Adjust Me if I Can't: The Effect of Firm Incentives on Labor Supply Responses to Taxes

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Abstract

I provide theoretical and empirical evidence on the importance of statutory incidence in labor markets in the presence of asymmetric frictions. Using a theoretical model I show that labor supply responses are stronger when the statutory incidence of taxes or labor rules falls on firms even when wages can adjust freely. I explore these mechanisms by studying labor responses to incentives generated by the "Mini-Job" program aimed at increasing labor supply of low-income individuals in Germany. Using administrative data, I show evidence of a strong behavioral response – in the form of sharp bunching – to the mini-job threshold that generates large discontinuous changes both in the marginal tax rates and in the total income and payroll tax liability of individuals in Germany. Sharp bunching translates into elasticity estimates that are an order of magnitude larger than has been previously estimated using the bunching approach. To explain the magnitude of the observed response, I show that in addition to tax rates, fringe benefit payments also change at the threshold. Mini-job workers receive smaller yearly bonuses and fewer vacation days but are paid higher gross wages than regular workers. These results indicate that lower fringe benefits make mini-jobs attractive to employers, thus facilitating labor supply responses in accordance with the model's predictions.

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The public finance literature has largely ignored the role of firms and firms' incentives when evaluating labor supply responses to tax policies. Under standard neoclassical assumptions and in presence of perfectly elastic labor demand, workers are paid their marginal products, leading to full passthrough of income and social security taxes to employees regardless of the statutory incidence of taxes. This incidence result effectively eliminates firms' involvement in the determination of equilibrium quantities of labor supplied and wages paid. However, this simple framework does not take into account two factors. First, labor regulations and fairness concerns can limit the ability of employers to pass through taxes to workers,[1] giving firms incentives to either avoid taxes by changing the labor structure or to evade taxes.[2] Second, the simple neoclassical setting does not take into account the intrinsic differences between employers and employees: workers are more likely to suffer from search costs, information frictions and behavioral biases than firms. Firms therefore have the ability to either exacerbate these biases by taking advantage of individuals,[3] or on the opposite, mitigate frictions, e.g. by informing workers.[4]

In this paper I challenge the traditional view that the statutory incidence of taxes and other labor rules is irrelevant in labor markets. Instead, I argue that in the presence of frictions, statutory incidence matters through its effect on firm incentives. Taxes, which statutory incidence falls on firms, generate immediate incentives to hire workers of the tax-advantaged type. These incentives allow firms to act as a conduit to workers' preferences, facilitating labor supply responses. On the other hand, taxes, which statutory incidence falls on workers, do not distort relative wages and therefore do not affect firm incentives, leaving it up to workers to find desired jobs.

I provide empirical evidence on the importance of statutory incidence by studying a large tax notch and kink generated by the "Mini-Job" program aimed at increasing labor supply of low-income individuals in Germany, similarly to the Earned Income Tax Credit in the U.S. or the Working Tax Credit in the U.K. Mini-jobs are defined as employment in which earnings do not exceed a predetermined monthly threshold.[5] Because mini-job earnings are exempt from income and employee-paid social security taxes, the mini-job threshold generates large discontinuous changes both in the total tax liability (a notch) and in the marginal tax rates of individuals (a kink). Despite the low value of the threshold - which ranged between €325 to €450 since 1999 – approximately 7.3 million individuals, or 18% of the labor force, hold mini-jobs.[6] Using administrative data of labor histories on a 2% representative sample of the German population, I find sharp bunching at the

[1] Several studies show that the social security taxes might not be fully borne by the employees, e.g. Anderson and Meyer (1997), Anderson and Meyer (2000), Saez et al. (2012), and even income taxes can be partially borne by the employers, e.g. Bingley and Lanot (2002), Kubik (2004), Leigh (2010) and Rothstein (2010).

[2] Firms can respond by hiring more employees with tax-advantaged status or by paying workers under the table. Similar types of optimizing behaviors have been observed in other contexts, e.g. Garicano et al. (2013) show that firms in France limit the number of employees in order to avoid labor regulations. Similar behavior in Italy has been documented by Garibaldi et al. (2004) and Schivardi and Torrini (2008).

[3] It has been shown in many settings that firms take advantage of customer bias, e.g. DellaVigna and Malmendier (2004), Gabaix and Laibson (2006), Ellison and Ellison (2009). See also Akerlof and Shiller (2015).

[4] Best (2014) shows that workers in Pakistan improve their knowledge of the tax schedule from firms' wage offers, which make them more responsive to income taxation.

[5] In addition to earnings requirement, employments were limited to 15 hours per week prior to 2003.

[6] The number of mini-jobs increased from about 4 million in 1999. Source: Federal Employment Agency.

mini-job threshold, which is consistent with employees reducing labor supply to avoid larger tax liabilities. I show that bunching is persistent over time and across demographic groups and follows the threshold precisely.

To estimate the magnitude of the behavioral response, I extend the methodological approaches of Saez (2010) and Kleven and Waseem (2013) to frameworks with large discontinuous marginal and average tax rate changes.[7] The approach separately accounts for the bunching due to a kink and due to a notch, thus generating an unbiased estimate of the earnings elasticity. Elasticity point estimates range from 0.08 to 0.18 for women and from 0.07 to 0.37 for men, depending on the year. Calculated elasticities are 5 to 10 times larger than has been previously estimated using the bunching method and are more in line with studies in the labor supply literature.

I show that the large magnitude of the observed response cannot be explained by salience or institutional settings; instead, I focus on firm incentives. I find that prior to 2003 individuals with multiple jobs and at least one regular job were bunching at the mini-job threshold despite having no incentive to do so, thus presenting direct evidence of firms' response to mini-job rules.[8] I then explore two channels that could make mini-jobs attractive to firms. First, lax labor enforcement might allow firms to reduce fringe benefit payments to mini-job employees as compared to other workers.[9] Second, mini-jobs might allow for more flexible working arrangements. I investigate these channels using firm and household surveys that provide information on working hours and earnings of employees in Germany. I find that mini-job workers receive smaller yearly bonuses and fewer vacation days than regular employees but are paid approximately 6% higher gross wages than regular part-time workers. These results suggest that higher gross wages paid to mini-job workers reflect the lower fringe benefit payments they receive.[10] Next, I rule out the second channel (flexibility of hours) by showing that mini-job workers have similar employment durations as regular part-time workers.

The findings indicate that in addition to tax rates, fringe benefit payments also change at the threshold. To better understand how such firm incentives may affect the magnitude of labor supply responses, I develop a partial equilibrium tax incidence model with job search costs and endogenous hour constraints. In the model, firms offer two types of contracts: regular jobs subject to high taxes, and mini-jobs which are bound by an earnings threshold but are subject to lower taxes. Employees draw job offers from the aggregate distribution of hour-contract combinations offered by firms and accept or reject offers based on individual consumption-leisure preferences and job-search costs. The theoretical model predicts that in the presence of search costs, labor supply responses are stronger if the statutory incidence of taxes or other labor costs falls on firms rather than workers. The

[7]See Kleven (2016) for a detailed review of the bunching approach and the related literature.

[8]Prior to 2003, mini-job threshold applied to cumulative earnings. Therefore individuals with multiple jobs had no incentive to limit their earnings to the mini-job threshold in any one job if their combined earnings exceeded the threshold. Such firm response has been termed "firm bunching" and has been first documented by Chetty et al. (2011). See also Best (2014).

[9]This has been suggested by self-reported survey evidence, see Bachmann et al. (2012), Wippermann (2012) and Weinkopf (2014).

[10]This finding rules out the possibility that the tax break given to employees is shared between workers and firms through lower wages paid to mini-job workers.

result remains robust even controlling for firm frictions. Thus model's predictions explain the large magnitude of observed response to mini-job threshold: because the statutory incidence of fringe benefits falls on firms, differences in fringe benefit rates make mini-jobs attractive to employers, thus facilitating labor supply responses.

The results of this study are policy relevant for two reasons. First, understanding the seeming popularity of mini-jobs is important because similar types of policies have been proposed in other countries.[11] It has been further argued that the flexibility of the German labor market system, and the existence of mini-jobs in particular, are the reasons why Germany faired better in the Great Recession than other countries.[12] Second, since the statutory incidence of taxes is relatively easy to change, the results in this paper suggest that statutory incidence can be used as a policy tool and the choice of statutory incidence should depend on the outcomes the government is trying to achieve. If policymakers wish to reduce distortions arising from taxes and labor rules, then taxes and rules should apply to workers. Further, the results caution against policies that give employers incentives to hire certain tax-advantaged groups: mini-jobs in their current form incentivize workers to enter the labor force but then stay locked in in low-paying jobs. On the other hand, if the government wishes to stimulate job creation, giving incentives directly to firms might lead to faster employment, because such policies generate immediate incentives to hire workers, instead of relying on workers' ability to put downward pressure on equilibrium wages.

This paper contributes to several literatures. An emerging literature in public finance shows that the economic incidence of taxes and the tax revenue collected may vary with the statutory incidence and remittance mechanism if the ability to evade or avoid taxes varies across economic agents (Slemrod (2008) and Kopczuk et al. (2013)), or if the salience of taxes depends on the statutory incidence (Chetty et al. (2009)). This paper is the first to document and explain the mechanism through which the statutory incidence of labor costs can affect the magnitude of labor supply responses to taxes in the presence of frictions. The results demonstrate that adjustment frictions and search costs (Chetty et al. (2011), Chetty (2012), Kleven and Waseem (2013), Gelber et al. (2013)), as well as information frictions (Chetty and Saez (2013) and Chetty et al. (2013)) could be partially mitigated by firm responses.

This paper also contributes to a small literature that studies the role of firms in workers' earnings responses to taxes.[13] Chetty et al. (2011) and Best (2014) show that firms help workers respond to taxes by tailoring the distribution of hours offered to workers' preferences. This paper argues that such "tailoring" and hence the distortions generated by tax notches and kinks will be stronger when the statutory incidence of taxes falls on employers. This paper shows that firms' incentives are important even in circumstances where wages can adjust freely (see also Pencavel (2016)).

This study also closely relates to the vast literature that estimates how measures of labor supply

[11]Specifically, in Spain `http://www.expansion.com/2011/12/07/economia/1323268271.html`, and in the UK `http://www.theguardian.com/society/2012/aug/19/treasury-boost-employment-mini-jobs`.

[12] See Burda and Hunt (2011) for a review.

[13]Relatedly, Kopczuk and Slemrod (2006) stress firms' importance in tax systems due to their central role in the tax collection process.

respond to changes in tax rates. While the approach taken in this work is closest to studies that estimate elasticity of taxable income (e.g. Saez (2010), Chetty et al. (2011), and Kleven and Waseem (2013)), I estimate an elasticity of *wage earnings* which can be directly compared to other labor studies that measure changes in hours (see Keane (2011) for a comprehensive review). This paper makes a methodological contribution by showing how the elasticity of earnings can be estimated in the presence of large kinks and notches. Further, by looking at a subset of single individuals, who only experience changes in social security taxes at the mini-job threshold, this study also contributes to a smaller literature that estimates responses to payroll taxes specifically (Gruber (1997), Saez et al. (2012), Liebman et al. (2009), Lehmann et al. (2013), Bozio et al. (2017)). The results in this paper suggest that it is unlikely that workers value social security benefits at actuarially fair rates.

Finally, the paper makes several contributions to a literature that specifically studies mini-jobs in Germany. First, I document the large bunching at the mini-job threshold and estimate the corresponding elasticity of earnings with respect to net-of-tax rate.[14] Second, this paper provides compelling empirical evidence that mini-jobs are attractive to firms because of the lower fringe benefit costs. Previous studies, see Bachmann et al. (2012) and Wippermann (2012), relied on small surveys of mini-job workers only, providing no evidence as to whether the fringe benefits are denied to mini-job workers specifically or part-time workers in general.[15]

1 Institutional Setting

Marginal employment, or *mini-jobs*, have existed in Germany since 1977. From 1999 until April 2003 marginal employment included jobs in which employees earned less than €325 per month and worked less than 15 hours per week.[16] The employer paid 22% social security tax while the employee was exempt from *both* social security and income taxes. The mini-job threshold applied to the sum of earnings and if these earnings exceeded the mini-job threshold, employees were subject to regular social security contributions (combined 42%) and income taxes on the *entire* earnings. The €325 threshold thus represented a large notch for employees, particularly for married women with high-earning spouses.[17]

The Hartz II reforms introduced on April 1, 2003 made mini-jobs more attractive by abolishing

[14]Caliendo and Wrohlich (2010) use differences-in-differences approach to study the effect of the 2003 reform and find small intensive margin responses, but an increase in the number of mini-jobs as secondary employment. Steiner and Wrohlich (2005) use a structural model and household data data to simulate the effects of the 2003 reform.

[15]See page 45 in Bachmann et al. (2012) and page 59 in Wippermann (2012).

[16]There are two types of marginal employment (*Geringfügige Beschäftigung*) in Germany: employments with earnings below the mini-job threshold (which are the focus of this paper) and short-term marginal employments (*kurzfristige Beschäftigung*), which are not subject to an earnings limit but are limited in duration to 50 working days or two months per year. This second type of employment is significantly less popular than mini-jobs and is not the focus of this paper.

[17]In Germany, married couples are taxed based on the joint income, though there is no marriage penalty. The income schedule for married couples is based on brackets that are twice the size of single individuals. However, spouses may elect, if they choose, to be taxed separately.

the hour constraint and increasing the monthly earnings limit to €400.[18] The employer's social security tax rate on mini-jobs was increased from 22% to 25%. In addition, the reform smoothed the social security notch at the new threshold by substituting it with a kink. The reduced tax liability was now fully phased out upon reaching €800, at which point both employees and employers are subject to regular social security taxes. The reform, however, did nothing to smooth the tax notch in the income tax liability of married individuals: the reduced rate does not apply to income taxes. The mini-job contribution rate was further increased from 25% to 30% on July 1, 2006, but the €400 threshold remained intact until April 1, 2012, at which point the €400 and €800 thresholds were increased to €450 and €850 respectively. The mini-job threshold, social security tax rates and average income tax rates are summarized in Table 1. The budget constraints of individuals are shown in Figure 1.[19]

It is worth noting that while employers pay "social security" taxes on mini-job earnings, these contributions do not qualify mini-job workers for social security benefits (pension, unemployment credits, and medical insurance) on *their own* record. However, there are several ways mini-job workers can obtain social security benefits while in marginal employment. First, spouses of workers in regular employment qualify for medical insurance on their spouse's behalf; a similar rule applies to children under age 18 and students under age 25. Second, all individuals qualify for non-contributory unemployment assistance or means-tested social support which provide individuals with monthly stipends and medical insurance.

Finally, prior to January 1, 2015 Germany did not have a universally applicable minimum wage. Instead industry-specific minimum wages were established through bargaining by respective labor unions. These bargaining agreements covered a large number of full-time workers, however, were not necessarily applicable to part-time workers and especially mini-job workers because coverage depends on workers' union membership. As I show in Section 3 most mini-job employees work less than 15 hours per week and earn between €7 to €10 per hour. However, some mini-job employees report working nearly full-time hours and earning less than €4 per hour.[20]

[18]For a comprehensive review of the Hartz reforms in English see Jacobi and Kluve (2006). For a review of the labor market policy in Germany in 1991–2005 see Ebbinghaus and Eichhorst (2007).

[19]The 2003 reform also allowed workers in regular employment to hold one mini-job tax-free. While multiple mini-jobs are still added up to determine one's social security tax liability, individuals who hold at least one job subject to regular social security taxes, i.e. earning more than €400, can now hold an additional mini-job that would be subject to the mini-job rules. The reform thus made mini-jobs an attractive addition to workers in regular employment, allowing them to earn extra income without paying social security or income taxes on that income. See Tazhitdinova (2017).

[20]These survey reports are consistent with anecdotal evidence of very low wages in Germany. For example, in a 2012 article, Reuters quote a head of a local job agency report that some employees earn as little as 55 cents per hour, see `http://tinyurl.com/reuters2012-lowwages`. See also `http://tinyurl.com/nytimes2011-lowwages`.

2 Behavioral Responses to the Mini-Job Threshold

2.1 Conceptual Framework and Elasticity Estimation Procedure

The bunching approach pioneered by Saez (2010) and extended by Kleven and Waseem (2013) allows researchers to calculate the elasticity of taxable income with respect to the net-of-tax rate by estimating the excess mass at kinks or notches of the tax schedule, defined as discrete changes in marginal tax rates and large discrete jumps in tax liability respectively.[21] Both approaches rely on the ability of a researcher to credibly estimate the counterfactual distribution – hypothetical earnings distribution in the absence of tax changes. But while kinks and notches both lead to bunching they have different implications on the shape of the counterfactual earnings distribution and therefore require different approaches to recover it. In this section I extend the framework of Saez (2010) and Kleven and Waseem (2013) to consider large simultaneous kinks and notches. Following the literature, I assume individuals maximize quasi-linear utility functions $u(c, z) = c - \frac{n}{1+1/\varepsilon}\left(\frac{z}{n}\right)^{1+1/\varepsilon}$ that are increasing in consumption c and decreasing in before-tax income z subject to a budget constraint $c = z - T(z)$. The crucial assumption of the framework is that under a flat tax t, individuals' density of incomes $h(z)$ is smooth and continuous. For simplicity of exposition, I assume that the heterogeneity in incomes z stems only from the heterogeneity in abilities imbedded in utility functions $u(c, z)$. I will return to the more generous case, where individuals' labor supply elasticities vary with ability, at the end of the section.

