifteen years before and five years after DI exit. Before the withdrawal of benefits, the employment rate of recipients who do not appeal differs only very little from that of recipients who do (successfully or unsuccessfully) appeal. The employment rate increases sharply after the withdrawal of benefits for beneficiaries who do not appeal, while the employment rate steadily declines for beneficiaries who are re-allowed. There is also a rise in the employment rate after benefit withdrawal for recipients who are denied on appeal, although the employment rate is considerably lower compared to recipients who do not appeal.

Figure B.2: Unemployment and Sick Leave Before and After Initial Decision



Notes: The figure shows the share of individuals in unemployment and sick leave before and after the year of the initial decision for different groups of DI applicants. The sample consists of all initial applicants in the years 2005-2007.

Figure B.3: Unemployment and Sick Leave Before and After DI-exit



Notes: The figure shows the share of individuals in unemployment and sick leave before and after the year of DI-exit for different groups of DI claimants. The sample consists of all individuals who left the DI program in the years 2004-2007, except for those who have been transferred to the old-age pension program.

In addition to disability insurance, unemployment and sick leave insurance also provide income replacement in the case of a separation from the labor market for economic or health reasons. It is likely that the receipt of disability benefits impacts unemployment and sick leave enrollment. Figure B.2 display trends in unemployment and sick leave up to fifteen years before and five years after the initial determination, while B.3 shows analogous trends before and after the removal of disability benefits. Both figures show that spillover effects among these government transfer programs are important. More specifically, in the year before the initial decision 30-50% of applicants are registered as unemployed and about 20% claim sick leave benefits. These numbers drop to zero five years after the initial determination for applicants awarded DI benefits, while the unemployment and sick leave rates remain large for ultimately denied applicants. Similarly, there is sizeable increase in the unemployment and sick leave rate in the first year after individuals lose their DI benefits. These rates decline steadily for recipients who are re-allowed to the program but remain high for those who permanently exit the DI rolls.

Table B.1 presents OLS estimates on the impact of being awarded DI benefits on employment (positive working days), employment above SGA (e.g., earning more than 5,268 Euros in 2012), annual earnings, registered unemployment, and sick leave. The key explanatory variable *ALLOW* is equal to one if an applicant is awarded benefits (up to five years after the initial decision), and zero otherwise. Panels A-C show that receiving DI leads to a 22.7-27 percentage point drop in employment, a 19.4-22.5 percentage point drop in the probability of earning more than the annual SGA threshold, and a 4,278-4,726 Euros drop in annual earnings. These estimates are very close to the OLS estimates (and slightly above the IV estimates) reported in Maestas et al. (2013) for the United States. Moreover, panels D and E show that receiving DI is associated with a 35.1-39.3 percentage point decrease in unemployment and a 7.7-8.6 percentage point decrease in sick leave absence.

Table B.1: Impact of DI benefit receipt on employment, earnings, and transfers

Years after decision	Two	Three	Four	Five
A. Working days > 0				
Coefficient on ALLOW	-0.265***	-0.270***	-0.251***	-0.227***
	(0.003)	(0.003)	(0.003)	(0.002)
R^2	0.150	0.168	0.172	0.170
Mean dependent Variable | allowed	0.047	0.049	0.049	0.049
Mean dependent Variable | denied	0.248	0.221	0.194	0.172
B. Earnings > SGA				
Coefficient on ALLOW	-0.217***	-0.225***	-0.213***	-0.194***
	(0.003)	(0.003)	(0.002)	(0.002)
R^2	0.125	0.141	0.145	0.146
Mean dependent Variable | allowed	0.039	0.040	0.040	0.041
Mean dependent Variable | denied	0.208	0.182	0.160	0.143
C. Earnings				
Coefficient on ALLOW	-4,410***	-4,726***	-4,591***	-4,278***
	(69)	(70)	(66)	(66)
R^2	0.102	0.111	0.119	0.107
Mean dependent Variable | allowed	898	918	915	970
Mean dependent Variable | denied	4,389	3,773	3,361	3,054
D. Unemployment				
Coefficient on ALLOW	-0.381***	-0.393***	-0.384***	-0.351***
	(0.003)	(0.003)	(0.003)	(0.003)
R^2	0.226	0.252	0.261	0.244
Mean dependent Variable | allowed	0.020	0.023	0.025	0.025
Mean dependent Variable | denied	0.405	0.344	0.298	0.257
E. Sick leave				
Coefficient on ALLOW	-0.077***	-0.084***	-0.086***	-0.078***
	(0.002)	(0.002)	(0.002)	(0.002)
R^2	0.028	0.038	0.046	0.046
Mean dependent Variable | allowed	0.006	0.007	0.008	0.010
Mean dependent Variable | denied	0.105	0.086	0.071	0.062
Observations	88,562	87,285	86,114	84,997

Notes: The sample consists of first applicants for DI benefits in the years 2005-2007. Control variables include: experience past 15 years, unemployment past 15 years, sick leave past 15 years, tenure in years prior to decision, average wage, and dummies for gender, occupation, region (37) and industry (251). Significance levels: ***=1% , **=5% , *=10% .

