Frictions in Adjusting Earnings: Evidence From Notches in German Mini Jobs*

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Abstract

We study earnings adjustment frictions for workers in German mini jobs using earnings records from the German Social Security system. Mini jobs provide an ideal setting for quantifying and characterizing earnings adjustment frictions. Mini jobs are tax- and social security contribution-free up to a predetermined monthly income threshold. Exceeding the threshold results in a tax on gross earnings, thereby creating a notch in the tax schedule. In addition, a policy reform in 2003 increased this threshold to 400 euro a month from 325, providing useful empirical variation. We quantify adjustment frictions using two distinct sources of identification i) residual bunching at the old (non-binding) notch after the policy change, and ii) the share of workers stuck in a strictly dominated earnings region, wherein they could both reduce work hours and increase earnings. In our preferred specification, we estimate that workers face an average fixed adjustment cost of 29 euro a month (9% of earnings), with 15% of workers facing adjustment frictions exceeding 130 euro a month. While such optimization frictions may arise from an array of sources, little is known about which source of frictions really matter in practice. We investigate whether - and to what extent - firm-side demand constraints prevent workers who want to adjust to the policy change from doing so. We develop a simple model in which all workers want to adjust but are constrained by their firms demand growth and take testable predictions to the data. We argue that the evidence is strongly supportive of firm-level characteristics restricting workers' labor supply.

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PRELIMINARY AND INCOMPLETE - PLEASE DO NOT CITE OR CIRCULATE

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1 Introduction

A range of frictions prevent workers from costlessly adjusting their earnings (Chetty et al. (2011), Kleven and Waseem (2013), Gelber et al. (2013)). Understanding the magnitude, duration, and source of these frictions matters for positive and normative economic analysis. Firstly, frictions can greatly attenuate micro-econometric estimates of key structural parameters, like the elasticity of taxable income, distorting the essential ingredients of standard policy and welfare analyses, as well as optimal taxation theory (Chetty (2012)). Further, frictions help explain puzzles like the lack of bunching at kink points and disparate micro and macro elasticity estimates (Saez (2010), Chetty et al. (2012)). Finally, understanding the duration of frictions has implications for how frequently tax policies should be changed, while understanding the sources of frictions affects which policies can help ease adjustments. Yet, quantifying frictions is empirically challenging as it requires a setting that can distinguish between low elasticity and frictions. Investigating the most likely sources of frictions, taking into account both firm and worker behavior, introduces additional difficulties.

This paper takes advantage of German labor market policies and high quality administrative data to, first, quantify frictions in adjusting earnings and, second, investigate the potential sources of frictions. The first section complements recent work on identifying and quantifying adjustment costs (Gelber et al. (2013), Chetty et al. (2011), Kleven and Waseem (2013)), but does so for a new population – prime age, married women with low monthly earnings in Germany – using a combination of techniques ideally suited to our setting. The second section provides insight into which frictions matter by taking predictions of our new model to the data. The literature has proposed an array of candidates, such as search and renegotiation costs (Pissarides (2011)), inattention/salience, lack of information (Chetty et al. (2009), Chetty et al. (2013)), and firm-side hours constraints (Chetty et al. (2011)). In particular, we follow (Chetty et al. (2011), and Best (2014)) in emphasizing the role that firms play in how workers respond to frictions, by allowing for both workers *and* firms to face frictions of their own. We show that transitions after a policy reform are consistent with predictions from a model with both firm and worker side frictions.

We document sizeable frictions in a setting where one might expect frictions to be low since the policy is salient and the gains of adjustment large. We estimate that workers face an average fixed adjustment cost of 16.5 euro a month (5% of post-tax earnings), with 15% of workers facing adjustment frictions exceeding 100 euro a month. To put these numbers in context, Chetty (2012) shows that the utility costs of ignoring tax reforms like the U.S. Tax Reform Act of 1986 are less than 2% of income per year, implying that the estimated frictions are enough to prevent responses to smaller policy changes biasing observed elasticities to zero. Additionally, our estimates are similar to those in Gelber et al. (2013), who find adjustment frictions of $152.08 per annum among the elderly at the U.S. Annual Earnings Test kink. Like that paper, we also find that these frictions decline over time, highlighting the dynamic nature of adjustment costs.

German mini jobs provide an ideal setting for quantifying and characterizing earnings adjustment frictions. Mini jobs are tax- and social security contribution-free up to a predetermined monthly income threshold. Exceeding the threshold results in a tax on gross earnings, thereby creating a "notch" in the tax schedule. This produces stronger incentives to bunch than a kink and introduces a dominated region – a region in which it is possible to both reduce hours worked and keep more money after tax. In addition, a policy reform in 2003 increased this threshold to 400 euro a month from 325, providing essential empirical variation.

We quantify adjustment frictions using two distinct sources of identification. We set up our model following Kleven and Waseem (2013), which allows for simultaneous estimation of a (frictionless) elasticity with respect to the net of tax rate and a measure of the share of workers facing frictions too large to bunch. The estimation combines information on the amount of bunching at the notch point with the share of workers in the dominated earnings region. While this measure of frictions is revealing, it is somewhat crude and cannot account for things like dynamic career concerns. To address this, we extend the model to take advantage of a 2003 policy moving the notch point from 325 euro a month to 400. In the spirit of Gelber et al. (2013), this extension allows for simultaneous estimation of a fixed adjustment cost and elasticity identified off of residual bunching at the old threshold after its removal. Both methods yield comparable elasticity estimates and measures of frictions.

In ongoing work, we delve into the "black box" of what drives adjustment frictions. While optimization frictions may arise from an array of sources ranging from poor information or worker inattention, to search costs or firm fixed costs in adjusting hours, little is known about which source of frictions really matter in practice.[1] We suggest that frictions arise from firm-side demand constraints interacting with search costs. Intuitively, imagine a cleaning firm with many mini jobbers who all ask at once to increase their hours. If the firm faces a relatively fixed demand, it cannot accommodate this shock. Only if it grows sufficiently (or if enough workers leave or are fired), might it be able to do so. We develop this intuition formally, and test predictions in the data. Preliminary results suggest that firm side constraints play an important role in shaping worker adjustment. This complements recent work that also emphasizes the importance of firms in affecting worker earnings (Chetty et al. (2011), Best (2014), and Tazhitdinova (2015)).

Our work complements that of Tazhitdinova (2015) who also studies behavioral responses to mini jobs, but differs in focus. Tazhitdinova focuses on why behavioral responses to the mini job tax policy are so large relative to other bunching studies. She theorizes and supports the view that workers are particularly responsive to this tax regime because firms are incentivized at the margin to employ mini-jobbers over regular workers. We focus on quantifying and understanding labor market frictions; studying in particular how workers' adapt to the policy change moving the notch.

The outline of this paper is as follows. In section 2, we describe the policy environment. In section 3, we develop the theoretical and conceptual framework used to estimate adjustment costs. In section 4, we describe the data and sample construction. In section 5, we estimate elasticities and frictions in the data and compare the two methods/sources of variation. In the (unfinished) section 6, we model firm demand constraints and generate testable predictions that we take to the data. In section 7, we conclude.

[1]This exercise is very much in the spirit of advancing the literature. To quote from Gelber et al. (2013): "Following most previous literature, we have treated the adjustment cost as a "black box," without modeling the process that underlies this cost, such as information acquisition or job search. Future research could model such processes and distinguish these explanations using data."

2 Policy Environment

This section describes the necessary context for our study. It first describes mini jobs and the tax schedule they induce. It also describes changes arising from the 2003 reform. The second section provides details on how we compute tax liability upon exceeding the notch.

2.1 Mini Jobs

Marginal employment in Germany has existed since the 1960s and has been subject to various reforms. We focus here on mini jobs in the 1999-2003 period and the 2003-2013 period.

In 1999, mini jobs were defined as employment activity not exceeding 15 hours per week with renumeration not exceeding 325 euro per month in gross earnings. Up to this threshold, earnings were exempt from both social security and income taxation. At the threshold, social security contributions totaling 21% of gross wages were applied in addition to any applicable income tax. Thus crossing the threshold resulted in a loss of after tax income. Using the terminology of Kleven and Waseem (2013), there was a 'notch' in the tax schedule. Even if the person in question was not liable for any income tax after crossing the threshold, they would have had to earn 412 euro (an extra 87 euro a month) to retain the original 325. Married individuals subject to their partner's potentially large marginal tax rate faced even more sizeable notches. Employers paid social security contributions (SSC) totaling 22% of gross earnings, comparable to the employer contribution in a normal job of 20%. Mini jobs were not allowed as secondary employment. Multiple mini jobs were allowed, but income was accumulated and treated as one. Importantly, mini jobs need to registered as such.

On April 1st 2003 as a result of the Hartz II reforms, the income threshold was raised to 400 euros per month and the limit on working hours per week was abolished. Between 400 and 800 euros, a sliding zone (midi jobs) was introduced, such that social insurance contributions increased linearly from 4% to the full contribution of 21%.[2] Mini job income no longer accumulated with regular income, encouraging mini jobs as secondary employment. Employers paid a 25% SSC contribution, as opposed to their normal contribution of 20% for workers earning above 400 euro a month.[3] Steiner and Wrohlich (2005) and Bargain et al. (2010) provide additional details in English, and Eichhorst et al. (2012) in German.

In January 2013 the threshold was again increased to 450 euros, but our data does not yet allow us to study this second policy reform.

While mini jobs are supposed to provide equal benefits to regular jobs (on a pro-rated by time basis) for benefits like sick leave, there are some differences. Importantly, employees are not covered by health insurance unless they derive it from other sources (like their spouse), and do not accrue pension benefits unless they voluntarily contribute to increase future pensions.[4]

In order to quantify elasticities and frictions accurately we need to know the tax rate upon exceeding the threshold. Since this depends on whether or not the individual is married, we focus on married

[2] Social Security contributions continue at all income levels until contributions reach a ceiling.