Suppose that individuals' tax liability $T(z)$ depends on their gross income z:

$$T(z) = \begin{cases} t_1 z & \text{if } z \leq K \\ \Delta T + t_1 K + t_2(z - K) & \text{if } z > K, \end{cases} \tag{1}$$

where t_1 and t_2 are marginal tax rates below and above some fixed threshold K and ΔT is a lump-sum tax individuals must pay whenever their earnings exceed K. The tax schedule thus presents a combined kink-notch at K, where $t_2 - t_1$ determines the size of the kink, i.e. an increase in the marginal tax rate, and ΔT the size of the notch, i.e. a discrete change in the tax liability at the threshold.

Figure 2 illustrates the effects of kinks and notches on labor supply separately. Panel A shows the resulting budget constraint, drawn in bold. The increase in the tax rate from t_1 to t_2 rotates the budget constraint at the threshold, resulting in a dashed line. Individuals who wish to earn between K and z_{kink} under the tax rate t_1 would instead bunch and earn income K when the tax rate increases to t_2. Thus, the kink will generate some bunching as shown in Panel B and lead to a parallel leftward shift of the distribution of earnings. The discrete increase in the tax liability generated by the pure notch ΔT will shift the budget constraint downward from the dashed line to a bold line, as shown in Panel A of Figure 2. This notch will create a region of strictly dominated incomes, so that no individual would choose to earn between K and z_{notch}. The notch will thus lead to further bunching at the threshold K and generate a hole in a final distribution of incomes,

[21] See Kleven (2016) for a detailed review of the bunching approach and the related literature.

as shown in Panel B with a bold curve.

Panels A and B of Figure 2 thus show that the the missing mass does not equal to the entire bunching but only to the portion attributed to the notch. Therefore to construct a credible counterfactual distribution, one must determine what proportion of bunching is to be attributed to the kink rather than the notch. Kleven and Waseem (2013) show that the total bunching is given by

$$B_{total} \approx \Delta z_{total} \cdot h(K), \tag{2}$$

where $h(K)$ denotes the counterfactual density at the threshold K and Δz_{total} solves

$$\left(1+\frac{1}{\Delta z_{total/K}}\right)\left(\frac{1-t_2}{1-t_1}+\frac{\Delta T/K}{1-t_1}\right)-\frac{1}{1+1/\varepsilon}\left(\frac{1}{1+\Delta z_{total}/K}\right)^{1+1/\varepsilon}-\frac{1}{1+\varepsilon}\left(1-\frac{t_2-t_1}{1-t_1}\right)^{1+\varepsilon}. \tag{3}$$

Setting $\Delta T = 0$, one can approximate the amount of bunching due to the kink as in Saez (2010):

$$B_{kink} \approx \Delta z_{kink} \cdot h(K) = \left[\left(\frac{1-t_1}{1-t_2}\right)^{\varepsilon} - 1\right] \cdot K \cdot h(K). \tag{4}$$

Equation (2) thus relates the amount of total bunching at the threshold K, B_{total}, to the elasticity of earnings with respect to net-of-tax rate, ε, while equations (2) and (4) together specify the proportions of total bunching attributable to the kink and the notch. Several observations are worth noting from equations (2) and (4). First, when $\Delta T = 0$ then $B_{total} = B_{kink}$ and therefore the entire bunching is due to the kink. Similarly, when $t_2 = t_1$ then $B_{kink} = 0$ and the entire bunching will be due to the notch. However, for any small changes in tax rates some bunching will always be attributed to the kink only.[22]

The conceptual framework presented above allows me to estimate elasticities of taxable income with respect to the net-of-tax rate by estimating the excess mass at the mini-job threshold in Germany. Because the share of bunching due to the notch is not proportional to the elasticity, one must know the underlying elasticity in order to accurately estimate the counterfactual density – the density that describes what the earnings distribution would be if all jobs in Germany followed the mini-job rules. Since this elasticity is unknown and is the variable of interest, I implement an iterative procedure that starts with an elasticity guess and iterates until a fixed point

[22] Elasticity formulas derived in (2) and (4) assume that elasticities are constant across individuals. These formulae also apply to cases where elasticities are heterogeneous. If the distribution of elasticities is independent from the distribution of ability, (2) and (4) estimate average elasticity in the population. If, on the other hand, the distribution is joint, (2) and (4) estimate average elasticity of individuals at income level K. To see this, suppose ability and elasticities are jointly distributed according to some distribution $\psi(z, e)$. Then $h(K) = \int_e \psi(K, e)de$. Define $\bar{e}_K \equiv \int_e e\psi(K, e)de/h(K)$ to be the average elasticity at earnings level K. Then from (4) follows that the number of individuals bunching at K due to a kink of size $t_2 - t_1$ is equal to $B_{kink} = \int_e \left[\left(\frac{1-t_1}{1-t_2}\right)^e - 1\right]\psi(K, e)de \approx \int_e e \log\left(\frac{1-t_1}{1-t_2}\right)\psi(K, e)de = \bar{e}_K h(K) K \log\left(\frac{1-t_1}{1-t_2}\right)$, where we use approximation $\log(1+r) = r$ with $r = \left(\frac{1-t_1}{1-t_2}\right)^e - 1$. Note that the independence of ability and elasticity distributions implies $\bar{e}_K \equiv \int_e e\psi(K, e)de/h(K) = \int_e \phi(e)de = \bar{e}$, where $\phi(e) = \psi(z, e)/h(z)$. From (2) follows that bunching due to a notch ΔT is equal to $B_{notch} = \int_e \Delta z_{total}(e)\psi(K, e)de = h(K)\mathbb{E}[\Delta z_{total}]$. Therefore, if there is heterogeneity in the population, bunching measures average earnings response.

is found. My empirical procedure closely follows the established approaches of Chetty et al. (2011) and Kleven and Waseem (2013). Below I summarize key points of the estimation algorithm; detailed explanation is available in Appendix Section A.2.

I start with an elasticity guess e^0 and calculate a predicted proportion of bunching due to the notch, $\pi^0_{notch} \equiv 1 - B^0_{kink}/B^0_{total}$, using equations (2) and (4). Next, I generate a counterfactual distribution by fitting a high degree polynomial to the observed density excluding a region around the mini-job threshold. The polynomial is fit in such a way as to equate the proportion of excess mass due to the notch, π^0_{notch} to the missing mass to the right of the threshold. Next, I adjust the estimated counterfactual distribution rightward until the area under the entire counterfactual density equals the area under the observed distribution, to account for the fact that the excess mass due to the kink comes from the individuals moving from points of the distribution to the right of the threshold. An estimate of bunching $\hat{B}^0_{total}$ for the elasticity guess e^0 is then calculated as the difference between this adjusted counterfactual and the observed distribution. The estimated amount of bunching pins down an elasticity of earnings with respect to the net-of-tax rate $\hat{e}^0$ through equation (2). If the elasticity estimate $\hat{e}^0$ matches the initial guess e_0, the initial guess was correct and estimation stops. If the estimated elasticity does not match the guess, i.e. $\hat{e}^0 \neq e^0$, I update the guess to $e^1 = \hat{e}^0$ and repeat calculations for the new guess. I proceed with these iterations until a fixed point is achieved, such that $\hat{e}^k = e^k$.

Standard errors are calculated using a parametric bootstrap procedure where a large number of estimated vector of errors ε_j are drawn from (24) with replacement. The new errors are used to generate a large number of earnings distributions and, employing the technique above, corresponding estimates of $\hat{b}$. Standard errors are defined as the standard deviation of the distributions of excess bunching measures $\hat{b}$ and elasticities $\hat{e}$. The bootstrap procedure takes into account both iterative processes: it incorporates both a search for an optimal missing mass, i.e. finding z_u, and a search for a fixed point elasticity.

2.2 Data Description

The main source of data is the weakly anonymous Sample of Integrated Labor Market Biographies (Years 1975 - 2010).[23] The Sample of Integrated Labor Market Biographies (SIAB) provides information on employment, job search and receipt of unemployment benefits for a 2% sample of the *wage earners* – 1,639,325 individuals – in Germany from 1975 until 2010.[24] However, the information on mini-job workers who are the main subject of this study is only available starting from 1999. Employment histories consist of employer notifications which are submitted when an employee is hired, terminated, or when an employment is interrupted. In addition, all employment relationships

[23] Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access. For detailed data description see vom Berge et al. (2013).

[24] The 2% sample comprises of all individuals who were subject to Social Security or received unemployment benefits according to Social Code books II and III (since 1975), have been marginally employed (since 1999), or registered as a job seeker or participated in a training measure (since 2000). In short, the SIAB dataset presents a 2% sample of the *non-self-employed* labor force in Germany.

that exist as of December 31 generate an end-of-the-year notification. Thus if no changes are made to the employment relationship then only one notification is recorded per year. Otherwise, multiple notifications, that are precise to the day, are recorded.[25] The data provides demographic and establishment variables such as sex, age, citizenship status, education, occupation, economic activity of the establishment, number of employees at the establishment and the median wage. Unfortunately, marital status and number of children is known only for benefit recipients and those engaged in job search.

Since the mini-job threshold applies to combined earnings, I estimate elasticities based on average monthly earnings. For individuals with one episode of uninterrupted employment, average monthly earnings are calculated as the reported daily wage times the number of days worked divided by 30. For individuals with multiple employment periods, I focus on the period of longest employment and disregard any employments that do not overlap with this "main" episode by at least 5 days. I then calculate the average monthly earnings as the sum of earnings from all employments divided by the duration of the "main" spell." The core sample is restricted to individuals in regular and marginal jobs who are not receiving unemployment benefits; employments of other types, e.g. trainees, casual workers, etc, are dropped. Unless otherwise noted I further restrict the sample to individuals aged 31 through 54. I do so for two reasons: first, a large number of secondary and postsecondary students receive funding through the Federal Training Assistance Act (BAföG). While the students are allowed to hold part-time jobs, BAföG stipends are withdrawn euro per euro when earnings exceed €400 per month.[26] Second, individuals in partial retirement or on disability insurance, which are most commonly claimed starting from the age of 55, become subject to an earnings test on their benefits when the earnings exceed €400.

Table 1 summarizes the social security tax rates for mini-job and regular workers, τ_{Mini} and τ_{Full}, as well as the *average* income tax notch ΔT_{Income} and marginal tax rate τ_{Income} for men and women. Corresponding budget constraints are shown in Figure 1. Because Germany allows for joint taxation of married couples, the size of the income tax notch ΔT_{Income} and marginal income tax rate τ_{Income} at the mini-job threshold depend on individual's marital status. Since the SIAB data does not contain information on spousal earnings, I estimate ΔT_{Income} and τ_{Income} using the German Socio-Economic Panel (SOEP).[27] When calculating spousal incomes I take two types of earnings into account: labor earnings (regular and self-employed) and social security pensions (old-age, disability, and widowhood).[28] Further, using the results from Doerrenberg et al. (2017), I

[25]Because the SIAB data includes all notifications submitted by employers on behalf of their employees, some duplicate entries are present. Appendix A.1 carefully describes how duplicate observations are identified and the number of dropped observations.

[26]BAföG stipends can be, in principle, received at any age, therefore some individuals in my sample might be responding to the BaföG incentives rather than the mini-job threshold. The number of such individuals older than 25, however, should be small: from 2004 through 2013 the total number of BAföG recipients ranged from 532,000 to 620,000, among these less than one third was given to postsecondary students. See the Federal Ministry of Education and Research statistics.

[27]For the details of the calculations see Appendix A.3.

[28]Prior to 2005 statutory pensions were tax-exempt. Starting from 2005, 50% of pension earnings are subject to income tax, and the percentage has been increasing by 2 percentage points each year. Taxation of private pensions vary and for this reason are not included in the main analysis. In the Appendix A.3 I consider alternative income

assume that individuals can claim 20% of their earnings as deductions.[29] Table 1 shows that women experience the largest income tax notch at the threshold, ranging between €71 to €88 depending on the year. Men experience smaller income notch at the threshold, ranging from €25 to €34.

Because employer taxes differ between mini-job and regular workers, I calculate elasticities using changes in marginal tax rates that apply to *gross* earnings – actual wages paid plus the employer portion of social security taxes and I assume that the social security and income taxes are fully passed through to the employee. Finally, my elasticity estimates rely on two additional assumptions. First, that individuals do not value social security benefits (unemployment insurance, health insurance and pension insurance) gained from regular employment. This assumption is weakly consistent with evidence that people do not assign high value to pension benefits, see Fitzpatrick (2014) and Tazhitdinova (2015), and implies that the estimated elasticities represent a *lower* bound on the true magnitude of behavioral response. Second, I assume that only tax liabilities change at the threshold. Thus I disregard the possibility that mini-jobs and regular jobs differ in job security, likelihood of promotion, or fringe benefits. Since regular jobs are likely to provide with better long term prospects, the elasticity estimates again represent a *lower* bound on the true elasticities of earnings with respect to net-of-tax rate. I return to this assumption in Section 3 where I study fringe benefits of mini-job and regular workers using a different dataset.[30]

2.3 Estimates of Labor Responses to Mini-Job Threshold

2.3.1 Graphical Evidence

Figures 3 and 4 show the distributions of monthly *posted* (exclusive of employer social security taxes) wage earnings of women and men by calendar year. Each point shows the number of individuals in a €25 bin, scaled to represent the German population in that year from a 2% SIAB representative sample. The vertical red lines identify mini-job thresholds: €325 prior to 2003 and €400 thereafter. Several observations are striking. First, both men and women show strong responses to tax incentives in the form of sharp bunching at the threshold. Second, bunching is concentrated just below the threshold with little excess mass above the threshold consistent with the existence of a notch. The positive mass to the right of the threshold indicates that some individuals experience large frictions and are not able to adjust working hours as necessary. Third, bunching is substantially larger for women than for men which is consistent with women experiencing larger tax changes at the threshold (due to income taxes) and hence stronger incentives to bunch. Fourth, when the threshold increases from €325 to €400 on April 1, 2003, bunching adjusts quickly but not

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specifications and show that calculations are not sensitive to the specification because the vast majority of Germans rely on statutory pensions as their main source of income during retirement.

[29] As a robustness check, I also consider a more conservative assumption that individuals only take advantage of the wage-related expenses deduction ("Werbungskosten") and other deductible expenses deduction ("Sonderausgabenpauschbetrag") in the Appendix A.3.

[30] Results in Section 3 suggest that mini-job workers receive smaller bonuses and fewer paid vacation days but that their gross wages are approximately 6% higher than the gross wages of regular employees. These results indicate that the total labor expenditures for mini-job and regular workers are similar, in which case elasticities described in Section 2.3.2 are estimated correctly.

immediately. In the year of the change, in 2003, there is substantial bunching at the new threshold. Already by the end of 2004 roughly two thirds of the excess mass is shifted to the new threshold.[31]

Figures 3 and 4 show earnings distributions by year for men and women aged 31 through 54. In Figures 5 and 6, on the other hand, I plot earnings distributions for men and women by 4 age groups: under 30, 31-44, 45-54, and over 55 year olds. For comparison I show respective earnings distributions in 1999-2002, 2003-2005 and in 2006-2010. Bunching patterns in Figures 5 and 6 show substantial heterogeneity between men and women of different age groups. For women, bunching shows inverse U-shaped relationship with age, with most bunching observed for 35-45 year old women. This observation is consistent with tax incentives experienced by women: spousal incomes and child-rearing responsibilities are largest mid-life. For men, bunching shows U-shaped relationship, with most bunching observed for young men (likely corresponding to students receiving BAföG stipends) and older men in early retirement. Figures 5 and 6 also show considerable heterogeneity in the speed of adjustment to the new threshold. Younger individuals adjust the fastest, as can be seen by relatively small excess bunching at the €325 threshold in 2003-2005. Older individuals adjust slower with oldest men adjusting the slowest: large number of males aged 55+ continued to bunch at the old threshold in 2003-2010.

2.3.2 Elasticity Estimates

I follow the estimation procedure outlined in Section 2.1 and tax rate changes described in Section 2.2 to calculate the earnings elasticities with respect to net-of-tax rate. Table 2 summarizes elasticity estimates and corresponding excess mass by year for men and women.[32] To calculate elasticities, I fit a 7th degree polynomial to the empirical distribution of *gross* earnings: it is important to use the distribution of gross earnings because posted earnings (shown in Figures 3–6) do not account for differences in employer-paid social security taxes below and above the threshold, making the comparison inappropriate.[33] The lower bound of the exclusion region z_l is determined visually and ranges from 4 bins (not including the threshold bin) 1999-2002 to 7 bins in 2003-2005. The estimation procedure starts with an initial guess of $e_0 = 0.01$ and iterates until a fixed point is reached. Bootstrap standard errors are based on 1000 iterations. The estimated elasticities are not very sensitive to the specification: in Appendix A.4 I show that results are robust to the choice of

[31] Another observation from Figures 3 and 4 is that individuals do not respond to a concave kink point at €800. Recall that starting from 2003, the social security taxes paid by individuals are gradually phased out in the monthly earnings interval of [€400,€800]. For monthly income $X \in$ [€400,€800], the total amount of social security tax due is equal to $[400 \cdot \tau_{Mini}/\tau_{Full} + (2 - \tau_{Mini}/\tau_{Full})(X - 400)] \cdot \tau_{Full}$, and therefore the combined marginal tax rate changes from $\frac{2\tau_{Full} - \tau_{Mini} + \tau_{Income}}{1+0.5\tau_{Full}}$ to $\frac{\tau_{Full} + \tau_{Income}}{1+0.5\tau_{Full}}$ at €800.