Table B.2: Impact of DI benefit loss on employment, earnings and transfers

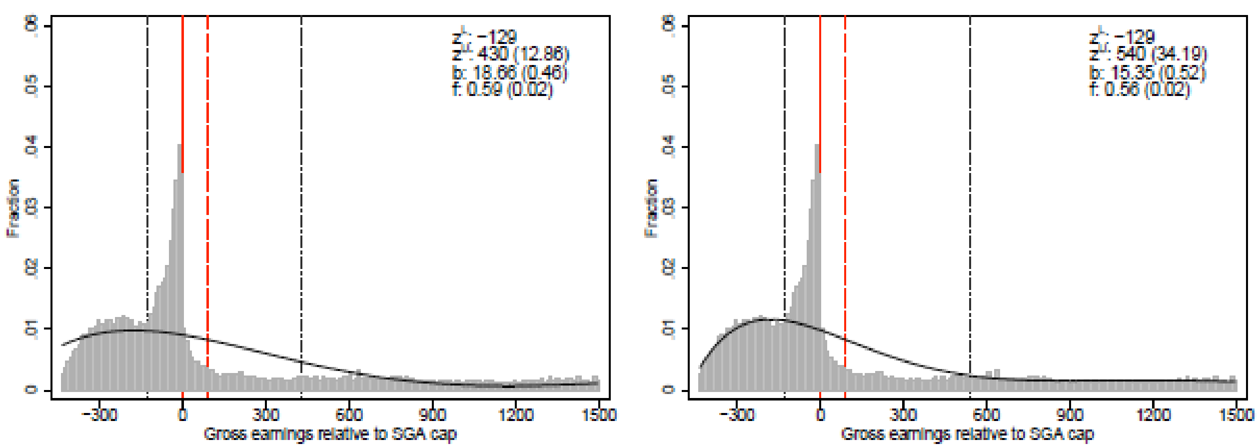
Years after decision	Two	Three	Four	Five
A. Working days > 0				
Coefficient on ALLOW	0.206***	0.255***	0.278***	0.292***
	(0.012)	(0.012)	(0.011)	(0.011)
R^2	0.189	0.218	0.248	0.255
Mean dependent Variable | allowed	0.455	0.471	0.474	0.466
Mean dependent Variable | denied	0.187	0.159	0.141	0.118
B. Earnings > SGA				
Coefficient on ALLOW	0.196***	0.234***	0.256***	0.276***
	(0.010)	(0.010)	(0.010)	(0.010)
R^2	0.197	0.224	0.247	0.273
Mean dependent Variable | allowed	0.346	0.369	0.374	0.369
Mean dependent Variable | denied	0.099	0.083	0.066	0.044
C. Earnings				
Coefficient on ALLOW	3,975***	4,519***	5,183***	5,545***
	(215)	(220)	(221)	(221)
R^2	0.200	0.216	0.232	0.250
Mean dependent Variable | allowed	6,698	7,090	7,457	7,520
Mean dependent Variable | denied	1,653	1,510	1,214	872
D. Unemployment				
Coefficient on ALLOW	0.090***	0.184***	0.210***	0.240***
	(0.013)	(0.012)	(0.012)	(0.011)
R^2	0.101	0.100	0.089	0.119
Mean dependent Variable | allowed	0.432	0.383	0.340	0.324
Mean dependent Variable | denied	0.387	0.240	0.164	0.117
E. Sick leave				
Coefficient on ALLOW	-0.019**	-0.000	0.040***	0.029***
	(0.008)	(0.008)	(0.007)	(0.007)
R^2	0.004	0.015	0.022	0.024
Mean dependent Variable | allowed	0.092	0.091	0.106	0.078
Mean dependent Variable | denied	0.102	0.077	0.053	0.039
Observations	5,967	5,912	5,841	5,791

Notes: The sample consists of all individuals who left the DI program in the years 2005-2007, except for those who have been transferred to the old-age pension program. Control variables include: experience past 15 years, unemployment past 15 years, sick leave past 15 years, tenure in years prior to decision, average wage, and dummies for gender, occupation, region (37) and industry (251). Significance levels: ***=1%, **=5%, *=10% .