[3] Employer contributions were increased in June 2006 to 30% (13% for health, 15% for pension, and 2% lump sum income tax). Also, note fees are lower for mini jobs in private households 12%. Such employment arrangements are excluded from our analysis.

[4] Takeup in 2004 was 10% Leschke et al. (2006).

women and use rounded information on husband earnings.[5] This has the added benefit of allowing us to avoid determining the value of health insurance, as couples obtain insurance via their working spouse. In addition we will restrict to persons for whom a mini job is their only job. Further details are provided in section 4. Figure 1 depicts after-tax income as a function of pre-tax income under the pre-2003 and post-2003 policies for a single and a married individual (assuming they are married to a partner earning 33,000 euro a year, the average in our sample).

By 2011, there were 7.4 million mini jobbers in Germany. The majority (63%) were women. Compared to typical jobs, they were disproportionately (25%) held by both the young (under 20) and the elderly (over 64). Another quarter held a mini job as a second job. Average work hours for exclusive mini jobbers in 2010 are 9.4 hours per week at an average wage of 8.6 euro per hour. Jobs are predominately in the service sector, for example retail, hospitality, cleaning, and business services (Eichhorst et al. (2012)).

2.2 Couple Taxation

We need to calculate effective tax rates upon exceeding the notch for our primary sample of interest – married women. This section briefly describes these calculations.

Income is subject to a variety of deductions. In 2005, the standard deduction for singles was 920 and for two wage earners in a couple is 1840. Other important deductions are charitable donations, child allowance/benefit, alimony, church tax, travel expenses to and from work, capital earnings deduction, and profits on sales.[6] These deductions are unobservable to us, so in our estimation we apply only the standard deduction. This will slightly overestimate effective tax rates upon exceeding the threshold. We also compute results assuming a larger deduction for robustness.

Married couples can choose to be taxed jointly or separately, with the former being assumed for cohabitating married couples. Under joint taxation, household income is summed up and halved. Then this total is subjected to the tax brackets that singles face to determine tax liability. Finally this liability is doubled. This process produces the largest advantages when incomes of spouses differ, and no advantage when they are equal.[7] The maximum benefit to choosing joint taxation is roughly 8000 euro when one spouse earns more than 100,000 and the other nothing.

We are interested in calculating the correct marginal tax rate applied to a married person exceeding the notch threshold. Exact rates vary year by year. For clarity, we focus on 2005 below. In 2005, income was tax-free up to 7,664 euro at which point it was taxed at 15%. This tax rate increased linearly from 15 to 24% between 7,664 and 12,740 euro. Between 12,740 and 52,151 euro in taxable income, the tax rate

[5]In principle, one could investigate married men, but by far the most comment arrangement is having a woman in a mini job and male working a fulltime job.

[6]The child allowance/benefit (*kinderfreibetrag/kidergelt*) is either a tax credit or a monthly benefit depending on which is more advantageous. The child benefit pays a certain amount per month, tax-free, totaling 1824 euro per child. For low income couples, the child benefit is more advantageous. Tax allowances become more advantageous for earnings of about 50,000 euro per year. These give a 5808 euro deduction per child. Since our couples will be below this threshold, we assume they take the benefit which does not affect their tax rates.

[7]Final income is based on annual incomes summed together as described. What happens on tax returns during the year varies. Married couples can choose between filing as categories IV/IV or III/V, which affect deductions from their paychecks, but not final tax amounts. A person in category IV faces the tax brackets of a single person. A person in category III doubles the brackets of a single person and a person in category V gets taxed immediately as if they exceeded the first bracket. Typically one high earner and one low earner will choose III/V, so it is reasonable to assume that the person working a mini job will be in category V, implying that if she changed to a non-mini job she would see sizable taxes immediately deducted from her paycheck.

increased linearly from 24% to 42%. There is also a solidarity surcharge of 5.5% of *the income tax amount* due.[8]

Information on husband's wage (rounded to the tens of euros) allows us to calculate the approximate tax penalties that would result were his wife to exceed the mini job threshold. For a woman whose husband earns 40,000 euro a year, crossing the 400 euro threshold reduces household earnings by 116 euro, effectively increasing the wife's gross earnings tax from 0 to 29%. [9]

3 Elasticity and Friction Estimation Framework

3.1 The Model

In order to distinguish frictions from elasticities we impose a simple structural model due to Kleven and Waseem (2013). In the model workers respond to tax changes based on an elasticity parameter. Later, we extend the model to incorporate a fixed adjustment cost. Throughout, the counter-factual (unobserved) tax regime is a situation in which the tax exemption from mini jobs continues indefinitely beyond the notch.

Suppose that utility is given by the following iso-elastic, quasi linear function

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

where z denotes pre-tax earnings, $T(z)$ is tax liability, and n is an ability parameter that is smoothly distributed according to cumulative density function $F(n)$. This utility function, commonly used in the literature, rules out income effects and ensures that the utility of moving to the notch is decreasing with n.

Thus, it is not applied without loss of generality. Thus far, we perform all estimations using this structural approach, but Kleven and Waseem (2013) also develop a more reduced form approach, that we can adapt to perform robustness checks.

Suppose that tax liability is $T(z) = tz$ (which for mini-jobs is $T(z) = 0$). The first order condition in this case is $z = n(1-t)^e$. Thus, e represents the elasticity of earnings with respect to the marginal net of tax rate. [10]

Note the smooth ability distribution translates into a smooth earnings distribution. If we denote the cumulative density function of earnings as $H(z)$, then $H(z) = Pr(Z < z) = Pr(n(1-t)^e < z) = Pr(n < \frac{z}{(1-t)^e}) = F(\frac{z}{(1-t)^e})$.

Now suppose we introduce a notch in the tax schedule at pre-tax earnings level z^* . Absent the notch

[8]The solidarity surcharge only applies to income taxes exceeding a certain threshold (eg. 1,340 euro in 2014).

[9]A sample calculation follows. **Without crossing:** The husband earns 40,000, or 32000 after social security. Subtracting the standard deduction brings this to 30160. Total tax due inclusive of solidarity charges is 3296. Net of tax income is thus: $32000 + 400 - 3296 = 29104$. **With crossing:** Taxable income, including the 401 less social security, is now $30160 + 401(1 - 0.04) = 30545$. Taxes due are 3397. Net of tax income is thus: $32000 + 401(1 - 0.04) - 3397 = 28988$. **Difference:** Crossing the threshold results in a deduction of 116 euro, or 29% of 400 euro. This is also approximately the marginal tax rate at which all future earnings of the wife will be taxed, although in practice the rate will increase slightly, but continuously, as earnings expand.

[10]At the optimum z^o, $\frac{dz^o}{d(1-t)} = \frac{en(1-t)^e}{(1-t)} = e\frac{z^o}{(1-t)}$ and hence $e = \frac{dz^o}{d(1-t)} \times \frac{(1-t)}{z^o}$, or the elasticity of earnings with respect to the marginal net of tax rate.

we presume that t continues to equal 0, such that $T(z) = 0$. We represent the notch as $T(z) = \mathbf{1}(z > z^*)\Delta t \times z$ where Δt is the tax rate applied on total earnings once the mini-job threshold is exceeded. For example if workers are exempt from all taxes below 325 euro, but have to pay a 40% tax on gross earnings if they exceed 325 (and a 40% marginal tax rate thereafter), then $z^* = 325$ and $\Delta t = 0.4$.

The notch introduces a dominated region $(z^*, z^* + \Delta z^D)$, in which workers can reduce work hours and increase net of tax income. Moreover, if $e > 0$, some individuals located above $z^* + \Delta z^D$ originally now also bunch at the threshold z^*. In the model, the marginal buncher is well defined and is the individual who is just indifferent between bunching at the notch and choosing her optimum earnings under the new tax schedule.

Specifically, denote her ability level by n^m. Then if she chooses to bunch at the notch where $t = 0$ and $1(z > z^*)\Delta t = 0$ she receives utility

$$u^N = z^* - \frac{n^m}{1 + 1/e}\left(\frac{z^*}{n^m}\right)^{(1+1/e)}$$

If on the other hand she chooses the interior point under the new tax schedule, she follows her first order condition: $z^* = (n^m)(1 - \Delta t)^e$ and her utility is given by

$$u^I = (1 - \Delta t)^{1+e}\frac{n^m}{1 + e}$$

Finally, this individual's earnings level pre-introduction would be $z^m = n^m(1 - t)^e$. In our case, since $t = 0$, this reduces to $z^m = n^m$. This is the highest earnings level that will bunch post-introduction of the notch. Let Δz^* denote the earnings response of the marginal buncher such that $z^m(= n^m) = z^* + \Delta z^*$.

Equating u^I and u^N and incorporating this final equality, yields

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

Equation 1, which is the same as that in Kleven and Waseem (2013) with $t = 0$, relates the elasticity e to the percentage earnings response of the marginal buncher $\Delta z^*/z^*$ and the marginal tax applied at the notch Δt. The latter is known; the former is estimated using bunching (see next section). Thus Equation 1 provides an estimate of the elasticity from this model.

Finally, note that the upper limit of the dominated region is given by $(1 - \Delta t)z^D = z^*$, i.e. $z^D = \frac{z^*}{(1-\Delta t)}$ so $\Delta z^D = z^D - z^* = \frac{z^*}{(1-\Delta t)} - z^* = \frac{\Delta t z^*}{(1-\Delta t)}$. Note also that as the elasticity e approaches 0 that Δz in equation 1 approaches $\frac{\Delta t z^*}{1-\Delta t} = \Delta z^D$. That is the marginal buncher in the 0 elasticity case is at the edge of the dominated region.