[32] Excess mass measures the amount of bunching at the threshold as percent of the counterfactual density in that region, see definition (25) in Appendix A.2. The actual fits of the counterfactual distributions are also available in the Appendix Figures C.1 and C.2.

[33] Assuming wages reflect all labor costs, an individual earning €400 in a mini-job in 2010 would have to work more hours than a person earning €400 in a regular job, because the employer-paid social security tax rate for mini-jobs was approximately 10% higher than for regular jobs. The empirical distributions are generated by multiplying reported posted earnings of mini-job workers by $1 + \tau_{Mini}$ and earnings of regular employees by $1 + 0.5\tau_{Full}$. Because $\tau_{Mini} > \tau_{Full}$ there is a small number of regular employees whose gross earnings fall in the interval $(K(1 + 0.5\tau_{Full}), K(1 + \tau_{Mini})]$. These individuals are dropped, so that all observations below the gross mini-job threshold $K(1 + \tau_{Mini})$ correspond to observations below the official posted mini-job threshold K.

income bin width, degree of polynomial and income definition.

The results in Table 2 show that yearly elasticity point estimates range from 0.08 to 0.18 for women and 0.07 to 0.32 for men. Excess bunching, on the other hand, shows smaller variation, ranging from 12.67 to 16.48 for women and from 8.1 to 12.69 for men. Both sets of elasticities show an upward trend, with largest elasticities in 2007-2010 than in 1999-2002. Table 2 suggests that earnings responses to the mini-job threshold are large. If the magnitude of the observed response is driven by individuals' preferences, we should observe substantially smaller bunching for individuals who experience smaller tax changes at the mini-job threshold. On the other hand, if the large bunching is due to firms readily offering mini-job positions, at-the-threshold jobs will be "diffused" across population groups and we will see substantial bunching regardless of individual's status. To investigate how the magnitude of response changes with individuals' incentives, I divide the sample into several groups: individuals with multiple jobs, single individuals, women and men of different ages, and individuals working in different industries. The results described below show that at-the-threshold jobs are readily available in the labor market and are often taken up by individuals who have small incentives to bunch (e.g. singles, men) or none at all (individuals with multiple jobs before 2003).

Figure 7 focuses on individuals with multiple jobs. Prior to 2003, the mini-job threshold applied to cumulative earnings, therefore, individuals who had a regular job had no incentive to limit their secondary earnings to the mini-job threshold, since doing so would not reduce their tax bill. Nevertheless, Figure 7 shows substantial bunching at the mini-job threshold in the distribution of secondary earnings in 1999-2002.[34] Of particular interest is that in addition to bunching at the mini-job threshold, the distribution shows a permanent drop at the threshold. Figure 7 implies that for the vast majority of individuals who hold multiple jobs, the second job is effectively a mini-job. This bunching has been termed "firm bunching" by Chetty et al. (2011) and is a direct evidence of firm responses to the mini-job threshold.[35]

Table 3 shows how labor supply responses vary by marital status, age and industry. Recall that mini-jobs provide two types of tax breaks: first, they exempt workers from employee-paid social security taxes, and second, they exempt workers from income taxes. The income tax exemption is irrelevant to single individuals because their total earnings remain too low to qualify for income taxes. Therefore, for these individuals bunching at the mini-job threshold identifies responses to changes in social security liability only. Table 3 shows elasticity estimate for a selected sample of plausibly single individuals.[36] The results show reasonable estimate of elasticity in 1999–2002

[34]To generate these figures, I restrict the sample to individuals with only 2 jobs per year that are held *concurrently* at different establishments. Because the SIAB data provides job status identifiers, I can verify that these secondary employments are indeed subject to regular social security taxes. Figure 7 thus presents the lower bound on the total amount of bunching in secondary jobs, because individuals who work at 3 or more establishments during the year are not included.

[35]Starting from 2003, individuals with a regular job are allowed to hold one-mini job tax-free. This reform lead to an increase in take up of secondary jobs, with a large number of these jobs being at-the-threshold jobs (Tazhitdinova (2017)).

[36]The SIAB earnings data in general does not provide information on individual's marital status, however, this information is available when individuals apply for unemployment insurance (UI) benefits or register with an employment agency. Because of these limitations, in my sample of "single" individuals I include workers who have applied

when single individuals experienced a large social security notch. However, when the notch was eliminated in 2003–2010, the elasticity estimates double, reflecting similarly large number of individuals in at-the-threshold jobs despite a decrease in tax incentives to bunch. I find substantial heterogeneity in elasticities across age groups: the results are again consistent with job diffusion prediction: individuals that experience relatively small incentives to stay below the threshold show larger elasticities than individuals with stronger incentives. For example, women and men under age 31 or over age 55 appear to be more responsive to tax incentives than individuals aged 31-54.

To summarize, the results show large bunching and higher corresponding elasticities among individuals with weaker financial incentives to stay below the mini-job threshold: I document larger elasticities for men than women, unusually strong responses among younger and older workers, high elasticities for single individuals, and I observe bunching among secondary job holders who have no incentives to bunch. These findings together suggest that mini-job workers are readily offered in the market and individuals experience large enough frictions that prevent them from perfectly sorting across jobs.

2.3.3 Explaining the Large Magnitude of Response

Estimated elasticities are substantially larger than have been previously estimated using the bunching method. Previous studies estimated elasticities of less than 0.06 even though most of these studies focused on *taxable income* rather than wage earnings. For comparison, Saez (2010) finds elasticities of 0.003–0.025 (statistically insignificant) for wage earners around the EITC limits in the USA; Chetty et al. (2011) estimate elasticities of approximately 0.01 for all wage earners, 0.02 for women, and 0.06 for married women professionals in Denmark; and Bastani and Selin (2014) find statistically significant elasticity of 0.001 for wage earners in Sweden. Instead, elasticities estimated in this paper are of comparable magnitude to elasticities estimated using non-bunching methods.[37] In the rest of this section I argue that institutional differences do not present a sufficient explanation for the large magnitude of observed response and require a different explanation.

There are several reasons why elasticities derived from the responses to the mini-job threshold may be larger than previous estimates. First, this study focuses on part-time workers who are likely to have greater ability to adjust working hours and locate at the mini-job threshold. Second, the magnitude of the notch and kink at the mini-job threshold is particularly large, providing stronger incentives to optimize. Third, the mini-job threshold remained fixed over time thus becoming more salient. Fourth, there could be unobserved institutional differences that make German workers particularly responsive to tax incentives. Fifth, the observed response represents evasion, rather than true real response. In this section, I discuss the validity of each of these explanations.

for UI or registered with an employment agency at least twice during 1999-2010 and who reported the same marital status in those years. I then assume that these individuals had the same marital status *in between* the reports. The obtained subsample, of course, is not a representative sample of single individuals, since individuals are selected based on their unemployment and/or job search experience. To partially mitigate this concern, I further require that these individuals have at least a 3 year gap between UI applications and only include years when individuals did not receive UI benefits.

[37] For example, Keane (2011) reports an average elasticity of 0.31 across more than 100 studies.

While part time workers have more flexibility in adjusting their hours, previous studies failed to uncover large responses within this group of workers. For example, Saez (2010) finds little response among the part-time workers to the first kink of the EITC and estimates statistically insignificant elasticities close to zero. Paetzold (2017) focuses on part-time workers in Austria and estimates a taxable income elasticity of 0.1, with most of bunching stemming from adjustments in the amount of deductions claimed rather than wage earnings. Finally, Tazhitdinova (2015) studies labor supply responses to the kink generated by the payroll and income tax exemption thresholds in the UK and estimates small elasticities of 0.04 – 0.08.

The combined kink and notch at the mini-job threshold is indeed very large, however, several previous studies considered large tax changes and found weak responses. For example, Bastani and Selin (2014) and Paetzold (2017) study responses to kink points at which income tax increased from 36.4% to 59.7% or from 0% to 38.33% respectively. Both studies obtain small elasticities of 0.01 or 0.1, despite focusing on taxable income. It could also be argued that notches induce a disproportionally stronger response than kinks. Nevertheless, the two recent studies that rely on notches – Kleven and Waseem (2013) and Hargaden (2015) – find elasticities of taxable income of less than 0.06 even after accounting for frictions that individuals experience.[38]

The mini-job threshold has been nominally fixed for a number of years and therefore might be more salient than inflation-adjusted thresholds studied by other researchers. There are several reasons why this is an unlikely explanations for the large magnitude of response. First, prior to 1999 the mini-job threshold was inflation-adjusted, yet, we observe large bunching and large corresponding elasticities in 1999. Second, bunching adjusts rapidly when the threshold increases (recall Figure 3) suggesting that people are well aware of the threshold value. Third, Paetzold (2017) also study nominally fixed threshold and found weak bunching. Finally, it is important to note that there is nothing a priori more salient about mini-job rules than other regulations. Mini-jobs are widely advertised on job search exchanges, however, this form of salience can be the result of their popularity rather than the cause of it.

It is possible that German workers are particularly responsive to tax incentives for some unobserved institutional reasons. To counter this explanation I estimate elasticity of taxable income around the first kink of the income tax schedule in 1998 and 2001 using the Wage and Income Tax public-use datasets.[39] I find small bunching and small taxable income elasticities, ranging from 0.04 to 0.08, see Figure 8. These elasticities are several times smaller than the elasticities estimated in Section 2.3.2, despite reflecting both real responses – reductions in hours worked – and potential avoidance responses – through income deductions. Doerrenberg et al. (2017) recently show that the elasticity of taxable income in Germany is 2-3 times larger than the elasticity of earnings exclusive of deductions.

[38]Kleven and Waseem (2013) use the share of unresponsive workers to scale elasticities to account for the percent of individuals affected by the frictions costs in Pakistan and calculate an upper bound on the taxable income elasticity of less than 0.035 for wage earners. Applying this approach to this paper would make elasticities 1.5-2 times larger.

[39]See Lohn- und Einkommensteuerstatistik datasets, `http://www.forschungsdatenzentrum.de/bestand/lest`. Unfortunately, a similar exercise cannot be applied to other tax brackets because the income tax schedule in Germany consists of continuously increasing marginal tax rates.

Because all wage earnings are third-party reported, the large bunching observed at the mini-job threshold could not be due to outright evasion. Nevertheless, it is possible for employers and employees to collude and report at-the-threshold earnings. However, in circumstances where such collusion is jointly attractive, a more attractive strategy involves paying employees' "under the table" thus also avoiding mini-job social security taxes.[40] As a robustness check I study how the amount of bunching and estimated elasticities change with firm size, since collusive behavior is unlikely to be prevalent among larger firms. In Appendix Table C.5 I show that bunching is indeed larger for smaller firms but the difference is not substantial. Beyond evasion, mini-jobs can be attractive to smaller firms because of lower administrative costs.[41]

Finally, estimated elasticities could be biased upward if the mini-job threshold leads to strong extensive margin responses, whereby a large number of workers have preferences for working strictly more than the mini-job threshold. Such responses would make the observed distribution to the right of the threshold lower than it would be otherwise, and leave the distribution to the left unchanged. Therefore, when fitting the counterfactual, we might slightly overestimate the amount of bunching. The amount of overestimation is likely to be very small for two reasons because estimation of the counterfactual distribution relies not on the total number of individuals who exit the labor force, but the percent of these individuals in each bin, which is likely to be negligible.[42] A recent study explored the importance of extensive margin responses on the elasticity estimates around a large notch in the disability insurance system in Austria and found the bias to be very small (Ruh and Staubli (2017)). Since the reform in 2003 increased net-of-tax incomes above the notch, individuals who quit the labor force had an incentive to return to the labor force. Figure C.3 overlaps 2002, 2003 and 2004 distributions for women. While there is a small increase in the number of people immediately to the right of the threshold (consistent with intensive margin responses), there are no increases in participation rates further to the right of the threshold. This provides some evidence that extensive margin bias is likely to be small.

3 Differences in Wages and Fringe Benefits

So far we have assumed that job choice is driven by tax considerations alone. However, it is possible that mini- and regular jobs differ in aspects other than taxes. In this section I use detailed firm

[40] These taxes generate no benefits for the employees and therefore under-the-table income is equivalent to mini-job income from employees' point of view.

[41] Social security reporting and remittance is very complicated for regular workers, since different types of social security contributions must be remitted to different offices. Späth (2013a), Späth (2013b) and Koch et al. (2013) show that marginal employment and other flexible contracts are particularly popular with young firms, which are likely to be small.

[42] Suppose the total amount of mass at the threshold is B and the true counterfactual value is c. Then ideally, we would like to estimate the excess bunching as $(B-c)/c$. Let p identify the percent of individuals who choose to exit the labor force, then we will underestimate the counterfactual by approximately $p \cdot c$ and therefore the estimated excess bunching will be $\frac{B-c(1-p)}{c(1-p)}$. The absolute value of bias is $\frac{Bp}{c(1-p)}$, or as proportion of excess mass, $\frac{B}{B-c}\frac{p}{(1-p)}$. Since the $c \ll B$ in case of mini-job, the size of the bias will be driven by the magnitude of the extensive margin response $\frac{p}{(1-p)}$. The bias effectively overestimates intensive margin elasticity by incorporating extensive margin responses. This type of bias applies to the bunching approach around kinks also, though the bias is likely to be stronger for notches.

and household data to explore how mini- and regular jobs differ in working hours, wages, fringe benefits, as well employment durations.

3.1 Empirical Approach

Consider the following thought experiment. Suppose firms are perfectly competitive and pay wages w_1 and w_2 to mini-job and regular workers according to the labor market equilibrium. Assume that firm f production needs require an employee i who would work h_{if} hours per week. A firm searches for a worker in the labor market and hires one as a mini-job worker if the hour needs are low and $h_{if} \cdot w_1 \leq K$, and as a regular worker otherwise. Because the mini-job threshold K is set exogenously by the government and as long as production hour needs arrive at random, the equilibrium wage differential $\log(w_1/w_2)$ if given by β_0 from

$$\log(w_{if}) = \alpha_0 + \beta_0 \cdot \text{Mini}_{if} + \alpha_1 \cdot D_{if} + \mathbf{X}_i' \cdot \gamma + \mathbf{F}_f' \cdot \theta + u_i, \tag{5}$$

where w_{if} defines hourly gross wage of individual i working at establishment f, Mini_{if} indicates whether the job individual holds is a mini-job, $\mathbf{X}$ is a vector of individual controls, and $\mathbf{F}$ is a vector of firm controls.

In practice, observed individual controls $\mathbf{X}$ omit such important wage determinants as ability, work effort, etc. Failure to control for omitted variables leads to a bias in the estimate of β_0. I use two approaches to generate an unbiased estimate of wage and fringe benefit differential of mini- and regular workers. First, I restrict the sample to individuals with plausibly similar skills. A reasonable proxy for skills is income itself: individuals earning similar incomes are likely to have similar abilities. Specifically, I restrict the sample to a narrow window around the mini-job threshold, $[K - €50, K + €100]$.[43] Second, I use income as a proxy for skills by including a polynomial of income in specification (5). This leads to the following econometric model:

$$\log(w_{if}) = \alpha_0 + \beta_0 \cdot \text{Mini}_{if} + \alpha_1 \cdot D_{if} + \alpha_2 \cdot D_{if}^2 + \beta_1 \cdot D_{if} \cdot \text{Mini}_{if} + \beta_2 \cdot D_{if}^2 \cdot \text{Mini}_{if} + \mathbf{X}_i' \cdot \gamma + \mathbf{F}_f' \cdot \theta + u_i, \tag{6}$$

where $D_{if} \equiv (Y_{if} - K)/K$ is the percent difference between individual's income Y_{if} and the mini-job threshold K. In this case, I restrict the sample to employments with monthly earnings under €1,500 per month and include wage trend polynomials of second degree.[44] In both cases, the coefficient of interest, β_0, captures the discontinuity of wages or fringe benefits at the mini-job threshold.

A natural concern of specification (6) is that individuals might select into mini-jobs based on unobserved preferences or abilities. Alternatively, only certain types of jobs, which qualities are not observed to the researcher, might be allowed under the mini-job status. As the results show, mini-jobs typically offer worse working conditions than regular part-time jobs, therefore selection into mini-jobs should primarily depend on one's savings due to the mini-job tax exemptions. To control

[43]Note that a slightly larger window is used to the right of the threshold because the number of observations is smaller.

[44]For both approaches, the results are robust to the choice of window.

for this type of selection, I include, whenever available, a measure of potential tax savings which depends on individual's marital status and spousal earnings. Further, if workers are negatively (positively) selected into the mini-job status, they should receive both lower (higher) wages and lower (higher) fringe benefits. The results in Section 3.3 are not consistent with this pattern and suggest that selection is unlikely to play an in important role.

The datasets used to estimate equation (6) provide information on earnings and working hours, but do not have information on wages. Therefore, two types of measurement error are possible under specification (6). First, working hours might be reported with error. The estimate of the effect of mini-job status on wages β_0 will remain unbiased and consistent, so long as the measurement error in hours is not correlated with the independent variables and working hours do not determine's one's job status. For this reason I focus on observations from 2003 on, when the hour requirement for mini-jobs was cancelled. Second, earnings could be reported with error. Because an overstated income would overstate both wages and increase the likelihood of assigning that individual to a regular job status, measurement error in income leads to a negative bias in the estimate of β_0. Fortunately, this type of error is easily alleviated as long as we can correctly assign individuals to the mini-job status. Among the two datasets I use to study estimate (6), one dataset (a firm survey) provides mini-job identifiers and therefore eliminates the possibility of a negative bias.