Table B.2 displays corresponding estimates for the sample of DI recipients who lose benefits between 2005 and 2007. Here, *ALLOW* is equal to one if a recipient is not re-allowed to the DI program, and zero otherwise. The estimates are quite similar to the results for DI entrants, suggesting that many DI recipients have considerable work capacity. More specifically, panels A-C indicate that exiting the DI programs leads to a 20.6-29.2 percentage point rise in employment, a 19.6-27.6 percentage point increase in the probability of earning above the annual SGA threshold, and a 3,975-5,545 Euros increase in annual earnings. These estimates are very close to the evidence presented in Moore (2015) who studies the labor supply effects of the removal of drug and alcohol addictions as qualifying conditions in the U.S. DI program. Panel D indicates that the removal of DI benefits leads to a sizeable increase in registered unemployment, while Panel E shows that by four years after program exit sick leave receipt starts to increase. Overall, the similarity of the labor supply estimates indicates that the work capacity of DI recipients in Austria is comparable to that of DI recipients in the U.S., lending support to the external validity of our analysis on the earnings response to the SGA cap.

C. Robustness of Results to Different Polynomials

Figure C.1: Estimated counterfactual earnings distributions around the SGA Cap for fifth-degree (left panel) and seventh-degree (right panel) polynomials



Notes: The figure shows the earnings distribution of monthly gross earnings around the SGA cap (marked by the vertical solid line) for DI beneficiaries between 2001 and 2012. The upper bound of the dominated range is marked by the vertical dashed line and excluded ranges $[z^L, z^U]$ are marked by vertical dotted lines. The histogram bins are monthly gross earnings relative to the SGA cap in the relevant year. The bin width is 10 Euros. The solid line beneath the empirical distribution in the left (right) panel is a fifth-degree (seventh-degree) polynomial fitted to the empirical distribution using equation (12). Proportional bunching b is excess mass in the excluded range below the notch relative to the counterfactual density at the notch, f is the share of DI recipients in the dominated range who are constrained by frictions, and z^U has been estimated such that missing mass equals bunching mass. Bootstrapped standard errors are shown in parentheses.

D Alternative Approaches to Estimate Earnings Elasticity

Table D.1: Earnings Elasticities for Full Sample and Subgroups, Reduced-form Approach

Group	Frictions	Earnings response Δz^*		Earnings elasticity e	
	f	Lower-bound	Upper-bound	Lower-bound	Upper-bound
		$b/(1-f)$	z^U	$b/(1-f)$	z^U
A. Full sample					
	0.551***	342***	400***	1.126***	1.417***
	(0.021)	(18.97)	(14.35)	(0.094)	(0.073)
B. Age					
< 35	0.465***	291***	690***	1.071***	3.306***
	(0.032)	(37.45)	(200)	(0.206)	(1.095)
35 – 49	0.543***	347***	400***	1.198***	1.468***
	(0.028)	(37.97)	(36.55)	(0.193)	(0.191)
50 – 56	0.568***	346***	380***	1.077***	1.235***
	(0.02)	(19.36)	(14.14)	(0.091)	(0.069)
C. Gender					
Men	0.542***	339***	390***	0.971***	1.199***
	(0.024)	(23.98)	(23.68)	(0.105)	(0.11)
Women	0.553***	333***	390***	1.33***	1.654***
	(0.031)	(36.94)	(34.6)	(0.211)	(0.2)
D. Health impairment					
Mental	0.543***	284***	340***	0.882***	1.153***
	(0.047)	(34.03)	(20.38)	(0.161)	(0.101)
Physical	0.548***	341***	400***	1.047***	1.325***
	(0.069)	(78.31)	(44.69)	(0.38)	(0.22)
Other	0.578***	395***	460***	1.381***	1.712***
	(0.031)	(36.77)	(71.54)	(0.187)	(0.372)
E. Worker status					
Blue-Collar	0.513***	263***	310***	0.732***	0.939***
	(0.02)	(15.76)	(20.6)	(0.07)	(0.096)
White-Collar	0.585***	515***	670***	1.696***	2.418***
	(0.037)	(61.46)	(115)	(0.28)	(0.539)

Notes: Frictions f in column 2 correspond to the share of DI beneficiaries in the dominated range who are unresponsive, a lower bound on the earnings responses Δz^* to the SGA cap is obtained from observed bunching scaled by frictions $b/(1-f)$ (column 3) and an upper bound is obtained from the point of convergence z^U (column 4), lower-bound and upper-bound elasticities in columns 5-6 are obtained using the reduced-form approach in equation (11). Standard errors in parentheses are obtained using a bootstrap procedure where we sample from the population with replacement. The standard deviation of the distribution is shown in brackets. All estimates are based on a sixth-order polynomial fitted to the empirical earnings distribution. Significance levels: ***=1%; **=5%; *=10%.