3.2 Estimating Bunching, Earnings Responses, and Elasticity

In order to recover an elasticity, we need an estimate of Δz^*, the earnings response of the marginal buncher. This can be recovered from bunching behavior. Specifically let B denote bunching. In the model, bunchers come entirely from the region between z^* and $z^* + \Delta z^*$. Let the pre-introduction earnings CDF be $H_o(z)$. Thus,

$$B = \int_{z^*}^{z^*+\Delta z^*} h_o(z)dz \approx h_o(z^*)\Delta z^*$$

The approximation assumes a constant counter-factual density in the bunching range z^* and $z^*+\Delta z^*$. In practice, we discretize the data into bins and estimate B as the excess count of individuals in a visually-determined bunching region relative the counterfactual density. Then

$$\Delta z^* = \frac{B}{\text{counterfactual frequency at } z^*} \times \text{binwidth}$$

Within each year, we divide wages into earnings bins z_i. For each z_i, we calculate c_i, the count of people with earnings in the range $[z_i - \delta/2, z_i + \delta/2)$. We normalize z^* to 0 at the (325) 400 euro threshold. For wide enough bins this captures minijobbers that fell slightly above (325) 400 as well. We set the binwidth $\delta = 20$, such that for $z_i = 0$ we group earnings between -10 and 10, corresponding to earnings between (315 and 335) 390 and 410 euro per month.

We estimate the regression equation:

$$c_i = \sum_{d=0}^{D} \beta_d (z_i)^d + \sum_{n=z_L}^{z_U} \gamma_n 1\{z_i = n\} + \epsilon_i$$

This excludes earnings between z_L and z_U in estimating the counterfactual density. D is the degree of the polynomial used in estimation. Thus the counterfactual density is $\hat{c}_j = \sum_{d=0}^{D} \hat{\beta}_d (z_i)^d$. Excess bunching and missing mass are estimated as the difference between observed and counterfactual bin counts in the relevant earnings ranges. That is $\hat{B} = \sum_{j=z_L}^{z^*}(c_j - \hat{c}_j) = \sum_{j=z_L}^{z^*} \hat{\gamma}_j$. Our normalized measure of bunching divides by the counterfactual frequency at z^* and is recovered as $\hat{\hat{B}} = \frac{\sum_{n=z_L}^{z*} \hat{\gamma}_n}{\hat{\beta}_0}$, where the numerator corresponds to the estimated excess probability of locating at the notch relative to the polynomial and the denominator represents the predicted density at notch if there were no bunching[11]. Thus

$$\hat{\Delta z^*} = \frac{\sum_{n=z_L}^{z*} \hat{\gamma}_n}{\hat{\beta}_0} \times \delta \tag{2}$$

This exercise requires setting z_L and z_U appropriately. Typically z_L is set visually. The upper bound is not obvious. Kleven and Waseem (2013) argues that this is best determined endogenously. Exploiting the fact that the bunching mass should be equal to the missing mass (i.e. $\hat{B} = \hat{M}$ where $\hat{M} = \sum_{j>z^*}^{z_U} \hat{\gamma}_j$), we can pin down z_U using an iterative code. To be precise, we start from a low z_U such that $\hat{M} < \hat{B}$ and gradually increase z_U until $\hat{M} = \hat{B}$. In practice we choose z_U that minimizes the distance between $\hat{M}$ and $\hat{B}$. This procedure is sensitive to the polynomial degree and is not ideal for such a large bunching region, particularly when the Δt considered is relatively large as this generates intensive margin responses among the non-bunchers. Applying this method, the estimated bunching will typically be robust, but the share of frictions may not be. We perform robustness to polynomial degree as well as explore potential biases in simulations. Standard errors can be calculated via the Delta Method or via

[11] I could also divide by the average counter-factual frequency in the dominated region, for example, which accounts for some curvature

bootstrapping.

The identifying assumptions are as follows: 1) The counter-factual distribution is smooth. 2) Bunchers come from a continuous set M = B above the cutoff such that there exists a well-defined marginal buncher.[12]

3.3 Remarks

The model assumes a homogenous elasticity. For the estimation, we select a relatively homogenous group (women with husbands at similar income levels). Moreover, as Kleven and Waseem (2013) show if elastiticies are heterogeneous this process recovers the average earnings response.

The model compares a situation in which mini-jobs exist without a notch to one that introduces the notch, and people to the right of the notch bunch. In practice, if mini jobs are introduced one might expect the favorable rates to attract workers from unemployment (who proceed to bunch). Thus, bunching would be partially driven from people on the left. This is not what is being modeled. In other words, the model implicitly assumes that everyone who wanted a mini job has already gotten one. It compares a baseline that keeps mini jobs but eliminates the notch to the present situation with the notch.

The notch may also cause extensive margin responses from people located above the notch before it existed, but these will be small for people closest to the notch Kleven and Waseem (2013).

Intensive margin responses by non-bunchers also pose challenges. By determining z_U such that $\hat{M} = \hat{B}$, we ignore a potential shift in the earnings distribution within the interior of the upper bracket due to intensive responses by those who do not bunch. This means that some of the missing mass is spread over the entire distribution. As Kleven and Waseem (2013) note this is a minor issue if Δt is small, but in this setting the change in marginal tax rates considered is relatively large. We are exploring sensitivity to this in simulations.

3.4 Incorporating Frictions to Estimate a Structural Elasticity

Even in the absence of a policy reform, one can incorporate frictions into the model (Kleven and Waseem (2013)). Suppose individuals have adjustment costs $\alpha(z)$ that potentially vary with income. If the benefit of moving to the notch exceeds these costs, individuals move and bunch precisely. If we make the (strong) assumption 3) that the degree of friction α^* is locally constant and can be inferred from the dominated region. That is, we estimate α^* as the share of individuals in the dominated region relative to the counter factual: $\alpha^* = \sum_{j \in D} c_j / \sum_{j \in D} \hat{c}_j$.

Under this assumption we can estimate a 'structural' elasticity that takes frictions into account, by inflating the bunching estimate by a factor of $\frac{1}{1-\alpha^*}$. That is,

$$B = \int_{z^*}^{z^*+\Delta z^*} (1-\alpha(z)) h_o(z) dz \approx h_o(z^*)(1-\alpha^*)\Delta z^*$$

such that

$$\Delta z^* = \frac{\sum_{n=z_L}^{z*} \hat{\gamma}_n}{\hat{\beta}_0 (1-\alpha^*)} \times \delta \tag{3}$$

[12]This is problematic if for example people take on mini-jobs as a second job and potentially come from far higher up in the earnings distribution. Hence we restrict to persons who do not hold a mini-job as a second job.

and equation 1 determines the elasticity.

This arguably provides a conservative estimate of earnings responses. Since the benefits to bunching diminish away from the threshold, the adjustment costs required to prevent bunching diminish. Thus the share of people with frictions sufficiently high to prevent bunching likely increases as we move away from the threshold. Thus the share in the dominated region α^* is likely underestimated and hence $(1-\alpha^*)$ is overestimated, decreasing Δz^* and e.

One critique of this methodology is that persons in the dominated region may be there rationally, due to dynamic career concerns. While this may be a concern, it will be addressed in the next section where we formally include an adjustment cost in the model.

3.5 Estimating Adjustment Costs

We now move away from using pure cross sections to to comparing cross sections before and after the 2003 change in the notch threshold (z^*) from 325 to 400 euro. I incorporate a fixed adjustment cost into the workers utility function. This parallels Gelber et al. (2013), who apply a similar strategy for kinks in the U.S. Annual Earnings Test.[13]

We extend the model in Section 3.1 to incorporate a fixed adjustment cost in terms of utility ϕ, paid upon adjusting earnings. Specifically

$$u = z - T(z) - \frac{n}{1+1/e}\left(\frac{z}{n}\right)^{1+1/e} - \mathbf{1}(\text{adjustment} > 0) \times \phi$$

For now the sources of such adjustment frictions are unmodeled. They could be due frictions like lack of information, inattention or hassle costs, search or renegotiation costs, or hours constraints on the firm side combined with search costs. We delve into the sources more formally when we develop a new model in section 6. For now we simply aim to estimate an average adjustment cost.

Notice that we can no longer apply the same single cross section technique to identify ϕ and e. In general, the amount of bunching increases with elasticity and decreases with adjustment costs. One cross sectional notch alone allows us to estimate bunching but not be able to separately determine elasticity from adjustment costs; two cross sectional notches with variation in the location of the notch allow us to construct a system of equations for elasticity and adjustment costs, and solve for both.

The innovation of Kleven and Waseem (2013) is that two moments of the distribution, bunching and share of persons in the dominated region, can be used to identify an observed and a structural elasticity. The method applied here is similar in that it uses bunching in two different situations to distinguish elasticities from an frictions. Intuitively, the bunching in 2002 before the reform jointly identifies ϕ and e; the amount of left over bunching at the old notch after the notch moves to 400 provides the additional information needed to distinguish the two.

Formally, the model in Section 3.1 had a well defined marginal buncher.[14] Our previously defined

[13]A coincidental contribution of this paper is that it is the first that can apply both methodologies (Gelber et al. (2013) and Kleven and Waseem (2013)) and compare and contrast results.

[14]Specifically, the utility gain from moving towards the notch is given by

$$\Delta U = z^* - \frac{n}{1+e}\left(\frac{z^*}{n}\right)^{1+1/e} - (1-\Delta t)^{1+e}\frac{n}{1+e}$$

marginal buncher no longer bunches due to the adjustment costs. Provided the fixed adjustment utility is not so large as to prevent bunching entirely (which is clearly verified in the empirical setting), we can re-derive the elasticity equation we estimate for the new marginal buncher.