3.2 Data Description

I estimate specification (6) using two distinct datasets: a survey of firms and a survey of households. The survey of firms is a large dataset that provides reliable information on working hours and earnings, however, the dataset is not representative of the German population since only firms with 10 or more employees are surveyed. Moreover, the data does not include information on family structure or individuals' incentives to hold mini-jobs. The household survey, on the other hand, is representative of the population and includes detailed family structure, however, this survey more likely to suffer from measurement error because all information is self-reported. For both datasets, I restrict the core sample to individuals working more than 1 hour but not more than 45 hours per week, aged 16 to 80 and earning between €50 and €1500 per month in 2006-2010.

3.2.1 Firm survey – VSE

I use 2006 and 2010 waves of the Structure of Earnings Survey (VSE).[45] To create the VSE the German Federal Statistical Offices survey a large sample of firms with ten employees or more in selected industries. VSE 2006 did not include businesses operating in agriculture and fishing, public administration and defense, while VSE 2010 added employees working in public administration, defense and social security.[46] The main advantage of the VSE is that the working hour information

[45] In German: *Verdienststrukturerhebung*, VSE.

[46] In other words, VSE 2006 included businesses operating in mining and quarrying; manufacturing; energy and water supply; construction; trade; maintenance and repair of motor vehicles and personal and household goods; hotels and restaurants; transport, storage and communications; financial intermediation; real estate, renting and business activities; education, health and social work, other public and personal services sectors.

is reported by firms and therefore is less likely to suffer from measurement error. In addition to working hours, the VSE contains information about the employees themselves (age, sex, experience, training), their jobs (working hours, overtime hours, regular pay and bonuses, number of vacation days), and firms' characteristics (number of employees, industry, applicable bargaining agreements, geographical location) that can be linked across employees. Appendix Table C.6 provides summary statistics separately for five income groups: with posted earnings of [€50,€375], [€375, €400], [€400, €500], [€500, €1000], [€1000, €1500] per month.

The VSE 2006/2010 provide two estimates of working hours. The first estimate is based on the regular working hours defined as the mutually agreed regular hours or customary hours in the survey month.[47] The second measure is based on the total paid hours worked during the survey month, actual or estimated by the firm. As expected, the first measure of hours is often missing for part-time workers who do not have fixed hour schedules, but the second measure of hours is almost fully complete. For my main estimates I rely on the second measure of hours – hours worked in the month of survey – complemented with the first measures – regular hours – whenever missing.[48] The results that rely on the first definition of hours are very similar.

3.2.2 Household Survey – SOEP

I also use the German Socio-Economic Panel (SOEP) introduced in Section 2.2. While the SOEP data is more likely to suffer from measurement errors, it provides two advantages. First, the SOEP is representative of the entire German population and therefore includes employees working in all industries and at the establishments of all sizes. Second, the SOEP provides detailed information on family structure and therefore allows me to control for selection into mini-jobs based on individual tax incentives. Finally, the SOEP supplies more detailed information of worker's characteristics, such as education, total working experience, and citizenship status. The SOEP includes a self-reported marginal employment status identifier but the quality of this variable is very poor: many of the individuals who self-report as marginal workers earn substantially more than the mini-job threshold.[49] For these reasons, I identify mini-job workers based on the self-reported income only. Because a few yearly bonus observations show very high values, all yearly bonuses above the 99th percentile were set equal to the 99th percentile. A few individuals reported net wages that exceed posted wages. For these individuals net wage was set equal to the posted wage. Summary statistics from the SOEP are available in the Appendix Table C.7.

[47] October 2006 and 2010 respectively.

[48] There are 0 missing hour observations in 2010 and a total of 69,661 missing hour observations in 2006, of these 60,198 are reported by establishments working in education and 66,049 have reported incomes of less than €375 per month. Because missing hours are concentrated within one industry and within one income group, they are unlikely to bias the results.

[49] Moreover, the difference between gross and net wages for these individuals is large which is contradictory to mini-jobs being exempt from social security and income taxes. In contrast, for the majority of mini-job workers in the VSE 2006/2010 social security and income taxes are reported to be zero, consistent with mini-job rules.

3.3 Estimates of Wage and Fringe Benefits Differences

3.3.1 Graphical Evidence

Before estimating equations (5) and (6) I examine how reported hours, wages and fringe benefits change with workers' earnings visually in Figures 9 and 10. Figure 9 relies on firm survey data. Panel A, B and C show that there is a clear increasing trend in the number of working hours, gross and posted wages, however no apparent discontinuity at the mini-job threshold.[50] In contrast, panel D shows that net wages are higher for mini-job workers than regular workers consistent with mini-job workers paying lower taxes. In the VSE data some individuals with incomes below the mini-job threshold are regular employees, while some individuals with incomes above the threshold are mini-job workers.[51] If one restricts the sample to individuals whose incomes and mini-job status correspond precisely, the discontinuity in gross wages at the mini-job threshold becomes apparent, see Figure 11. Panels E and F show that mini-job workers receive substantially smaller yearly bonuses (which include holiday, Christmas and performance bonuses, severance payments, profit sharing, bonuses for improvement suggestions, allowances for inventions, and the taxable value of stock options) and are eligible for fewer full-time equivalent vacation days than regular workers.[52]

Figure 10 shows graphical evidence similar to Figure 9 but relies on household survey data. In contrast to the VSE data, the SOEP data shows clear discontinuity in working hours and gross wages. Mini-job workers appear to work fewer hours and earn higher gross wages. Evolution of posted and net wages appears to be similar to what was observed in Figure 9. Finally, Panel E again shows that mini-job workers receive smaller yearly bonuses (which includes 13th and 14th month pay, christmas and holiday bonus, and profit sharing payments) but the results are very noisy. Unfortunately, no information on the number of vacation days is available in the SOEP.

Hours reported in the SOEP are higher than in the VSE and could either be due to sample selection or measurement errors. It is possible that individuals working in firms with 10 employees or less earn lower hourly wage. Since VSE only surveys firms with 10 employees or more this would lead to a negative bias in hours reported in the VSE. Alternatively, survey respondents in the SOEP might include all hours worked, regardless of whether they were paid for these hours or not.[53]

[50] In the Appendix Figure C.4 I show the distributions of weekly hours and gross wages for at-the-threshold mini-jobs and regular part-time workers. The majority of these individuals report working less than 20 hours per week earning less than €13 per hour. Nearly 20 percent of individuals report earning very lower wages – under €7 per hour.

[51] Because the mini-job threshold applies to combined earnings, individuals with several low-paying jobs might be subject to regular taxation. Alternatively, workers who usually receive higher incomes, might temporarily experience low hours and hence report earnings below the mini-job threshold. Finally, mini-job workers are allowed to exceed the threshold several times per year.

[52] Surprisingly, at least 25% of workers are reported to qualify for zero vacation days despite vacation allowances being a legal requirement in Germany. This evidence is consistent with survey evidence of Bachmann et al. (2012) and Wippermann (2012), who find that many individuals are unaware of their rights and do not receive required by law holiday pay, sick day pay and etc.

[53] Further, the SOEP hour variable includes overtime hours, while in the VSE overtime hours are reported separately. The number of overtime hours reported in the VSE is very small since most of the individuals are part-time workers and thus it is unlikely to explain the difference.

3.3.2 Regression Estimates

I now turn to regression evidence. Results from the VSE (firm survey) are presented in Table 4. Columns (1) through (5) estimate specification (6) within a narrow window of earnings around the mini-job threshold: only individuals earning between €375 to €500 are included. Columns (6) through (9) extend the window to the core sample – individuals earning between €50 and €1500 per month – and include wage trends. Table 4 provides results for several dependent variables: logarithm of hourly gross, posted and net wages, yearly bonus (in euros), the number of full-time equivalent vacation days, and the logarithm of total gross wage calculated as the sum of all yearly payments divided by total yearly hours. Table 4 shows that gross and net wages are respectively 6-9% and 15-23% higher for mini-job workers than regular employees, while posted wages are approximately equal. Consistent with graphical evidence from Figure 9, mini-job workers receive smaller yearly bonuses – €60-100 less – and fewer vacation days – 2-3 days less – than regular employees. These results are robust across all 9 specifications. Including firm fixed effects in columns (2), (3), (4), (7) and (9) increases the wage differential but reduces the differences in fringe benefits, with likely explanation that firms that hire mini-job workers are more "frugal" and pay lower wages and smaller fringe benefits in general. Since wages show increasing trends both below and above the mini-job threshold, including linear and quadratic trends also increases the wage differential between the gross wages paid to mini-job and to regular workers.

Finally, the last dependent variable incorporates fringe benefits (bonuses and vacation day pay) into a measure of total labor costs and shows that accounting for bonuses and vacation pay does not equate the labor expenditures on mini-job workers and regular employees, but it reduces the difference substantially.[54] Unfortunately, the yearly bonuses and vacation days do not cover all fringe benefits received by the employees. For example, sick day pay, statutory holiday pay, and maternity leave payments are not included. The results in Table 4 therefore suggest that employers are willing to pay mini-job workers higher gross wages because they incur lower fringe benefit costs.

The regression results from the SOEP (household survey) are available in Table 5 and reinforce the finding that mini-job wages are higher at the threshold than regular wages. Columns (1) and (6) can be directly compared to columns (1) and (6) of Table 4, while columns (3) and (8) provide the closest comparison to columns (4) and (8) of Table 4 respectively. The gross wage differential varies between 6.5% to 13.7%, and thus is quite a bit larger in the SOEP than in the VSE. Yearly bonus appears to be smaller for mini-job workers, but not all coefficients are statistically significant. Not surprisingly, including bonuses in gross wage calculation does not decrease the wage differential between mini-job workers and regular employees substantially: the magnitude of reported bonuses is smaller in the SOEP as compared to the VSE. This difference could either be due to measurement error – individuals forget to report received bonuses – or due to firm selection – firms with 10 employees or more might give larger bonuses than smaller firms.

In columns (2), (4), (5), (7) and (9), I control for incentives to bunch at the threshold by

[54]The dependent variable is calculated as the sum of all yearly gross wages plus yearly bonuses plus the number of vacation days times 7.5 hours times the gross wage divided by the yearly equivalent of hours worked.

including the variable *individual notch* which measures the size of the tax notch experienced by a worker at the mini-job threshold and is based on spousal earnings. Results in columns (2), (4), (5), (7) and (9) suggest that controlling for marital status and tax incentives does not have a large effect on the wage differential. This finding is reassuring in light of my inability to control for family characteristics in the firm survey results, and again supports that idea that selection is unlikely to explain the differences in wages and fringe benefits.

Table 6 repeats specifications (4) and (9) from Table 4 but interacts the mini-job indicator with gender and age indicators, and indicators of collective agreements. Columns (1) and (4) show that the wage gap is slightly bigger for males, but the difference is extremely small. Most interaction terms with age variables are not statistically significant in columns (2) and (3). Finally, columns (3) and (6) study the effect of collective agreements. For each firm up to three types of collective agreements are reported, these include industry-level collective agreements which only cover workers from specific industries, firm collective agreements that cover workers of the firm, and enterprise level collective agreement which cover workers at the enterprise level. None of these agreements typically apply to mini-job workers. Moreover, not all agreements affect wages, some agreements only regulate working hours, overtime, vacancy postings, etc. Industry agreements are most common, however, these need not apply to all workers at the firm, merely to the workers who are part of the respective union. Results in column (3) suggest that only the presence of an enterprise-level agreement affects the wage differential between mini-job workers and regular employees, completely eliminating the difference. The presence of an industry agreement, on the other hand, increases the wage differential in specification (6). Finally, Appendix Tables C.8 and C.9 show that estimates in Tables 4 and 5 are robust to sample selection and hour definitions.

Together the results in Tables 4 and 5 provide strong evidence that mini-job workers are paid higher gross wages reflecting the lower fringe benefits received by the former. Because the data lacks information on all fringe benefits paid, I am not able to show that the total labor costs – inclusive of all wages, taxes and benefits paid – are equal for mini-job and regular workers, but the estimates in the last row of Table 4 suggests that this is likely to be the case.

3.4 Employment Duration

It is possible that mini-jobs and regular jobs differ in dismissal costs. Figure 12 shows the cumulative distributions of employment durations based on the SIAB data described in Section 2.2. To construct this Figure, I assume that employment spell is terminated if an individual quits labor force, switches to a different establishment, or employment is interrupted for more than 30 days. The results show that more than 65% of non-threshold mini-job workers, i.e. individuals earning less than the mini-job threshold minus €25 per month are employed for 1 year or less at any given establishment. In contrast, less than 60% of individuals working in at-the-threshold jobs or regular part-time workers who earn between the mini-job threshold and €800 per month are terminated within 6 months. The results in Figure 12 thus suggests that at-the-threshold mini-job workers enjoy similar job durations as regular part-time workers.

3.5 Re-evaluating Elasticity Estimates

The results in this section provide clear evidence that mini-jobs differ from regular jobs in multiple dimensions: in addition to a change in tax treatment, gross wages and fringe benefits, e.g. vacation pay and yearly bonuses, also change at the threshold. How do these findings affect the estimates of elasticities in Section 2.3.2? The answer to this question depends on how individuals value fringe benefits. If individuals assign an actuarially fair value to fringe benefits and total gross wages correctly reflect differences in employer fringe benefits, then elasticity estimates are correct. On the other hand, if the fringe benefits are not valued by workers and the total labor costs are not equalized, then in addition to tax-induced notch and kink individuals experience a further notch due to differences in wages, and hence elasticity estimates are wrong. Vacation pay and bonus payments as well as other benefits that mini-job workers appear not to receive according to survey evidence from Bachmann et al. (2012) and Wippermann (2012) – sick day pay, statutory holiday pay, maternity pay and company training – are mostly monetary benefits and therefore likely to be valued fully. Therefore, since the distribution of earnings used to estimate elasticities in Section 2.3.2 is inclusive of bonus payments, as well as vacation, sick day and statutory pay, elasticities estimated in Section 2.3.2 should provide accurate estimates of the elasticities of earnings with respect to the net-of-tax rate.

4 Theoretical Framework

The results in Section 2 show that in contrast to previous studies that find weak bunching at kinks and notches of tax schedules, workers in Germany are able to find at-the-threshold mini-jobs with ease. To explain the magnitude of response, I consider firm incentives and study how these incentives affect workers' ability to respond to taxes. In this section I extend the framework of Chetty et al. (2011) and develop a partial equilibrium tax incidence model with job search costs and endogenous hour constraints. I start with the baseline scenario of zero frictions and then extend the model to cases where individuals experience positive search costs and firms face frictions due to contractual obligations. I show that the magnitude of labor supply responses depends on the statutory incidence of taxes and that labor supply responses are strongest when the statutory incidence falls on the firms.

4.1 Baseline Model with Zero Search Costs

In this baseline model I assume that individuals and firms experience no frictions or search costs.

Labor Demand. A continuum of identical firms offers two types of employment: type 1 jobs (mini-jobs) that incur employer-paid taxes ϕ_1 and type 2 jobs which impose employer-paid tax ϕ_2. In line with Chetty et al. (2011), I assume that firms cannot change hours worked after the firm has been matched with a worker. Each firm posts job offers for each type of employment; combined these postings generate an aggregated distribution of hours offered.

Both types of labor are employed in a one-factor production technology that produces goods sold at a fixed price. I assume that differences in type 1 and 2 employments stem exclusively from the exogenous government policy and therefore type 1 and type 2 workers are perfectly substitutable. Each firm i determines optimal quantities of total labor hours in each type of jobs, L_{1i} and L_{2i}, by minimizing costs subject to a quantity constraint:

$$\min_{L_{1i},L_{2i}} C_i = \underbrace{(w_1 L_{1i} + w_2 L_{2i})}_{\text{Wages}} + \underbrace{(w_1 \phi_1 L_{1i} + w_2 \phi_2 L_{2i})}_{\text{Auxiliary Labor Costs}} \text{ s.t. } Q(L_{1i} + L_{2i}) = \bar{Q}, \tag{7}$$

where $Q(\cdot)$ is the production function. For each firm i, let Q'_i denote the marginal product of labor for firm i, then aggregating the first order conditions across a spectrum of firms yields a system of labor demand equations

$$L_{1i}: \quad w_1 + \phi_1 w_1 - \lambda Q' = 0, \tag{8}$$

$$L_{2i}: \quad w_2 + \phi_2 w_2 - \lambda Q' = 0. \tag{9}$$

It follows from (8)–(9) that when L_{1i} and L_{2i} are perfectly substitutable, the wage differential w_1/w_2 will only depend on *employer-paid* taxes ϕ_1 and ϕ_2:

$$w_1 = \frac{\lambda Q'}{1+\phi_1} \quad \text{and} \quad w_2 = \frac{\lambda Q'}{1+\phi_2}. \tag{10}$$

Therefore any tax differences which statutory incidence falls on workers will not affect the wage differential between type 1 and type 2 jobs. The intuition for this result is simple: when inputs are perfectly substitutable, employers will always hire the cheapest form of labor, thus in equilibrium employer costs of different types of labor must align in order for employers to be indifferent. Since the subsidies given to the employees do not directly affect firms' labor costs, they will not affect the relative prices of two labor inputs.