The new marginal buncher in 2002 (where z^* corresponds to the notch at 325) is indifferent between utility

$$u^N = z^* - \frac{n^m}{1+1/e}\left(\frac{z^*}{n^m}\right)^{(1+1/e)} - \phi$$

and

$$u^I = (1-\Delta t)^{1+e}\frac{n^m}{1+e}$$

Equating and using the relationship $n^m = z^m = z^* + \Delta\hat{z^*}$ we get

$$\frac{1}{1+\Delta\hat{z^*}/z^*} - \frac{1}{1+1/e}\left(\frac{1}{1+\Delta\hat{z^*}/z^*}\right)^{1+1/e} - \frac{1}{1+e}(1-\Delta t)^{1+e} - \frac{\phi/z^*}{1+\Delta\hat{z^*}/z^*} = 0 \quad (4)$$

As before, we can estimate $\Delta\hat{z^*}$ from bunching and z^* and Δt are known. In contrast to equation 1, this equation now has two unknowns, e and ϕ. In order to estimate this one-time, cross sectional variation no longer suffices. In particular, in the presence of such fixed adjustment costs estimated e as we do confounds it with ϕ.

Now suppose that the notch is moved from 325 euro to 400 euro a month. Previous bunchers at 325 will move to earnings between 325 and 400, provided the gains exceed the adjustment cost ϕ.

The gain from un-bunching after the removal (shift) of a notch is increasing in ability and pre-notch earnings (n and z). There exists a marginal un-buncher with low enough pre-notch earnings that the gains from un-bunching fail to exceed the fixed utility cost of doing so. We develop an equation relating this earnings level z (and hence $\Delta\tilde{z}$, the earnings response of this marginal un-buncher) to e and ϕ below. We estimate this new $\Delta\tilde{z}$ from the amount of bunching remaining at the original 325 threshold. This equation, together with the last, allows us to solve for e and ϕ.

The utility of moving to the new notch (or closer to the new notch) is increasing in pre-notch earnings[15]. Thus there is a buncher who is indifferent between unbunching and remaining at the old 325 euro threshold. If adjustment costs are high, this buncher will have sufficiently high n such that she would

for which

$$\frac{d\Delta U}{dn} = \frac{1}{e(1+e)}n^{-(1+e)/e}z^{*1+1/e} - \frac{(1-\Delta t)^{1+e}}{1+e}$$

which is monotonically decreasing in n.

[15]To see this consider first someone with ability n moving from 325 a month to their optimal level if it falls between 325 and 400. Their optimum occurs at z = n. Their utility gain is given by

$$n - \frac{n}{1+1/e} - z^* + \frac{n}{1+1/e}\left(\frac{z^*}{n}\right)^{1+1/e}$$

which is increasing in n. Second, consider a buncher whose optimum would occur above 400 and they relocate to 400, $z^{*'}$. Their utility gain is given by

$$z^{*'} - \frac{n}{1+1/e}\left(\frac{z^{*'}}{n}\right)^{1+1/e} - z^* + \frac{n}{1+1/e}\left(\frac{z^*}{n}\right)^{1+1/e} = (z^{*'} - z^*) - \frac{({z^{*'}}^{1+1/e} - z^{*1+1/e})}{1+1/e}\left(\frac{1}{n}\right)^{(1/e)}$$

which is increasing in n

like to unbunch and relocate at the 400 euro threshold.[16]. If adjustment costs are lower, this marginal buncher would un-bunch to a point between 325 and 400. In practice, adjustment costs are sufficiently low to ensure the marginal unbuncher relocates below 400.[17]

Thus, the marginal un-buncher, with ability $n^m = z^m = z^* + \Delta\tilde{z^*}$ is indifferent between utility

$$u^N = z^* - \frac{n^m}{1+1/e}\left(\frac{z^*}{n^m}\right)^{(1+1/e)}$$

and

$$u^I = n^m - \frac{n^m}{1+1/e} - \phi \text{ if } n^m < z^{*'}$$

The difference between u^I and u^N is given by

$$\frac{\Delta\tilde{z^*}}{z^* + \Delta\tilde{z^*}} - \frac{1}{1+1/e} + \frac{1}{1+1/e}\left(\frac{z^*}{z^* + \Delta\tilde{z^*}}\right)^{1+1/e} - \frac{\phi}{z^* + \Delta\tilde{z^*}} = 0 \tag{5}$$

.

Everyone between $z^* + \Delta\tilde{z^*}$ and $z + \Delta\hat{z^*}$ unbunch. Remaining bunchers represent persons originally located between z^* to $z^* + \Delta\tilde{z^*}$. The excess mass remaining at the old notch identifies $\Delta\tilde{z^*}$.

$$B_{\text{at old notch after policy change}} = \int_{z^*}^{z^* + \Delta\tilde{z^*}} h_o(z)dz \approx h_o(z^*)\Delta\tilde{z^*}$$

A complication arises from the fact that bunching at the new threshold may extend as far back as 300 if targeting is imprecise, so that we want to estimate excess bunching at the old 325 euro threshold after eliminating bunching that may be due to impreciseness at the new threshold. This is handled empirically by fitting a counter-factual distribution between earnings of 0 and 400, omitting bins at 312.5, 325, and 337.5.

Equation 5 together with equation 4 allow us to solve for ϕ and e. Equation 4 uses bunching at the 325 notch in 2002 to estimate elasticity in the presence of adjustment costs. In principle bunching could either be a result of high elasticity or low adjustment costs. Equation 5 uses left-over bunching at the 325 notch after a shift in policy in 2004 (the policy entered in April 2003) to separately pin down e and ϕ.

The Kleven and Waseem (2013) methodology of using the notch to estimate the share of persons with large enough adjustment costs circumvents the need for this approach and allows estimation of the structural e. However, this paper is interested in ϕ in and of itself. Moreover, we can now compare the

[16]In principle since Δt is now different, due to the new gradual schedule of SSC contributions, this person may want to adjust and move beyond the 400 euro threshold. Since the marginal un-buncher will actually end up below 400, this is immaterial

[17]If the marginal unbuncher were to locate at 400 we would set $u^N = u^{I'}$ where

$$u^{I'} = z^{*'} - \frac{n^m}{1+1/e}\left(\frac{z^{*'}}{n^m}\right)^{(1+1/e)} - \phi \text{ if } n^m \geq z^{*'}$$

Using $n^m = z^m = z^* + \Delta\tilde{z^*}$ this gives

$$\frac{z^{*'} - z^*}{z^* + \Delta\tilde{z^*}} - \frac{({z^{*'}}^{1+1/e} - {z^*}^{1+1/e})}{1+1/e}\left(\frac{1}{z^* + \Delta\tilde{z^*}}\right)^{1+1/e} - \frac{\phi}{z^* + \Delta\tilde{z^*}} = 0$$

two elasticity estimates, which should be similar. We can also see if the estimated adjustment cost aligns with the observed friction share.

This completes the framework for estimated structural elasticities in the presence of adjustment costs as well as the adjustment costs themselves. After describing the data in section 4, we turn to estimating first equation 1 and then equations 4 and 5 in order to recover the elasticity with respect to the net of tax rate (e), the share of workers with frictions large enough to prevent bunching (α^*), and a fixed adjustment cost (ϕ).

4 Data

We use administrative earnings records from the German Social Security system, assembled by the Institute for Employment Research into the Integrated Employment Biographies data file (IEB) (see also Schmieder et al. (2012), Card et al. (2013)). The data contain total earnings and employment duration for every job covered by social security.[18] The data also contain a unique identifier for registered mini jobs, as well information on occupation, industry, employer characteristics, and employee demographics. Our main analysis covers 1999–2013 and focuses on a sample of married women aged 26 to 59 for whom we know (rounded) husband annual earnings. For this sample, we can credibly determine the size of the notch.

The data does not contain marriage identifiers outside of unemployment spells. However, we are able to construct a sample of married individuals using the methodology outlined in Goldschmidt et al. (2014). The Research Data Center (FDZ) uses geocoded addresses, last names, gender, and ages to identify members of the opposite sex, sharing the same last name, living at the same location, whose age differs be less than 15 years. This produces a non-representative sample that likely identifies about 20% of married couples, but is unlikely to make false matches.[19] The couple identifiers are then used to create our sample of married women with rounded[20] annual husband wage.

We further restrict the sample to person-years in the standard social security category or in mini jobs.[21] We drop people who have both a mini and a regular job for sample homogeneity.

5 Quantifying Frictions in Adjusting Earnings

The first subsection estimates a structural elasticity and friction share (equation 1) in the 2002 cross section. The second subsection estimates a structural elasticity and a fixed adjustment cost (equations 4 and 5) using the policy variation in 2003.

[18] Almost 80% of all jobs fall within the social security system (the main exceptions being the self-employed, students, and government employees)

[19] A false match will arise, for instance, if two siblings are of the opposite sex are residing at the same location. Goldschmidt et al. (2014) show evidence that between 88 and 94% of identified couples are indeed married to each other.

[20] to the nearest 10 euro

[21] A standard employment spell is one in which the employment relationship is subject to only the standard social security contributions, as opposed to a myriad of potential exceptions.

5.1 Elasticity and Friction shares in the 2008 cross section

Figure 2 panel a) depicts the earnings distribution for identified married women aged 26-59 with husband wages between 25000 and 45000 euro in 2002. The sample is balanced over 2002–2004. Bunching is evident at the 325 euro threshold.

Figure 3 depicts the estimation procedure used to calculate friction shares, bunching, and thereby the earnings response of the marginal buncher and the structural elasticity. As described in Section 3, we estimate the counter-factual distribution by fitting a seventh degree polynomial to the distribution omitting the bunching area. Table 1 contains the corresponding estimates.

Bunching is estimated at 13.2 times the counter-factual frequency for the highest husband wages, implying an observed (non-friction adjusted) elasticity of 0.109.

The estimated friction share for the highest husband earners is 17% (15% if we only use half the dominated region) of the counterfactual distribution. This implies that between 15 and 17% of people face frictions large enough to prevent them moving to the notch. Adjusting for these frictions gives a structural elasticity of 0.182.

Before proceeding to estimate a fixed adjustment cost, we make two comments on the estimated friction share. Firstly, we admit the possibility that people locate here because of career concerns, or perhaps because they are some of the few that are misidentified as couples and hence face a much smaller notch (and potentially have health care incentives to locate in the dominated region). Nevertheless, career concerns appear unlikely precisely at 326 euro and the matching procedure is unlikely to produce false matches. Furthermore, these concerns do not apply to our second estimate of frictions in the following sections.

Secondly, since the gross tax on earnings upon exceeding the threshold is approximately 42%, this implies that moving from 326 euro to 300 euro saves 130 euro a month with negligible change in labor effort. If 15% of people indeed face adjustment frictions greater than 130 euro a month, then even all others face no adjustment frictions, this implies average frictions of at least 20 euro a month.

5.2 Using Panel Data to Estimate Fixed Adjustment Costs

Next, we turn to using the 2003 reform to estimate a fixed adjustment cost. Recall that the 2003 reform shifted the notch point from 325 to 400.[22]

Figure 4 illustrates the estimation procedure described in Section 3. We first estimate the earnings response of the marginal buncher in 2002 (figure 3). The reform was implemented in April 2003. We examine changes beginning in January 2004. Using 2004 data restricted to the same sample of persons in the 2002 data, we estimate the earnings response of the marginal unbuncher using excess bunching at the old 325 threshold. This requires taking a stance on how imprecise adjustment at 400 might be. The histograms of earnings give some idea of what to expect. We take a conservative approach and only call excess bunching that which clearly distorts the exponential shape of the density. To do so, we fit a polynomial between earnings bins up to 400 euro, excluding the bins centered at 312.5, 325, and 337.5.

[22] In addition, it abolished restrictions on working hours, which could have wage implications, and introduced the gliding zone of SSC contributions upon exceeding the notch. For couples, the gliding zone does not eliminate the notch due to income taxation.

The coefficients on these dummies give excess bunching. This is arguably a lower bound, as one could also define excess at 325 as everyone in these bins down to the original counterfactual distribution.

Table 2 contains the estimation results. The implied structural elasticity in 2004 is 0.177. The fixed adjustment cost is estimated to be 28.761 euro per month.

In work not shown, we repeat this estimation procedure in 2005 and 2006. Excess bunching at the old notch declines over time, resulting in decreased adjustment cost estimates. This parallels the findings in Gelber et al. (2013), where adjustment frictions appear to disappear within a 3 year window.

6 Understanding the Sourcers of Frictions (Ongoing)

In ongoing work, we attempt to better understand the sources of our estimated adjustment frictions. A vast variety of potential theories, ranging from search costs to information acquisition to habit formation could explain the lack of perfect adjustment – yet it is unclear what really binds in practice. We focus here on one potential source of frictions: firm demand constraints. To fix ideas, consider a firm that hires multiple mini jobbers as cleaners and disperses them across its client. Further, imagine all workers at a firm ask to increase their hours (by approximately 10 a month) in order to move from 325 to 400. Due to limited demand the firm says it cannot accommodate these requests yet, but plans to do so in the future. The workers could leave, but search costs could easily exceed the benefits of adjustment. In this scenario, workers will be stuck at 325 until the firm decides it can accommodate the increase. A firm that is growing rapidly could choose not to hire new workers and instead upgrade all workers. Likewise, a firm with enough worker exits (or fires) could adjust all of its workers. We formalize this intuition in a model in the next subsection (ongoing) and provide empirical support in the following subsection.

6.1 Model (Ongoing)

6.2 Data

We present a number of findings consistent with the above intuition. First, we show that the vast majority of workers do indeed stay at their firm; so understanding within firm adjustments is crucial. Second, we show that adjustment is worse in large firms (and more likely to be partial). This seems to rule out an information based story as it is difficult to imagine information being poorer in firms with more mini jobbers. While workers at large firms could simply be different than workers at smaller firms, this finding is nevertheless suggestive and consistent with larger firms finding it proportionally more difficult to increase all their workers' hours. Third, we show that adjustment is indeed better for firms that are experiencing large growth or large decay in terms of their regular (non-mini) workforce. This is again consistent with firms being constrained by limited demand. Finally, we show that this 'V'-shaped pattern is more prominent in areas with above median unemployment.

Table 3, takes all workers in our sample at 325 euro in 2002 (312.5–337.5) and tracks their transitions in terms of monthly earnings in 2004. 20% stay at 325, 18% move between 325 and 400 (337.5–387.5), and 30% move to 400. Of these workers, only 17% change firm, and those that do tend to move not to 400 but to higher paid regular jobs. So within-firm adjustment is an important avenue. Furthermore, we see that small firms and medium firms have much better adjustment to 400 than firms with more than

15 mini jobbers. Interestingly, partial adjustment between 325 and 400 is more common in larger firms, suggesting that fully meeting workers demand is indeed difficult.

Figure 5 examines how adjustment varies with firm workforce growth. Specifically, we decompose workers (by the firm they work at) into various growth category in terms of regular workers (regular workers in 2004 − regular workers in 2002 as a fraction of regular workers in 2002).[23] Under a leontief production function in terms of hours of mini jobbers and hours of regular workers, this would proxy for mini job growth over the period. Within each of these categories we calculate bunching at exactly 325 (312.5-337.5) in 2002 and in 2004 and compute the % drop in bunching. Higher drops correspond to better adjustment. Figure 5 reveals that workers in firms with high growth adjust better than workers in firms that are more stagnant, as would be expected if firm demand constraints mattered. Furthermore, the figure reveals that workers in firms that experience large reductions in their regular work force also adjust better. This could be because these firms are transitioning to a more mini-job centric model, or because these firms have enough quits or fires that they can adjust remaining workers without changes in demand.

Figure 6 repeats this exercise for firms of different sizes, as well as for firms located in areas (communities) with above median unemployment in 1999 and below median unemployment. The difference in levels works as expected – larger firms and firms in high unemployment areas have worse adjustment overall. The importance of growth in terms of adjustment seems to matter more in areas with high unemployment and in large firms, which is again in accordance with the firm demand constraint channel mattering most when there are more workers and when workers cannot easily leave.

In ongoing work we formalize the intuition here and take testable predictions to the data. Moreover, the above work should be viewed with caution as it is correlations and could be masking important omitted variables. Ongoing work examines robustness of these empirical facts.

7 Conclusion

We believe we have identified a setting that ideally lends itself to the analysis of frictions in adjusting earnings. We quantify these frictions using two complementary strategies, finding that on average frictions matter even when the policy at hand has large tax implications. The results complement similar findings for the elderly in the U.S. and for workers in Pakistan. These frictions are temporary, but large enough to negate short term responses to insufficiently sized tax changes, reinforcing the view that micro-econometric elasticity estimates may be seriously attenuated.

Importantly, we attempt to understand the likely sources of these frictions and use the data to inform us on which matter most. We have preliminary evidence suggesting an important role of firms in governing workers' earnings adjustments.

We make some final observations from a policy perspective. First, as expected by standard theory, this notch introduces huge distortions in the earnings distribution. Alternative, less distortive, taxation structures should be considered. Second, the analysis suggests that workers lose out while waiting for firms to be able to accommodate their increase in hours. Reducing unemployment and search costs would likely help.

[23]Workers at multiple firms are assigned the firm with the highest wage.