Labor Supply. Further, suppose that type 1 jobs (mini-jobs) are subject to employee-paid tax t_1, while type 2 jobs (regular jobs) are subject to employee-paid tax t_2.[55] Type 2 jobs are fully unrestricted and allow workers to earn any amount, while type 1 earnings are limited by a fixed threshold K, uniform to all workers. Individual k chooses a job from the aggregate distribution of hours offered with corresponding wages (w_1, w_2) that maximizes his utility

$$\max_{c,l} u(c,l) = c - \alpha_k^{-1/\varepsilon} \frac{l^{1+1/\varepsilon}}{1+1/\varepsilon} \tag{11}$$

given his individual ability parameter α_k, homogeneous elasticity of labor supply ε, and subject to one of the two constraints:

$$c = (1-t_1) w_1 l \text{ and } w_1 l \leq K \tag{12}$$

[55] Tax rates t_1, t_2, ϕ_1 and ϕ_2 should be interpreted as a sum of all taxes – social security and income – as well as other auxiliary costs such as fringe benefit payments that are required by law and which statutory incidence falls on employees or employers respectively.

or

$$c = (1 - t_2)w_2 l, \tag{13}$$

where w_1 is the wage offered in type 1 jobs and w_2 is the wage offered in type 2 jobs.

If equilibrium wages are such that $(1 - t_2)w_2 > (1 - t_1)w_1$, individuals will always prefer type 2 jobs and work $\alpha_k(1 - t_2)^\varepsilon w_2^\varepsilon$ hours, since earnings in type 2 jobs are unrestricted. An interesting case arises when the after-tax wage $(1 - t_1)w_1$ exceeds the after-tax wage $(1 - t_2)w_2$, since type 1 jobs are constrained by the earnings threshold K. Define $\alpha_1^* \equiv K/((1 - t_1)w_1)^{\varepsilon+1}$, then all individuals with $\alpha_k \le \alpha_1^*$ will choose type 1 jobs. Next, let α_2^* solve $u(K, K/w_1) = u(\alpha_2^*(1 - t_2)^{\varepsilon+1} w_2^{\varepsilon+1}, \alpha_2^*(1 - t_2)w_2^\varepsilon)$.[56] Individuals with $\alpha_k \in (\alpha_1^*, \alpha_2^*]$ would like to work more hours under wage $(1 - t_1)w_1$ but are unable to do so due to the threshold K. Because they find it suboptimal to work $\alpha_k(1 - t_2)^\varepsilon w_2^\varepsilon$ hours under lower wage $(1 - t_2)w_2$, they will bunch at the threshold K and work K/w_1 hours in type 1 jobs. Finally, individuals with $\alpha_k > \alpha_2^*$ will work $\alpha_k(1 - t_2)^\varepsilon w_2^\varepsilon$ hours in type 2 jobs. In summary, individuals with ability α_k will work l_k^* hours, where

$$l_k^* = \begin{cases} \alpha_k(1 - t_1)^\varepsilon w_1^\varepsilon & \text{if } \alpha_k < \alpha_1^* \\ K/w_1 & \text{if } \alpha_1^* \le \alpha_k \le \alpha_2^* \\ \alpha_k(1 - t_2)^\varepsilon w_2^\varepsilon & \text{if } \alpha_k > \alpha_2^*. \end{cases} \tag{14}$$

Thus for a cumulative distribution of skills $F_\alpha(\cdot)$ with corresponding density $f_\alpha(\cdot)$, the total labor supply of type 1 and 2 jobs will be given by

$$L_1^S = \int_{-\infty}^{\alpha_1^*} \alpha(1 - t_1)^\varepsilon w_1^\varepsilon f(\alpha) d\alpha + \int_{\alpha_1^*}^{\alpha_2^*} K/w_1 f(\alpha) d\alpha \quad \text{and} \quad L_2^S = \int_{\alpha_2^*}^{\infty} \alpha(1 - t_2)^\varepsilon w_2^\varepsilon f(\alpha) d\alpha. \tag{15}$$

Equilibrium. The equilibrium wages and quantities of labor will depend on tax rates t_1, t_2, ϕ_1, ϕ_2 and on elasticities of labor supply and demand. Equilibrium wages w_1^* and w_2^* will solve

$$w_1 = \frac{\lambda Q'(L_1^S(w_1, w_2) + L_2^S(w_1, w_2))}{1 + \phi_1} \quad \text{and} \quad w_2 = \frac{\lambda Q'(L_1^S(w_1, w_2) + L_2^S(w_1, w_2))}{1 + \phi_2}, \tag{16}$$

where L_1^S and L_2^S are given by (15).

It follows that if mini-job workers and regular workers are perfect substitutes, the subsidies given to the workers – e.g. exemption from income taxes and social security payments – can affect the overall levels of wages of all workers but not the wages of one group in particular. Therefore, unless productivity of workers depends on hours worked – e.g. if handling more employees increases costs non-linearly due to complexities of supervision or training needs – the total gross wages of mini-job and regular workers – inclusive of all taxes and fringe benefits – should be the same.

[56] Individuals with ability α_2^* are indifferent between earning K in job type 1 and working $\alpha(1-t_2)^\varepsilon w_2^\varepsilon$ hours in job of type 2.

4.2 Labor Responses in Presence of Frictions

In this section I extend the model presented in Section 4.1 by incorporating search costs and adjustment frictions. I show that when job search process is costly, the amount of bunching at a kink or a notch will depend on the statutory incidence of taxes.[57]

4.2.1 Incorporating Worker Frictions

Let

$$f(l;\mathbf{w}) = \int_0^\infty \mathbf{1}\{l_k^* = l\}\ f_\alpha d\alpha \quad \text{and} \quad F(l;\mathbf{w}) = \int_0^\infty \mathbf{1}\{l_k^* \le l\}\ f_\alpha d\alpha.$$

represent the probability density and the cumulative distribution functions of the distribution of "ideal" hours l^* given by (14) for a vector of wages $\mathbf{w} = (w_1, w_2)$.[58] Now suppose workers are not automatically matched to their ideal employments. Instead, the labor market clearing process proceeds as follows. Individuals observe the offered distribution of hours $G(l;\mathbf{w})$ and corresponding wages $\mathbf{w} = (w_1, w_2)$ and draw a job at random. At this point workers decide whether to accept the offer or search for an alternative. If a worker with ideal hours l^* declines the offer, he draws a new offer from a distribution $\hat{G}_{l^*}(l; G, \mathbf{w})$ that depends on his ideal hours l^* and the distribution of offered hours G. Let g and $\hat{g}_{l^*}$ denote the probability density functions of distributions $G(l;\mathbf{w})$ and $\hat{G}_{l^*}(l; G, \mathbf{w})$, $\mathbb{E}_F$ and $\mathbb{E}_{\hat{G}_{l^*}}$ denote expectations based on probability distribution F and $\hat{G}_{l^*}$ respectively, and $u(l) = u(c(l), l)$ from (11).

Further, assume that the search distribution $G_{l^*}(l; G, \mathbf{w})$ satisfies the following conditions:
1. $G_{l^*}(l; G, \mathbf{w})$ is continuous and differentiable with respect to l;
2. $\hat{G}_{l^*} = \mathbf{1}_{\{l=l^*\}}$ when individuals experience zero search costs;
3. $\hat{G}_{l^*} = G$ when individuals experience infinite search costs;
4. $\hat{G}_{l^*}$ is such that $\mathbb{E}_{\hat{G}_{l^*}}[u(L)] = u(l^*)$ or $\mathbb{E}_{\hat{G}_{l^*}}[L] = l^*$;
5. g_{l^*} satisfies $f(l) = f(l) \cdot \mathbb{E}_F[\mathbf{1}\{u(l) > \mathbb{E}_{\hat{G}_{l^*}}[u(L)]\}] + (1 - \mathbb{E}_F[\mathbf{1}\{u(l) > \mathbb{E}_{\hat{G}_{l^*}}[u(L)]\}]) \cdot \mathbb{E}_F[\hat{G}_{l^*}(l)]$ for a given distribution f.

Conditions 2 and 3 ensure that when the search process is costly, $\hat{G}_{l^*}$ is widely dispersed around l^*, with $\hat{G}_{l^*} = G$ whenever search costs are infinite. As search costs decrease, $\hat{G}_{l^*}$ tightens around l^* so that $\hat{G}_{l^*} = \mathbf{1}_{\{l=l^*\}}$ whenever search costs are zero. Condition 4 ensures that individuals' search efforts are based on their preference and in expectation the search process results in either ideal hours or ideal utility. To understand condition 5, note that a job with hours l is drawn with probability $g(l)$ and is accepted with probability $P = \mathbb{E}_F[\mathbf{1}\{u(l) > \mathbb{E}_{\hat{G}_{l^*}}[u(L)]\}]$. The same offer l can alternatively be drawn from distributions $\hat{G}_{l^*}$ with probability $\mathbb{E}_F[\hat{G}_{l^*}(l)]$. Therefore the density

[57] Economists have long focused on the economic rather than the statutory incidence of taxes. However, in many empirical applications the statutory incidence may play an important role. Slemrod (2008) shows theoretically and Kopczuk et al. (2013) provide empirical evidence that the economic incidence of taxes and the tax revenue collected may vary with statutory incidence if the ability to evade or avoid taxes varies across economic agents. Chetty et al. (2009) show that the statutory incidence of taxes is important if it affects the salience of taxes. In this section I argue that the statutory incidence of taxes affects the magnitude of labor supply responses if individuals experience search costs and the burden of search falls on the workers.

[58] Note that because $(1-t_1)w_1 > (1-t_2)w_2$, all jobs with hours $l \le K/w_1$ will be of type 1, and all jobs with hours $l > K/w_1$ will be of type 2.

of accepted jobs $g_{accepted}$ satisfies $g_{accepted}(l) = g(l) \cdot \mathbb{E}_F[\mathbf{1}\{u(l) > \mathbb{E}_{\hat{G}_{l^*}}[u(L)]\}] + (1 - \mathbb{E}_F[\mathbf{1}\{u(l) > \mathbb{E}_{\hat{G}_{l^*}}[u(L)]\}]) \cdot \mathbb{E}_F[\hat{G}_{l^*}(l)]$. The last condition thus ensures that the ideal distribution of hours F is always accepted the workers in aggregate.

Aggregating across workers, we find the distribution of accepted offers

$$G_{accepted}(l; \mathbf{w}) = P(l; F, G, \hat{G}, \mathbf{w}) \cdot G(l; \mathbf{w}) + (1 - P(l; F, G, \hat{G}, \mathbf{w})) \cdot \hat{G}(l; F, G, \mathbf{w}), \tag{17}$$

where $\hat{G}(l; F, G, \mathbf{w})$ represents the aggregated distribution of offers when individuals engage in job search and $P(l; F, G, \hat{G}, \mathbf{w})$ represents the probability that a job is accepted given the distribution of ideal hours $F(l; \mathbf{w})$, offered hours $G(l; \mathbf{w})$, and job-search distribution $\hat{G}(l; F, G, \mathbf{w})$. From conditions 2 and 3 follows that when search costs are infinitely high, $g_{accepted}(l) = g(l)$ and thus $G_{accepted} = G$, while when search costs are zero, $g_{accepted}(l) = f(l)$ and hence $G_{accepted} = F$.[59] Moreover, if $\hat{G}$ is such that $\mathbb{E}_{\hat{G}_{l^*}}[u(L)] = u(l^*)$, then $G_{accepted} = \hat{G}(l; F, G, \mathbf{w})$ since $u(l) \leq \mathbb{E}_{\hat{g}_{l^*}}[u(L)]$ for all l.

Now suppose we start with an equilibrium where employees and employers pay identical taxes on both types of labor, so that $1 - t_1 = \frac{1}{1+\phi_1} = 1 - t_2 = \frac{1}{1+\phi_2}$. The government decides to reduce the tax rate on type 1 workers by setting either $t_1 = 0$ or $\phi_1 = 0$. Does the choice of statutory tax break affect the magnitude of equilibrium labor response? If neither firms nor individuals experience search costs, the equilibrium distributions of hours will be the same.[60]

Now suppose the search process is costly. Then the equilibrium distribution of hours and corresponding wages must satisfy the following three conditions:

$$\mathbf{w}^* = \left(\frac{w}{1+\phi_1}, \frac{w}{1+\phi_2}\right) \text{ with } w = \lambda Q'\left(\int_0^\infty l\, dG\right) \tag{18}$$

$$G(l) = P(l; F, G, \hat{G}, \mathbf{w}^*) \cdot G(l) + (1 - P(l; F, G, \hat{G}, \mathbf{w}^*)) \cdot \hat{G}(l; F, G, \mathbf{w}^*), \tag{19}$$

$$\nexists \mathbf{w} < \mathbf{w}^* \text{ s.t. } G(l) = P(l; F, G, \hat{G}, \mathbf{w}) \cdot G(l) + (1 - P(l; F, G, \hat{G}, \mathbf{w})) \cdot \hat{G}(l; F, G, \mathbf{w}). \tag{20}$$

Condition (18) determines equilibrium wages $\mathbf{w}^*$ given the total amount of labor hours $L_1 + L_2 = \int_0^\infty l\, dG$ implied by the distribution G and follows from (16). Condition (19) ensures that the distribution of offered hours equals the distribution of accepted hours at the equilibrium wage levels $\mathbf{w}^*$ and follows from (17). From (19) follows that when search costs are zero, $\hat{G} = F$ and the only equilibrium solution is $G = F$, since it is the only fixed point of equation (19). On the other hand, when search costs are infinite, $\hat{G} = G$ and any distribution of hours offered will be accepted. As search costs increase, the set of possible equilibria increases and the equilibrium distribution of hours need not represent F closely. The reason why multiple equilibrium distributions of hours are possible is because individuals find job search costly, and therefore would be willing to accept offers that do not satisfy optimality condition (14) precisely.

Finally, condition (20) ensures that firms offer higher wages only when they exhaust labor

[59]To see this note that when $\hat{G}_{l^*} = G$, $\mathbb{E}_F[\hat{g}_{l^*}(l)] = \mathbb{E}_F[g(l)] = g(l)$. On the other hand, when $\hat{G}_{l^*} = \mathbf{1}_{\{l=l^*\}}$,then $\mathbb{E}_F[\hat{g}_{l^*}(l)] = f(l)$ and $\mathbb{E}_F[\mathbf{1}\{u(l) > \mathbb{E}_{\hat{g}_{l^*}}[u(L)]\}] = 0$.

[60]Since $\frac{\lambda}{1+\phi_1} = \lambda(1 - t_1)$, the after-tax wages will be the same. Because individuals do not experience search costs, they will only accept ideal hours given by (14). Hence, the equilibrium quantities of labor supply will be equal.

supply at lower wage levels. This condition sets apart cases where the statutory incidence of taxes falls on firms and from cases where it falls on individuals. When the tax break is given to individuals, $1/(1+\phi_1) = 1/(1+\phi_2)$, and wages of type 1 and type 2 workers are identical. Since the wage level is uniform, condition (20) does not affect the distribution of hours offered, merely the aggregate number of hours in equilibrium. On the other hand, when the tax break is given to the firms, equilibrium wages differ for type 1 and type 2 workers. In this case, condition (20) determines not only the overall number of hours, but also the number of hours offered within each job type. Condition (20) ensures that the wage level of type 1 workers is justified: employers have exhausted labor supply at lower wages.[61,62]

Define $\Omega_G = \{G : G \text{ satisfies (18) and (19)}\}$. Then it can be shown that when employee tax is set to zero, (20) implies

$$\int_0^\infty l\,dG \geq \int_0^\infty l\,dF, \tag{22}$$

and when employer tax is set to zero, (20) implies

$$\int_0^{K/w} l\,dG \geq \int_0^{K/w} l\,dF, \int_{K/w}^\infty l\,dG \geq \int_{K/w}^\infty l\,dF. \tag{23}$$

Conditions (22) and (23) follow directly from assumption 5, i.e. the fact that $\{F\} \in \Omega_G$. Condition (23) implies that the total number of hours supplied by type 1 and type 2 workers should be equal or greater than the number of hours predicted by the frictionless model. However, note that (23) does not impose any requirements on the distribution of hours.

Conditions (18)–(20) demonstrate that the statutory incidence of taxes is important when

[61] Without (20), conditions (18)–(19) allow for counter-intuitive equilibria: in extreme case of infinite search costs, (18)–(19) imply that firms would pay workers marginal product of labor regardless of total hours worked. This is counter-intuitive because the workers would accept the same job offers at lower wages. On the other hand, condition (20) implies an equilibrium where workers are employed for infinitely-many hours. While not practically realistic, it is consistent with the cost minimization incentives of firms.