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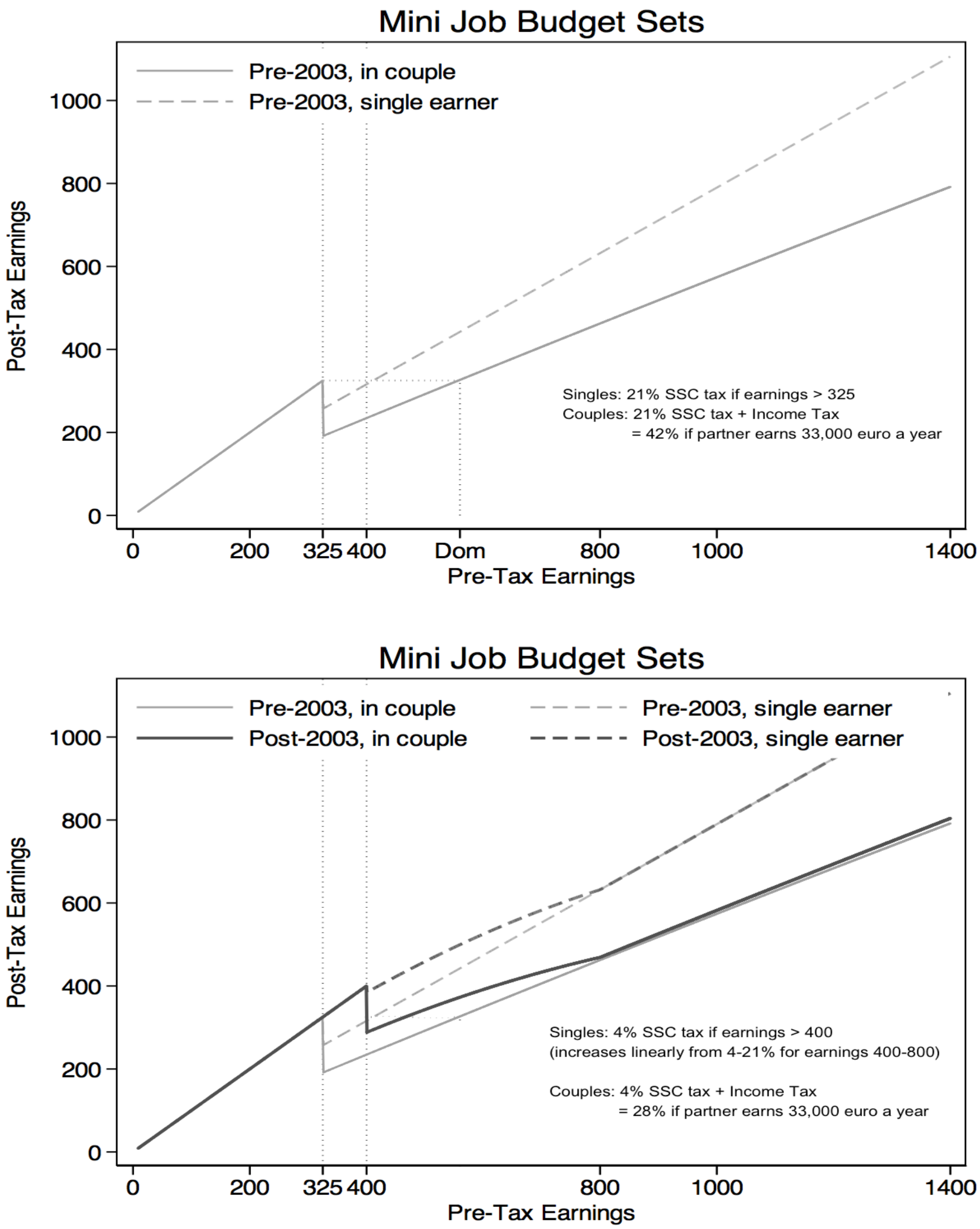
Figures

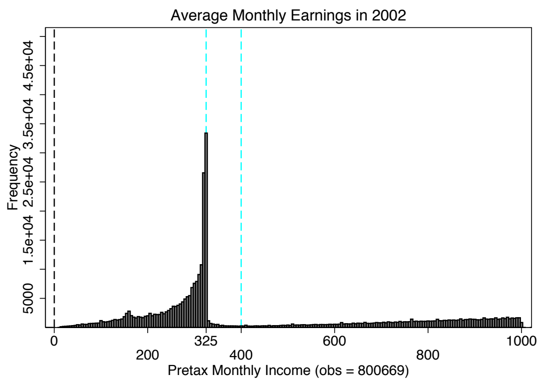
Figure 1: Mini Job Tax Schedules



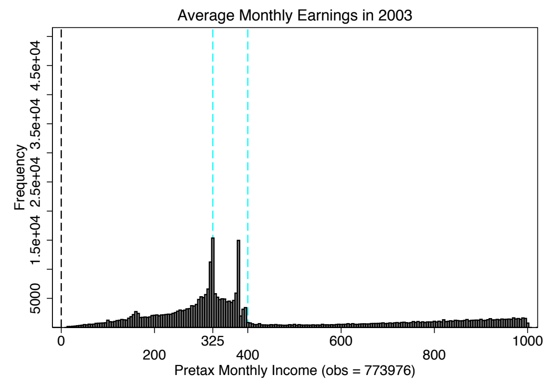
Notes: The figure depicts the notch in the tax schedule for single earnings and married earners in each of the pre- and post-reform periods. The first panel depicts the pre-reform period when the notch is at 325 euro per month. The dashed line is for singles, with the notch coming from having to pay 20% social security contributions on gross earnings once the threshold is exceeded. The solid line is for couples, who experience a larger notch as, in addition to social security contributions, they are subject to income tax from joint taxation upon exceeding the threshold. This figure is generated assuming the partner earns 33,000 euro a year and the mini job is this person's only job. The second panel depicts the post-reform period when the notch is at 400 euro a month. Exceeding the threshold now corresponds to the midi job region in which workers pay social security contributions on a sliding scale starting at 4% and increasing to the standard 20% at 800 euros. The notch remains for couples because they are still subject to income tax from joint taxation upon exceeding the threshold.

Figure 2: Average Monthly Wage Distributions of Married Women with $25000 \leq$ Husband Wage < 45000