[62] It is difficult to characterize the set of equilibria defined by equations (18)–(20) without making assumptions on the functional form and distribution of individual preferences. To illustrate the possibility of multiple equilibria, consider the following example. Suppose the production function exhibits constant returns to scale, then wages $\hat{w}_1^*$ and $\hat{w}_2^*$ are fixed and equal to the marginal product of labor. Further, suppose all individuals are identical and the density of the ideal distribution of hours F is given by: $f(h^*) = 1$ and $f(h) = 0$ whenever $h \neq h^*$. If by exerting some effort $\sigma C(1/\bar{l})$, with $C' > 0$ and $\sigma > 0$, individuals can narrow their search interval to $[h^* - \bar{l}, h^* + \bar{l}]$ of the offered distribution G, then $\hat{G} = \frac{G \cdot \mathbf{1}_{l \in (h^* - \bar{l}, h^* + \bar{l})}}{G(h^* + \bar{l}) - G(h^* - \bar{l})}$. Because both effort $\sigma C(\cdot)$ and the expected utility of a draw from $\hat{G}$ decrease with $\bar{l}$, individuals will choose an optimal $\bar{l}$ that maximizes their expected utility from job search process, i.e. $\bar{l} = \bar{l}(h^*, G)$. Moreover, $d\bar{l}/d\sigma > 0$, so that if $\sigma = 0$ then $\bar{l} = 0$, and if $\sigma \to \infty$ then $\bar{l} = \infty$.

Now consider a probability density function g that satisfies: $g(h^* - \hat{h}) = q_1, g(h^*) = q_2, g(h^* + \hat{h}) = q_3$, and $g(h) = 0$ otherwise for some values $\hat{h}$. Then any combination of $(\hat{h}; q_1, q_2, q_3)$ that satisfies the following condition at equilibrium prices $\hat{w}_1^*$, $\hat{w}_2^*$ is an equilibrium:

$$q_1 + q_2 + q_3 = 1 : \quad q_1 u(h^* - \hat{h}) + q_2 u(h^*) + q_3 u(h^* + \hat{h}) > u(h^*) - \sigma C(\hat{h}) \tag{21}$$

where $u(l) = u(c(l)l, l)$ given by (11). Condition (21) ensures that all individuals choose *not* to pay the search cost and draw a job from the entire distribution at random rather than pay the smallest necessary cost – $\sigma C(\hat{h})$ – to make the interval small enough so that only $h = h^*$ could be drawn. Condition (21) implies $\hat{G} = G$ and therefore G satisfies (18)-(20). It is easy to see that there are numerous combinations of $(\hat{h}; q_1, q_2, q_3)$ that satisfy condition (21) for most functions $\sigma C(\cdot)$. Further, higher values of cost shifter σ lead to a larger sets of equilibria. This example can be further generalized to discrete or continuous distributions of ideal hours F, asymmetric search intervals around h^*, etc.

workers experience search costs. If the statutory incidence of tax breaks falls on individuals, the magnitude of response to tax incentives depends on the ability of individuals to seek out, negotiate or otherwise convince employers to provide at-the-threshold jobs. If search costs are prohibitively high, individuals would be willing to accept any distribution of hours offered by employers, the magnitude of response to tax breaks is likely to be weak and will depend on firms' preferences. On the other hand, if the statutory incidence of tax breaks falls on the firms, firms have an incentive to hire tax-advantaged workers and the response to tax breaks will be strong. As follows from (23), the model does not predict the composition of available tax-advantages jobs, e.g. what portion of type 1 hours will be offered in the form of the at-the-threshold jobs, it merely shows that the total number of hours in type 1 jobs will be large.

4.2.2 Incorporating Firm Frictions

In the previous section we considered a framework where firms experience zero frictions and are able to offer any hour contracts. In reality firms are likely to experience two types of frictions.[63] First, certain hour contracts can be illegal (e.g. workers may not exceed 40 hours per week without incurring overtime pay) or be prohibitively expensive (e.g. training and supervision costs rule out 1-hour-per-week jobs). Such restrictions can be easily incorporated into the model by assuming that the distribution of hour offers G must belong to the set of feasible offers Γ. The predictions of Section 4.2.1 will remain valid.[64]

Second, in many cases firms are not able to change working hours of employees because of contractual obligations. Presence of contractual obligations does not erase asymmetry of search and adjustment frictions experienced by individuals and firms, and thus does not invalidate the results of Section 4.2.1, merely slows down the adjustment process to the new equilibrium. To see this, consider the following three-period model. In the first period the government sets flat tax rates $1 - t_1 = \frac{1}{1+\phi_1} = 1 - t_2 = \frac{1}{1+\phi_2}$. Firms and workers are matched as described in Section 4.2.1, resulting in an equilibrium distribution of hours G^1 with corresponding equilibrium wages (w_1^1, w_2^1). Further, assume that a share of contracts θ expire in the beginning of the second period, while $1 - \theta$ contracts expire in the beginning of the third period and cannot be changed until then. Workers and firms renegotiate contracts as they expire. In the beginning of the second period the government announces a reform that reduces the tax on type 1 workers by *either* setting $t_1 = 0$ or by setting $\phi_1 = 0$. Because in the third period all workers can renegotiate their contracts, the final equilibrium distribution G^3 satisfies conditions (18)–(20), and is identical to the equilibrium of a one-period model described in Section 4.2.1. The transitory distribution of hours in the second period $G^2 = \theta G^3 + (1 - \theta) G^1$ is a sum of third-period distribution G^3, for workers whose contracts expire in the beginning of the second period, and distribution G^1, for workers who are locked in until

[63] In this section I focus on hour constraints and disregard differences in ability. For this reason, I ignore productivity-matching frictions and defer to future work.

[64] An exception would be reforms that reduce taxes due on "infeasible" workers. In which case, the equilibrium outcomes will be identical, regardless of whether the tax break is given to individuals or firms, because firms will ignore such incentives altogether.

the third period. If the tax break is given to individuals, wages remain the same across periods, unless higher levels of labor supply lead to a lower equilibrium wage.[65] If the tax break is given to the firms, the wage differential between type 1 and type 2 jobs will grow gradually. The wages will satisfy $w_1^1 = w_2^1$, $w_j^2 \geq w_j^3$ for each type of worker $j = 1, 2$ and $w_1^t / w_2^t = 1 + \phi_2$ for each period $t = 2, 3$.[66]

4.3 Relation to Mini-Jobs and Discussion

The results in Section 4.2 show that when firms experience smaller frictions than individuals, observed labor supply responses to tax changes are larger when the statutory incidence of changes falls on firms rather than individuals. Such tax changes distort relative wages, incentivizing firms to hire tax-advantaged workers. On the other hand, when the statutory incidence of tax changes falls on individuals, wage levels remain uniform across contracts and firms experience no incentive to change the structure of working hours, making it harder for individuals to respond. In case of mini-jobs in Germany, differences in fringe benefits make mini-job workers attractive to firms, leading to a large number of mini-jobs available in the market. The setting studied in this paper is thus in stark contrast to the majority of previous empirical studies that estimate responses to taxes by focusing on kinks and notches in the *income tax schedules* of individuals. Because the statutory incidence of these changes does not fall on firms, weaker responses are observed.

Few studies consider settings in which *employer-paid* costs change at the threshold. In many countries, including Germany, both employee and employer payroll taxes need not be paid above a predetermined income cap. Because employer-paid payroll tax decreases above the income cap, firms have an incentive to hire workers "away" from the threshold, leading to a gap around the income cap. Alvaredo et al. (2017) study earnings responses around the Social Security cap in the UK and find no missing mass at the threshold.[67] There are two likely explanations for the lack of response. First, such income threshold represents a kink, rather than a notch, thus substantially limiting tax savings. Second, payroll caps are typically set at high income levels, where the majority of employees work full time. The differences in incomes, therefore, represent the type of work performed rather than the number of hours worked, making it harder to adjust working hours of employees.

The predictions of Section 4.2 raise an important question: if multiple equilibria are possible, which equilibrium will be observed in the market? Because firms offer the hour distributions and individuals search among posted jobs, firms should incorporate the choice of the offered hour dis-

[65] Adjustment to this new level of wages will be gradual, since only a fraction of workers will be able to increase working hours in period two. Hence, the wages will satisfy $w_j^1 \geq w_j^2 \geq w_j^3$ for each type of worker $j = 1, 2$ and $w_1^t = w_2^t$ for each period $t = 1, 2, 3$. Whether wages decrease or remain the same will depend on the production function Q and the implied elasticity of labor demand.

[66] The model can be further extended to frameworks where firms can change working hours of their employees in any period by paying a penalty $\pi \sim F_\pi$ with mean $\bar{\pi}$. In this case there exists a critical value of penalty π^*, so that all contracts with penalties $\pi \leq \pi^*$ are cancelled in the beginning of period 2. The speed of adjustment depends on how costly the penalties are: the lower the average penalty $\bar{\pi}$, the faster is the adjustment process. Note that if penalties or durations of contracts are not randomly assigned across job types, then the speed of adjustment will depend on the distribution of these restrictions across contracts. Adjustment is faster if a larger fraction of type 1 workers is associated with low levels of π or high value of θ.

[67] See also Liebman and Saez (2006) for similar evidence for the U.S.

tribution into the profit-maximizing function. In other words, in addition to choosing the total optimal hours of work L_{1i} and L_{2i}, each firm should further optimize on the distribution of hours it offers, G_i. Various incentives can make certain hour distributions preferred to the others.[68] For example, employee training requires the same amount of expenditures regardless of future working hours of the employees. In case of Germany, training costs encourage the existence of a double peaked distribution: with a large number of at-the-threshold mini-jobs and a large number of full-time-hour jobs. The resulting bunching at the threshold could then be larger than if it were based on individuals' preferences alone.

Labor regulations can also influence firms' preferred hour distributions. For example, the Affordable Care Act requires large firms to provide health insurance for employees working 30 hours per week or more. Will firms offer more 29-hours-or-less jobs? If wages of full-time workers can adjust downward and individuals value the health insurance provided, then no bunching will be present because individuals will be willing to accept lower wages in exchange for health insurance. However, if wages cannot adjust, e.g. because of fairness concerns, then firms' and workers' incentives diverge. Firms have an incentive to hire more 29-hour workers while workers – assuming they value health insurance – will prefer to work 30 hours with the goal of gaining insurance coverage. The equilibrium outcome will depend on the magnitude of search costs experienced by workers. If the search costs are high, firms' incentive will dominate and more 29-hour jobs will be offered. If, on the other hand, search costs are low and firms find it hard to fill 29-hour positions, bunching will be small.

5 Conclusion

This paper shows evidence of strong behavioral responses – in the form of sharp bunching – to a threshold that generates large discontinuous changes both in the marginal tax rates and in the total income and payroll tax liability of individuals in Germany. Using a firm and a household surveys I show that in addition to tax rates, fringe benefit payments also change at the threshold. A theoretical model shows that labor supply responses to taxes are strongest when the statutory incidence of tax breaks falls on the employers. I conclude that the differences in fringe benefits make mini-jobs attractive to employers, thus facilitating labor supply responses and leading to large bunching at the threshold.

The results of this paper highlight the inefficiency of notches: even in a presence of substantial adjustment costs notches can generate large distortions. These distortions can be further exacerbated by firm incentives, if policy gives all or part of the tax breaks to firms. These large distortions lead to effective entrapment of workers in low-paying jobs. The finding that many individuals who do not have incentives to limit hours worked end up with below-the-threshold jobs signifies the magnitude of the distortion. This paper demonstrates that policymakers should design programs that not only incentivize labor force entry, but also foster integration in the labor force. In case of

[68] For an insightful discussion on the topic see Pencavel (2016).

mini-jobs in Germany, integration could be improved by smoothing the mini-job notch with a kink and enforcing labor rules properly, to ensure firms' hiring decisions are not distorted.

The findings of the paper stress the importance of firms in the equilibrium outcomes of labor markets in general. While individuals are likely to suffer from adjustment costs, information frictions and behavioral biases, and therefore are constrained in their ability to respond to tax changes and labor regulations, firms are likely to be more responsive to incentives generated by tax systems and labor rules. To devise effective labor rules, policymakers should be careful take into account how policies affect firms' incentives.

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Table 1: Mini-Job Rules, Social Security Tax Rates, Income Tax Notches and Marginal Tax Rates

		Mini-Job Threshold	**Social Security**			**Income Tax Women**		**Income Tax Men**	
			Mini rate	Phase-out rate	Full Rate	Notch	MTR	Notch	MTR
		K	τ_{Mini}		τ_{Full}	ΔT_{Income}	τ_{Income}	ΔT_{Income}	τ_{Income}
by year:	1999	325	22	n/a	42	80	25	31	11
	2000	325	22	n/a	42	76	24	29	11
	2001	325	22	n/a	42	71	22	25	10
	2002	325	22	n/a	42	71	22	25	10
	2003	400	25	59	42	87	22	32	10
	2004	400	25	59	42	82	21	28	9
	2005	400	25	59	42	80	20	27	9
	2006	400	30	48	39	88	24	34	11
	2007	400	30	48	39	88	24	34	11
	2008	400	30	48	39	88	24	34	11
	2009	400	30	48	39	87	24	33	10
	2010	400	30	48	39	86	24	34	10

Notes: This table shows the size of the mini-job threshold (in posted earnings); mini-job, the phase out and full social security tax rates; as well as the average income tax notch and income tax marginal tax rate experienced by individuals at the mini-job threshold. Mini-job social security (SS) rate is charged on incomes below or at the mini-job threshold. The phase out SS rate is charged on earnings between €400 and €800 from 2003 on. Regular SS rate is charged on incomes above €400 prior to 2003 and above €800 from 2003 on. *Notch* is the average lump-sum payment of income tax an individual must make upon exceeding the mini-job threshold. *MTR* is the average marginal tax rate at the mini-job threshold. For single individuals, spousal income is set to zero. Spousal income includes labor earnings, as well as social security and private pensions. For further details see Section 2.2 and Appendix A.3. *Source*: Author's calculations using Socio-Economic Panel (SOEP), version 30.

Table 2: Elasticities by Year: Women and Men

year	Women: e	Women: s.e.(e)	Women: b	Women: s.e.(b)	Men: e	Men: s.e.(e)	Men: b	Men: s.e.(b)
1999	0.08	0.02	14.35	0.98	0.07	0.04	8.36	1.89
2000	0.11	0.04	15.08	1.68	0.09	0.05	8.81	1.53
2001	0.16	0.04	16.48	1.82	0.11	0.07	8.83	2.01
2002	0.12	0.03	14.59	1.16	0.10	0.06	8.58	1.79
2003	0.08	0.02	12.67	1.06	0.32	0.09	12.69	2.65
2004	0.15	0.03	15.16	1.80	0.30	0.09	11.28	2.48
2005	0.14	0.02	14.28	1.24	0.22	0.06	9.07	1.50
2006	0.14	0.02	14.29	1.36	0.17	0.05	8.10	1.23
2007	0.14	0.02	14.24	1.05	0.27	0.06	10.65	1.35
2008	0.13	0.05	13.78	1.87	0.28	0.14	10.84	3.50
2009	0.18	0.03	16.18	2.49	0.37	0.10	12.51	2.17
2010	0.17	0.02	15.31	1.29	0.34	0.09	11.99	2.13

Notes: This table shows elasticities of earnings with respect to net-of-tax rate by gender and year. These elasticities are estimated using an approach presented in Section 2.1. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Table 3: Heterogeneity of Elasticities by Gender, Age, Marital Status and Industry

		1999-2002		2003-2005		2006-2010	
		e	s.e.(e)	e	s.e.(e)	e	s.e.(e)
Singles:		0.14	(0.06)	0.57	(0.24)	0.55	(0.16)
Women:	under 40	0.18	(0.04)	0.22	(0.03)	0.20	(0.02)
	31-44 years old	0.07	(0.04)	0.08	(0.01)	0.11	(0.01)
	45-54 years old	0.14	(0.05)	0.14	(0.04)	0.13	(0.02)
	over 55	0.54	(0.09)	0.81	(0.17)	0.76	(0.11)
Men:	under 40	0.15	(0.02)	0.39	(0.04)	0.40	(0.04)
	31-44 years old	0.04	(0.05)	0.36	(0.09)	0.21	(0.06)
	45-54 years old	0.17	(0.06)	0.58	(0.15)	0.38	(0.07)
	over 55	0.47	(0.08)	0.56	(0.08)	0.46	(0.06)
Women:	Agriculture	0.1	(0.06)	0.13	(0.03)	0.2	(0.06)
	Food Manufacturing	0.1	(0.04)	0.16	(0.02)	0.2	(0.02)
	Other Manufacturing	0.08	(0.02)	0.14	(0.03)	0.17	(0.02)
	Construction	0.15	(0.1)	0.21	(0.06)	0.3	(0.09)
	Transportation and Storage, Motor Vehicles	0.12	(0.1)	0.2	(0.06)	0.17	(0.03)
	Wholesale	0.08	(0.03)	0.24	(0.07)	0.17	(0.04)
	Retail	0.14	(0.03)	0.15	(0.02)	0.15	(0.01)
	Food Services	0.13	(0.08)	0.29	(0.09)	0.25	(0.09)
	Professional Services, Real Estate	0.09	(0.08)	0.16	(0.07)	0.11	(0.02)
	Education	0.02	(0.02)	0.08	(0.02)	0.08	(0.01)
	Health Services	0.11	(0.03)	0.09	(0.01)	0.12	(0.01)
	Organizations	0	(0.02)	0.03	(0.04)	0	(0.02)
	Other Activities	0.09	(0.06)	0.41	(0.09)	0.22	(0.07)

Notes: This table shows elasticities of earnings with respect to net-of-tax rate by gender, age group, marital status and industry. These elasticities are estimated using an approach presented in Section 2.1. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Table 4: The Effect of Mini-Job Status on Wages, Bonuses and Vacation Days (Firm Survey VSE)

	Monthly Income €375–€500					**Monthly Income €50–€1500**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable: Log(Hourly Gross Wage)									
Mini-Job	0.060***	0.091***	0.057***	0.088***	0.062***	0.094***	0.095***	0.062***	0.070***
	(0.007)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)
Dependent Variable: Log(Hourly Posted Wage)									
Mini-Job	-0.017***	0.014***	-0.019***	0.012**	-0.014**	0.016***	0.017***	-0.015**	-0.007*
	(0.007)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)
Dependent Variable: Log(Hourly Net Wage)									
Mini-Job	0.173***	0.191***	0.151***	0.150***	0.147***	0.219***	0.231***	0.174***	0.182***
	(0.007)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.004)	(0.005)	(0.004)
Dependent Variable: Yearly Bonus									
Mini-Job	-141.561***	-80.246***	-81.099***	-60.706***	-94.085***	-134.388***	-108.769***	-112.651***	-89.406***
	(5.195)	(4.434)	(4.628)	(4.834)	(5.120)	(7.427)	(6.115)	(5.744)	(6.112)
Dependent Variable: Vacation Days									
Mini-Job	-6.244***	-3.776***	-3.041***	-1.894***	-2.543***	-6.951***	-5.843***	-4.548***	-3.948***
	(0.320)	(0.171)	(0.170)	(0.170)	(0.210)	(0.274)	(0.138)	(0.291)	(0.220)
Dependent Variable: Log(Hourly Gross Wage incl. Bonus and Vacation Pay)									
Mini-Job	-0.017**	0.053***	0.019***	0.055***	0.015**	0.015*	0.033***	-0.011**	0.008
	(0.009)	(0.006)	(0.005)	(0.006)	(0.007)	(0.008)	(0.004)	(0.006)	(0.005)
Firm FE	No	Yes	Yes	Yes	No	No	Yes	No	Yes
Individual Controls	No	No	Yes	Yes	Yes	No	No	Yes	Yes
Firm Controls	No	No	No	No	Yes	No	No	Yes	No
Linear Wage Trend	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Quadratic Wage Trend	No	No	No	No	No	No	No	Yes	Yes
Number of Observations	107,239	107,239	107,239	107,239	107,239	887,183	887,183	887,183	887,183

Notes: This table shows the coefficients from regressing the listed dependent variables on a mini-job indicator variable. Standard errors are clustered by firm. Individual controls include male indicator, age group indicators, company tenure, education indicators, occupational status and occupation indicators and year indicators. Firm controls include industry indicators, geographical indicators, number of male and female workers, indicators of applicable collective agreements, and indicators of whether a firm is part of a larger enterprise, whether a firm works in handcrafts, and whether a firm is publicly traded. Linear and quadratic trends include both linear/quadratic terms and their interactions with the mini-job indicator. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author's calculations.

Table 5: The Effect of Mini-Job Status on Wages and Bonuses (Household Survey SOEP)

	Monthly Income €375–€500					**Monthly Income €50–€1500**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable: Log(Hourly Gross Wage)									
Mini-Job	0.086**	0.065*	0.083**	0.069**	0.137**	0.099***	0.086***	0.100***	0.092***
	(0.038)	(0.038)	(0.033)	(0.033)	(0.061)	(0.022)	(0.021)	(0.029)	(0.029)
Indiv. Notch		0.003***		-0.001	-0.001		0.006***		0.004***
		(0.001)		(0.001)	(0.001)		(0.000)		(0.001)
Dependent Variable: Log(Hourly Posted Wage)									
Mini-Job	0.017	-0.004	0.014	-0.000	0.068	0.029	0.016	0.029	0.022
	(0.038)	(0.038)	(0.033)	(0.034)	(0.061)	(0.022)	(0.021)	(0.029)	(0.029)
Indiv. Notch		0.003***		-0.001	-0.001		0.006***		0.004***
		(0.001)		(0.001)	(0.001)		(0.000)		(0.001)
Dependent Variable: Log(Hourly Net Wage)									
Mini-Job	0.196***	0.158***	0.188***	0.150***	0.154**	0.242***	0.230***	0.177***	0.177***
	(0.043)	(0.043)	(0.038)	(0.039)	(0.071)	(0.023)	(0.024)	(0.032)	(0.032)
Indiv. Notch		0.005***		0.002	0.002		0.004***		0.001*
		(0.001)		(0.002)	(0.002)		(0.000)		(0.001)
Dependent Variable: Yearly Bonus									
Mini-Job	-81.028**	-79.377**	-56.797***	-57.303***	-19.068	15.406	5.503	-31.155	-38.612
	(34.184)	(35.239)	(19.326)	(20.189)	(31.994)	(20.987)	(21.776)	(28.693)	(29.099)
Indiv. Notch		-1.399*		-2.493***	-2.509***		3.182***		-0.312
		(0.761)		(0.868)	(0.863)		(0.531)		(0.702)
Dependent Variable: Log(Gros Wage incl. Bonus)									
Mini-Job	0.074*	0.054	0.074**	0.060*	0.132**	0.093***	0.078***	0.092***	0.084***
	(0.038)	(0.038)	(0.033)	(0.034)	(0.061)	(0.022)	(0.021)	(0.030)	(0.030)
Indiv. Notch		0.003***		-0.001	-0.001		0.006***		0.003***
		(0.001)		(0.001)	(0.001)		(0.000)		(0.001)
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indiv. Controls (subset)	No	No	Yes	No	No	No	No	Yes	No
Indiv. Controls (full)	No	No	No	Yes	Yes	No	No	No	Yes
Firm Controls	No	No	Yes	Yes	Yes	No	No	Yes	Yes
Linear Wage Trend	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Quadratic Wage Trend	No	No	No	No	No	No	No	Yes	Yes
Number of Observations	3,373	3,238	3,357	3,357	3,020	20,581	19,979	20,524	18,889

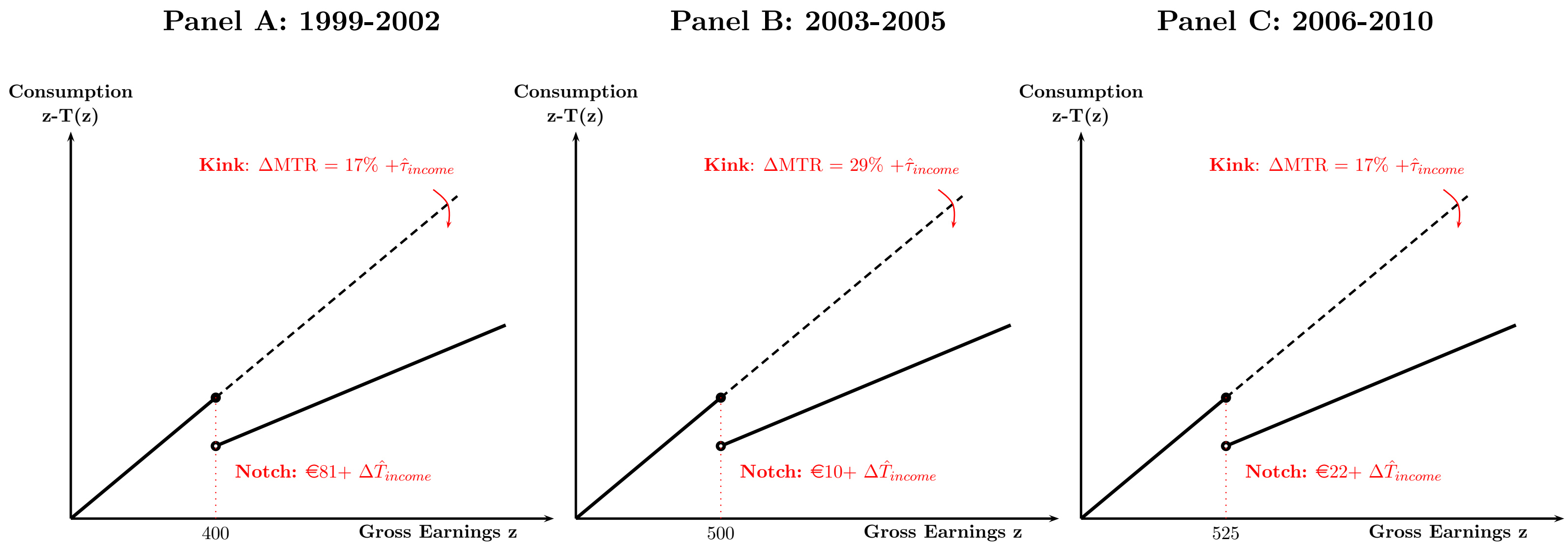
Notes: This table shows the coefficients from regressing the listed dependent variables on a mini-job indicator variable. Standard errors are clustered by individual. Individual controls (subset) include male indicator, age group indicators, company tenure, education indicators and occupation indicators. In addition to above controls, the full set also includes marital status, presence of a partner (if not married), citizenship indicator, indicator of whether a job matches completed training, experience working full time and experience working part time. Firm controls include industry indicators and indicators of size (by number of employees). Linear and quadratic trends include both linear/quadratic terms and their interactions with the mini-job indicator. *Source*: Socio-Economic Panel (SOEP), version 30.

Table 6: The Effect of Mini-Job Status on Gross Wage (Firm Survey VSE)

	Monthly Income €375–€500			**Monthly Income €50–€1500**		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable: Log(Hourly Gross Wage)						
Mini-Job	0.087***	0.087***	0.089***	0.066***	0.075***	0.061***
	(0.006)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)
Mini-Job x Male	0.001***			0.016***		
	(0.006)			(0.003)		
Mini-Job x Age<25		-0.011			-0.002	
		(0.009)			(0.004)	
Mini-Job x Age 40-60		0.007			-0.012***	
		(0.006)			(0.002)	
Mini-Job x Age 60-65		-0.011			0.011***	
		(0.013)			(0.004)	
Mini-Job x Age >65		0.002			-0.003	
		(0.013)			(0.006)	
Mini-Job x Industry Coll. Agr.			0.008			0.034***
			(0.010)			(0.005)
Mini-Job x Firm Coll. Agr.			-0.023			0.016
			(0.026)			(0.016)
Mini-Job x Enterprise Coll. Agr.			-0.101***			-0.056***
			(0.030)			(0.014)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Occupation Controls	Yes	Yes	Yes	Yes	Yes	Yes
Linear Wage Trend	Yes	Yes	Yes	Yes	Yes	Yes
Quadratic Wage Trend	No	No	No	Yes	Yes	Yes
Number of Observations	107,239	107,239	107,239	887,183	887,183	887,183

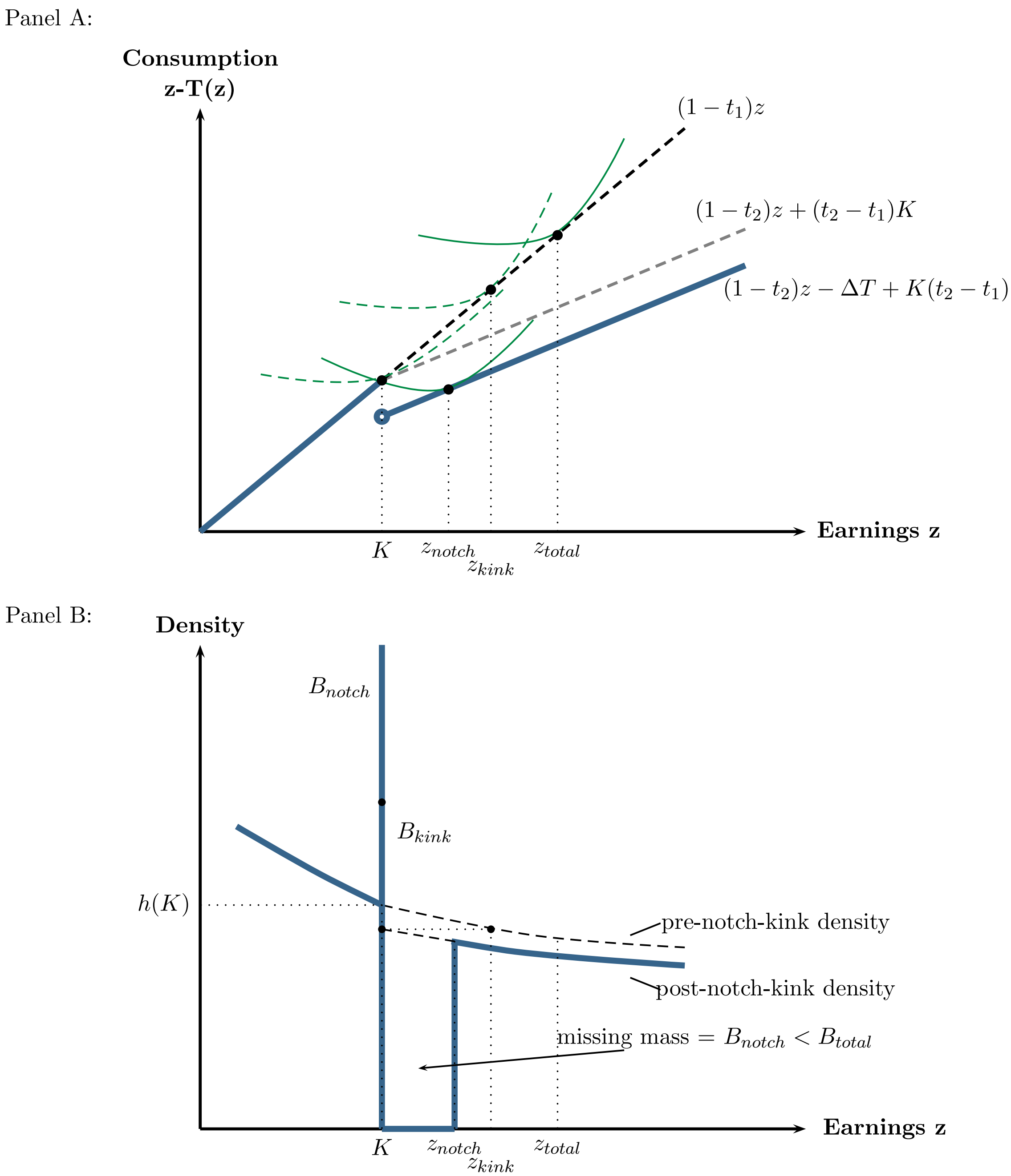
Notes: This table shows the coefficients from regressing the logarithm of gross wage on a mini-job indicator interacted with gender (columns 1 and 4), age (columns 2 and 5), collective agreements (columns 3 and 6). Standard errors are clustered by firm. Individual controls include male indicator, age group indicators, company tenure, education indicators, occupational status and occupation indicators. Linear and quadratic trends include both linear/quadratic terms and their interactions with the mini-job indicator. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author's calculations.

Figure 1: Budget Constraints Around the Mini-Job Threshold (in Gross Wages)



Notes: This figure shows budget constraints experiences by individuals in 1999-2002, 2003-2005 and 2006-2010 in terms of *gross* earnings. Gross earnings are defined as wages paid inclusive of all income and employee-paid social security taxes plus social security taxes paid by the employer. The budget constraints show the magnitude of the social security notch and the magnitude of change in social security tax rate (absolute difference). In addition to higher social security taxes, individuals must pay income taxes. The magnitude of income tax due, $\hat{\tau}_{income}$ and $\Delta\hat{T}_{income}$, depends on individual's marital status and spousal earnings. For single individuals, $\hat{\tau}_{income} = 0$ and $\Delta\hat{T}_{income} = 0$. For married individuals, $\hat{\tau}_{income} = \frac{\tau_{Income}}{1+0.5\tau_{Full}}$ and $\Delta\hat{T}_{income} = \Delta T + \tau_{income}\bar{K}\left(\frac{1}{1+0.5\tau_{Full}} - \frac{1}{1+\tau_{Mini}}\right)$, where τ_{Mini}, τ_{Full}, and average τ_{Income} and ΔT_{Income} are available in Table 1. For further details see Section 2.2.