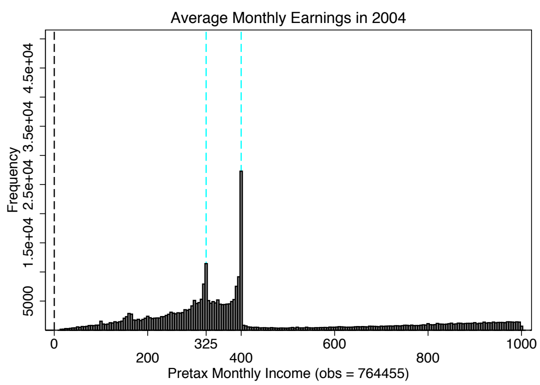
(a) 2002



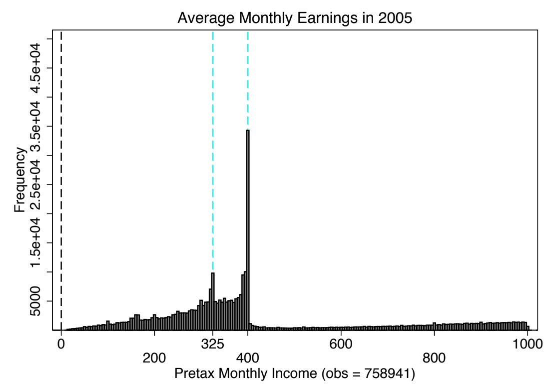
(b) 2003



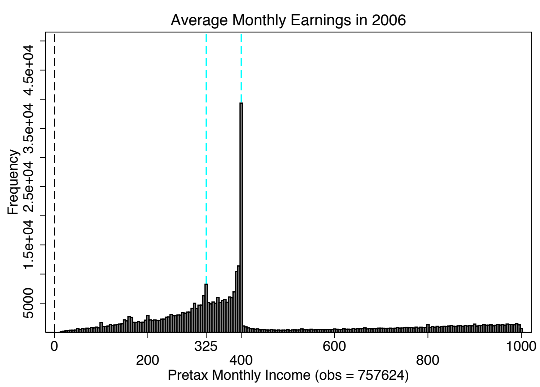
(c) 2004



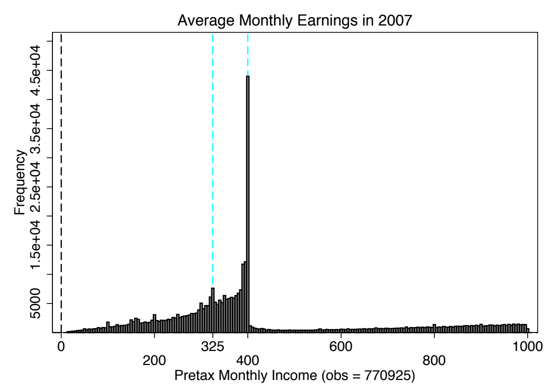
(d) 2005



(e) 2006

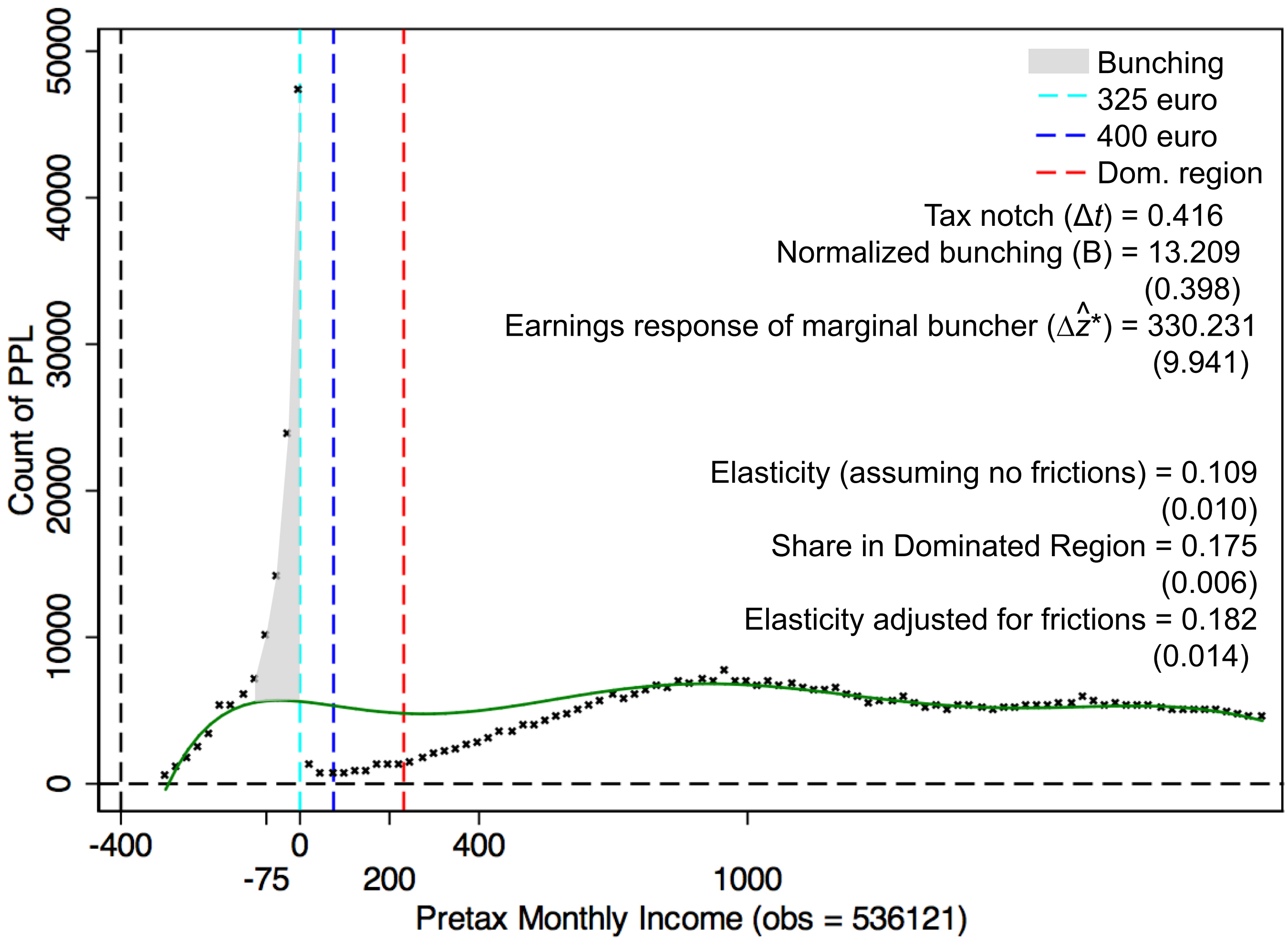


(f) 2007



Notes: The figure depicts the histogram of monthly wages for all identified married women with husband earnings between 25000 and < 45000 euro annually. The first vertical cyan line is at 325 euro, the old pre-2003 notch point, the second is at the notch of 400 euro. Notice that excess bunching at the old notch (325) is very sizeable in 2004, and that it diminishes over time.

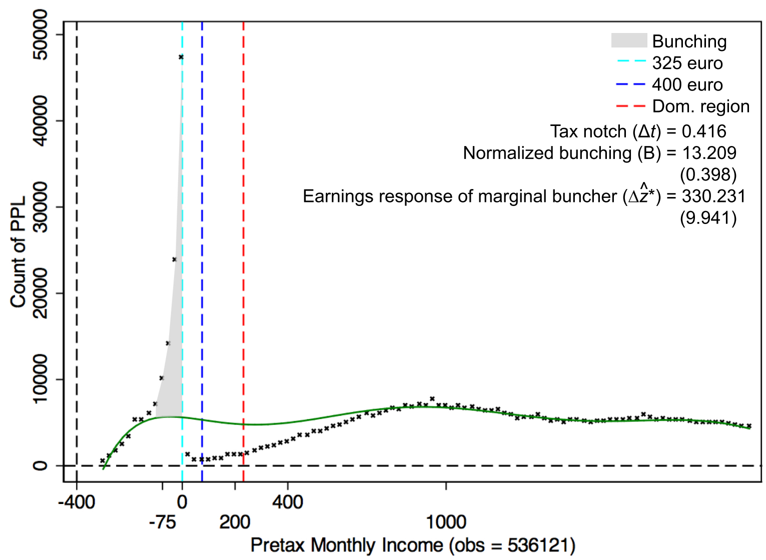
Figure 3: Bunching, Friction, and Elasticity Estimation for Married Women (2002)



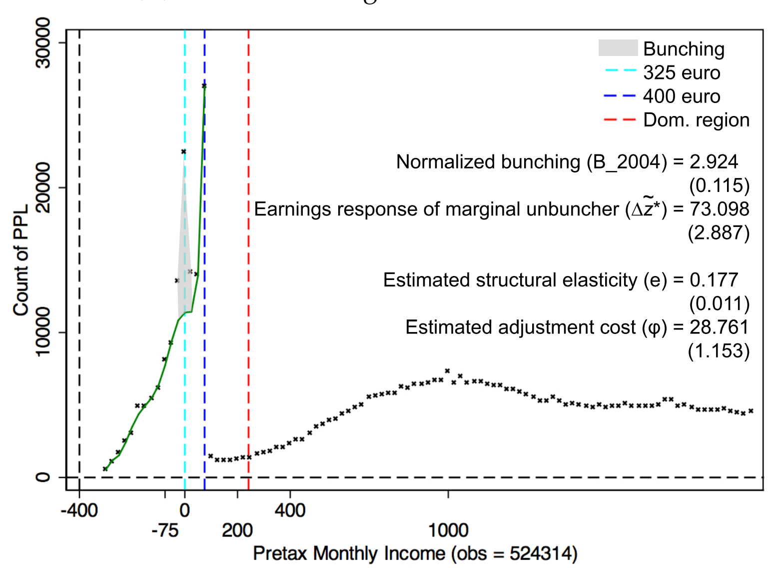
Notes: These panels depict the monthly wage distribution for married females with husbands' annual earnings as specified. Wages are collapsed into bins of size 25 euro, recentered so that 325 = 0. The first vertical line is at 325 euro, the pre-2003 notch point, the second is at the post-2003 notch of 400 euro, and the third line depicts the end of the dominated region assuming each woman's husband is at the average of husband earnings in the specified range. The estimated counter-factual distribution is drawn using the methodology explained in Section 3. The data is restricted to earnings below 2500 euro a month.

Figure 4: Friction and Elasticity Estimates Exploiting the 2003 Reform (for married women with annual husband earnings between 25000 and 45000 euro)

(a) Bunching at Notch in 2002



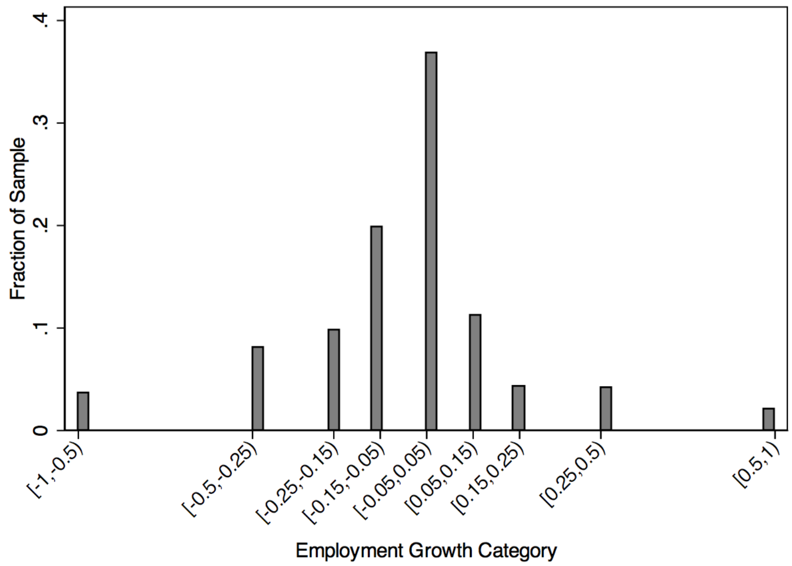
(b) Excess Bunching at Old Notch in 2004



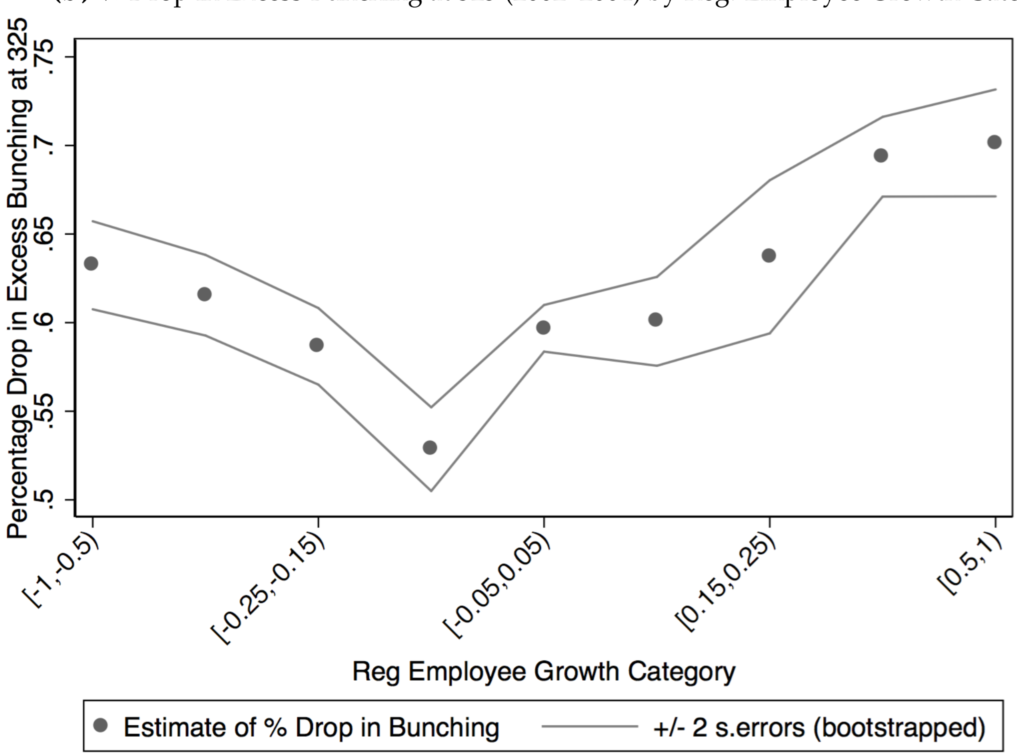
Notes: These panels depict the monthly wage distribution for all identified married women aged 25-59 whose husband earnings are between 25,000 and 45,000 euro annually. Panel A shows their earnings distribution in 2002, while panel B shows their earnings distribution in 2004. The sample in 2004 is balanced to 2002 and hence consists only of women who were working in 2002. Wages are collapsed into bins of size 25 euro, re-centered so that 325 = 0. The first vertical line is at 325 euro, the pre-2003 notch point, the second is at the post-2003 notch of 400 euro, and the third line depicts the end of the dominated region assuming each woman's husband is at the average of husband earnings in the specified range. Using the methodology in Section 3, we estimate a Structural elasticity and fixed adjust cost using excess bunching at the old threshold of 325 euro, a year after it has been moved to 400. The green line in Panel A plots the estimated counter-factual distribution, whereas in Panel B the green line plots the predicted distribution of earnings below 400 euro a month omitting the bins at 325 and 305 in order to compute residual bunching at the old notch after its removal. The data is restricted to earnings below 2500 euro a month.

Figure 5: Adjustment by Firm Size Growth/Decay

(a) Reg. Employee Growth Categories



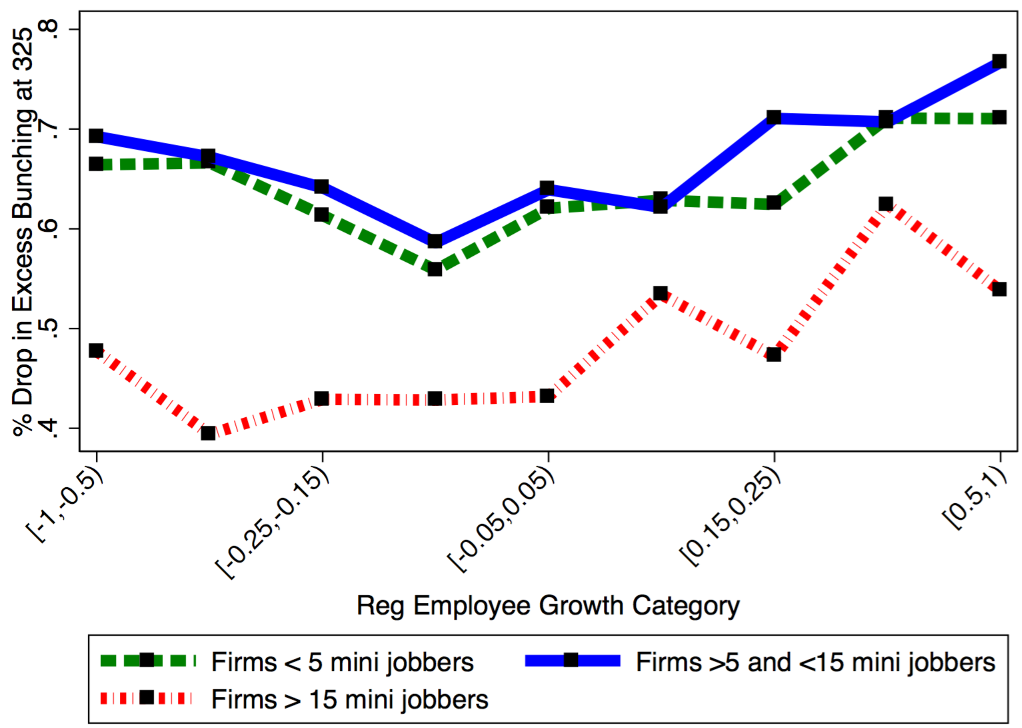
(b) % Drop in Excess Bunching at 325 (2002–2004) by Reg. Employee Growth Categories



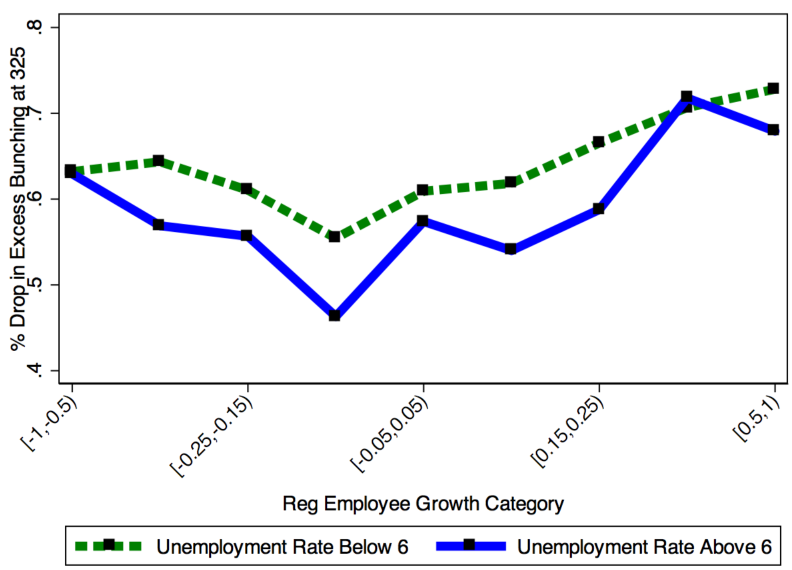
Notes: Panel A shows the regular employee growth categories (Employees in 2004 − Employees in 2002 as a fraction of employees in 2002) and what fraction of the sample they make up. Panel B shows how adjustment varies with these categories. Workers are assigned to the firm with the largest wage in that year if they have multiple firms. Adjustment is calculated as the % drop in excess bunching at exactly 325 between 2002 and 2004. Excess bunching in both cases is relative to the 2002 estimated counter-factual. Standard errors are based on bootstrapping.

Figure 6: Adjustment by Firm Size Growth/Decay: Heterogeneity by size and unemployment

(a) % Drop in Excess Bunching at 325 (2002–2004) by Reg. Employee Growth Categories & Firm Size



(b) % Drop in Excess Bunching at 325 (2002–2004) by Reg. Employee Growth Categories & Unemployment



Notes: Figures are the same as figure 5 except broken down into more categories. Unemployment data is at the community level in 1999.

Tables

Table 1: Structural Elasticity and Friction Share Estimates for Couples 2002

	2002
Δt	0.416
Dominated Region	556
Average Husband Wage	33375
Bunching in 2002	74249
	(566)
Bunching in 2002 (Normalized)	13.209
	(0.393)
Earnings Response of Marginal Buncher (2002)	330
	(9.827)
Friction Share	0.17
	(0.007)
Friction Share Half	0.15
	(0.006)
Adjusted Earnings Response of Marginal Buncher	400
	(15)
Estimated Structural Elasticity (e)	0.109
	(0.010)
Structural Elasticity Adjusted for Frictions	0.182
	(0.014)
N	536121

Notes: This table accompanies Figure 3 and reports estimates of the structural elasticity and friction share using the methodology described in Section 3. Standard errors are based on a bootstrap procedure with 200 trials. Estimates are based on a balanced sample of all identified married females with husband earnings between 25000 and 45000, aged 26-59. Additionally, the analysis restricts to persons in 'regular' jobs and mini-jobs and excludes persons with multiple jobs (with the exception of multiple mini jobs which are summed together).

Table 2: Structural Elasticity and Fixed Adjustment Costs Using the 2003 Reform

	2004
Tax Notch 2002 (Δt)	0.416
Bunching in 2002 (Count)	74249
	(566)
Bunching in 2002 (Normalized)	13.209
	(0.393)
Residual Bunching at Old Threshold (Count)	16435
	(523)
Residual Bunching at Old Threshold (Normalized)	2.924
	(0.115)
Earnings Response of Marginal Buncher ($\Delta \hat{z}^*$, 2002)	330.231
	(9.827)
Earnings Response of Marginal Unbuncher ($\Delta \tilde{z}^*$, 2004)	73.098
	(2.887)
Estimated Structural Elasticity (e)	0.177
	(0.011)
Estimated Adjustment Cost (ϕ)	28.761
	(1.153)
N (with earnings $<$ 2500) in 2002	536121
N (with earnings $<$ 2500) in 2004	524314

Notes: This table accompanies Figures 3 and 4. It reports estimates of the structural elasticity and fixed adjustment cost using the methodology described in Section 3. Standard errors are based on a bootstrap procedure with 350 trials. Estimates are based on a balanced sample of all identified married females with husband earnings between 25000 and 45000, aged 26-59. Additionally, the analysis restricts to persons in 'regular' jobs and mini-jobs and excludes persons with multiple jobs (with the exception of multiple mini jobs which are summed together).

Table 3: Transition Matrix (02-04) for Married Women at 325euro in 2002

	N	Stay at 325	Move Btwn	Move to 400	Exit Data	Move to 400-800	Move above 800	Move Below 325
OVERALL	108102	0.198	0.184	0.296	0.085	0.055	0.073	0.108
(of which stay in firm)	80466	0.238	0.208	0.345	0	0.055	0.058	0.096
(of which move to new firm)	18469	0.123	0.173	0.230	0	0.086	0.175	0.213
SMALL FIRMS (< 5 minij.)	60479	0.214	0.156	0.313	0.094	0.054	0.071	0.097
MED FIRMS (≥ 5 minij. < 15)	27961	0.174	0.202	0.317	0.071	0.056	0.076	0.105
LARGE FIRMS (≥ 15 minij.)	18422	0.186	0.252	0.215	0.070	0.057	0.076	0.146
	N	Enter at 325	Enter between 325–400	Enter at 400		Enter between 400-800	Enter above 800	Enter below 325
NEW ENTRANTS IN 2004	66388	0.052	0.096	0.099		0.077	0.350	0.326

This table shows how workers transition in terms of monthly earnings between 2002 and 2004. At 325 is defined as having average monthly earnings between 312.5–337.5. Between is 337.5–387.5. At 400 is 387.5–412.5. Movements are based on comparing 2002 to 2004. Rows (exclude observation numbers) sum to 1. New entrants are married women who meet sample restrictions in 2004 that were not present in 2002.