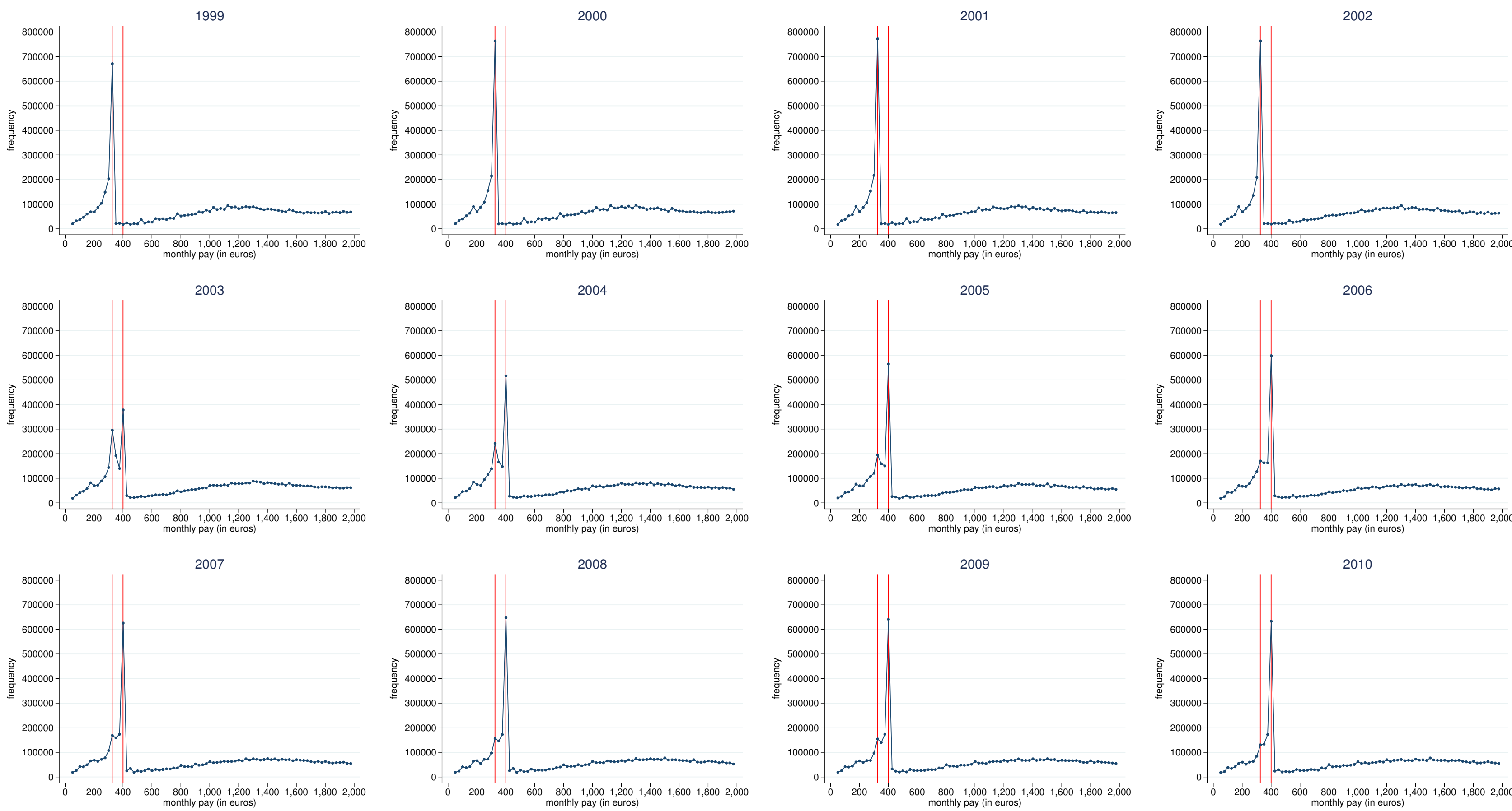
Figure 2: Budget Constraint in Presence of Kink and a Notch



Notes: Panel A shows the budget constraint of an individual whose marginal tax rate increases from t_1 to t_2 and who must pay a lump-sum tax ΔT at the threshold K. Panel B shows the corresponding distribution of earnings in the presence of such tax schedule.

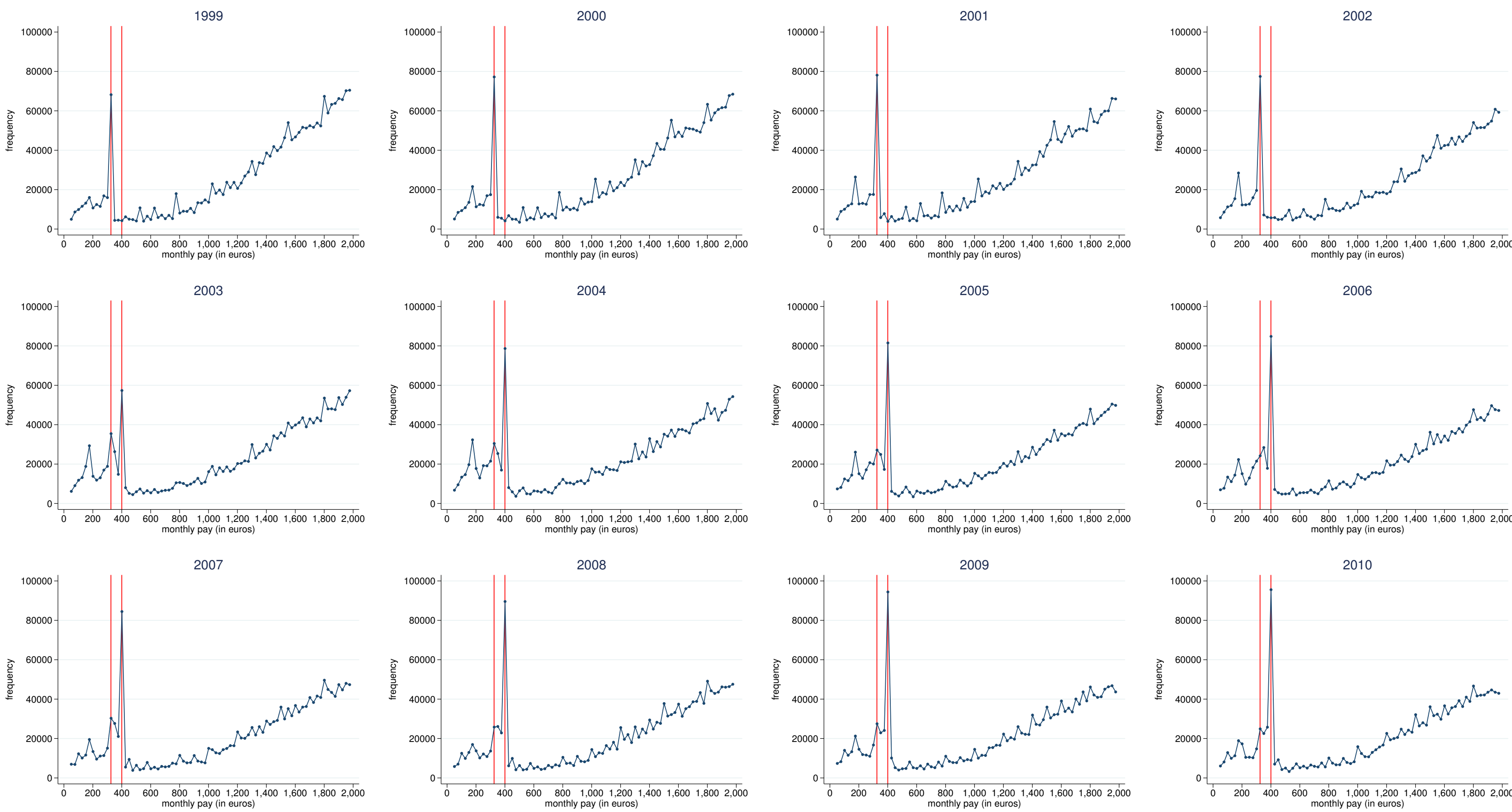
Individuals who wish to earn between K and z_{kink} under the tax rate t_1 would instead bunch and earn income K when the tax rate increases to t_2. The cutoff z_{kink} is chosen such that it is the highest income an individual could have earned under the budget constraint with slope $1-t_1$ and have his indifference curve tangent to the budget constraint with slope $1-t_2$ at the threshold K. The indifference curves of such an individual are shown as dashed green curves. Thus, the kink will generate some bunching as shown in Panel B and lead to a parallel leftward shift of the distribution of earnings. The notch will further create a region of strictly dominated incomes, so that no individual would choose to earn between K and z_{notch}. The cutoff z_{notch} is chosen such that an individual is indifferent between working more and earning z_{notch}, and working less and earning K. The indifference curves of this person are shown as solid green curves. The notch will thus lead to further bunching at the threshold K and generate a hole in the final distribution of incomes, as shown in Panel B with a bold blue curve. The size of the hole to the right of the threshold will not be equal to the entire amount of bunching, but will only account for the bunching generated by the notch.

Figure 3: Earnings in 1999–2010: Women



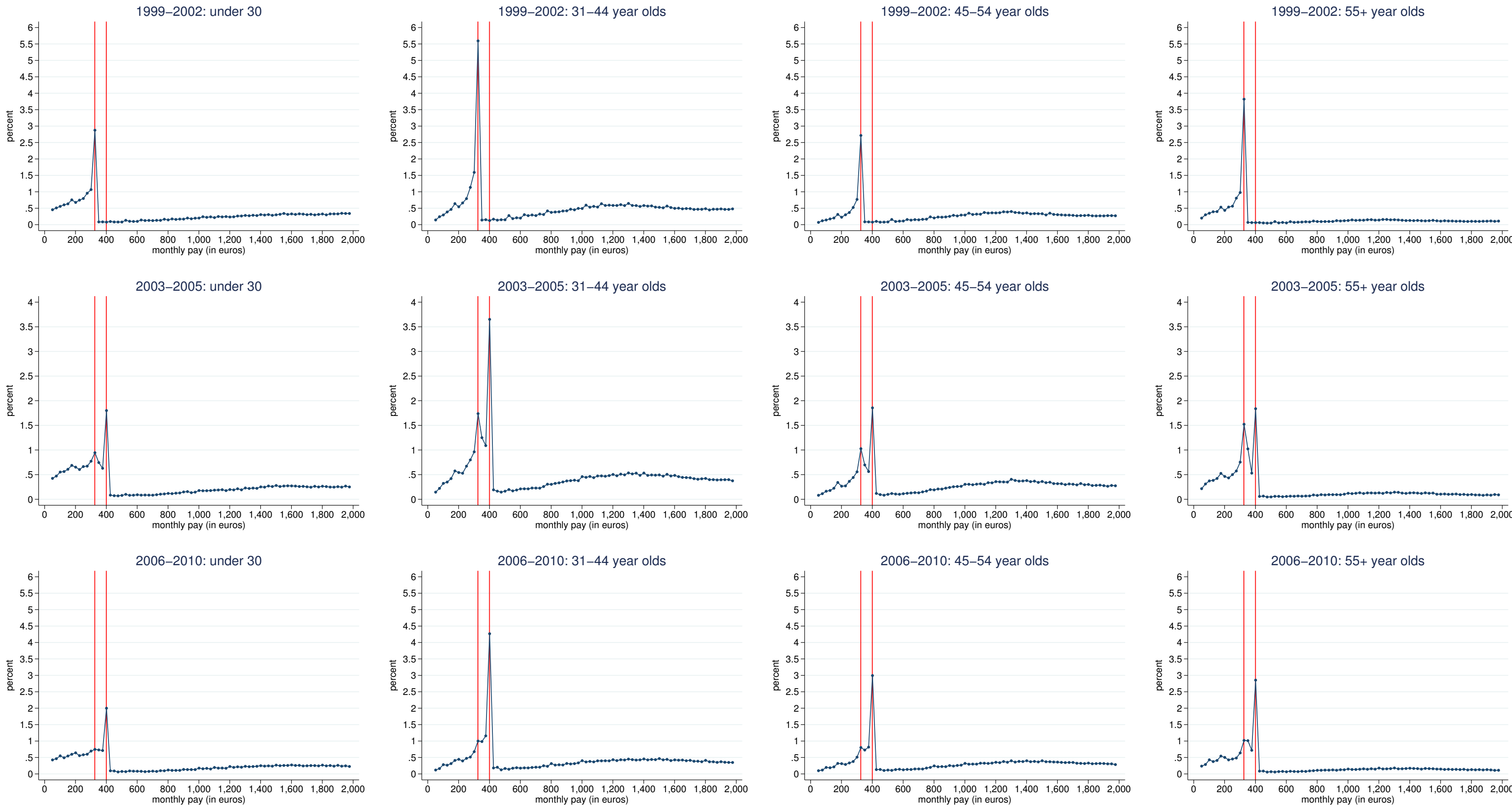
Notes: This figure shows the distribution of monthly wage earnings (posted) of women by calendar year. Each point shows the number of individuals in a €25 bin, scaled to represent the German population in that year from a 2% random sample. The vertical red lines identify the mini-job thresholds: €325 prior to 2003 and €400 thereafter. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Figure 4: Earnings in 1999-2010: Men



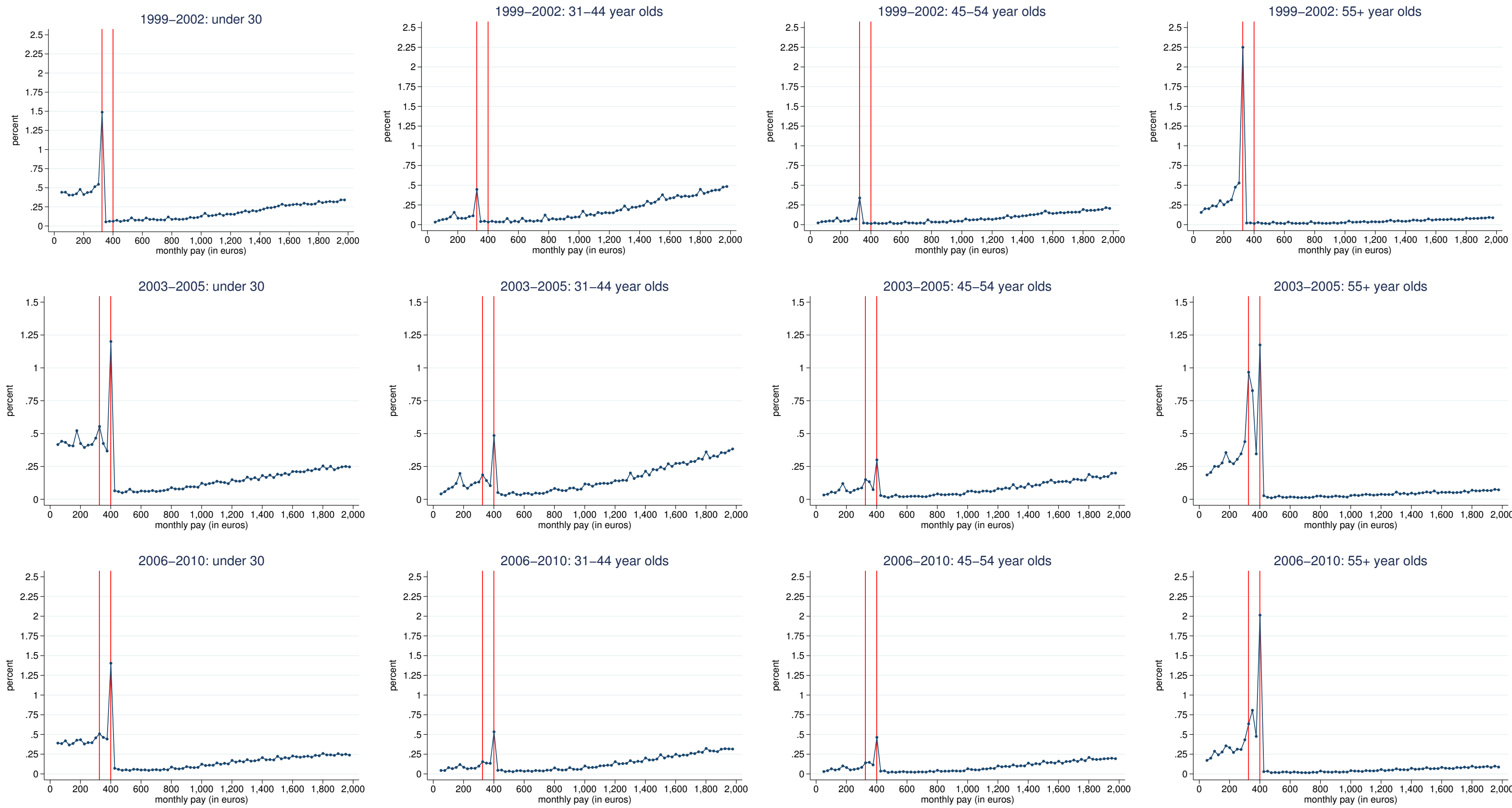
Notes: This figure shows the distribution of monthly wage earnings (posted) of men by calendar year. Each point shows the number of individuals in a €25 bin, scaled to represent the German population in that year from a 2% random sample. The vertical red lines identify the mini-job thresholds: €325 prior to 2003 and €400 thereafter. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Figure 5: Earnings in 1999-2002 and 2003-2010: Women by Age Group



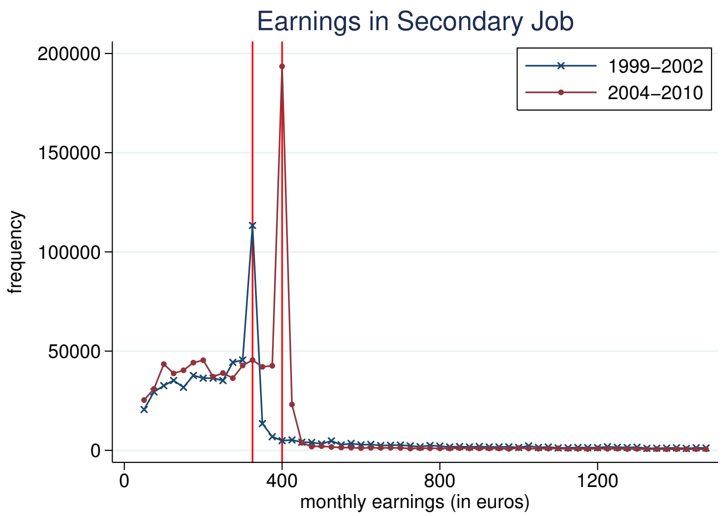
Notes: This figure shows the distribution of monthly wage earnings (posted) of women by age group in 1999-2002, 2003-2005 and 2006-2010. Each point shows the number of individuals in a €25 bin divided by the total number of females in that year group. The vertical red lines identify the mini-job thresholds: €325 prior to 2003 and €400 thereafter. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Figure 6: Earnings in 1999-2002 and 2003-2010: Men by Age Group



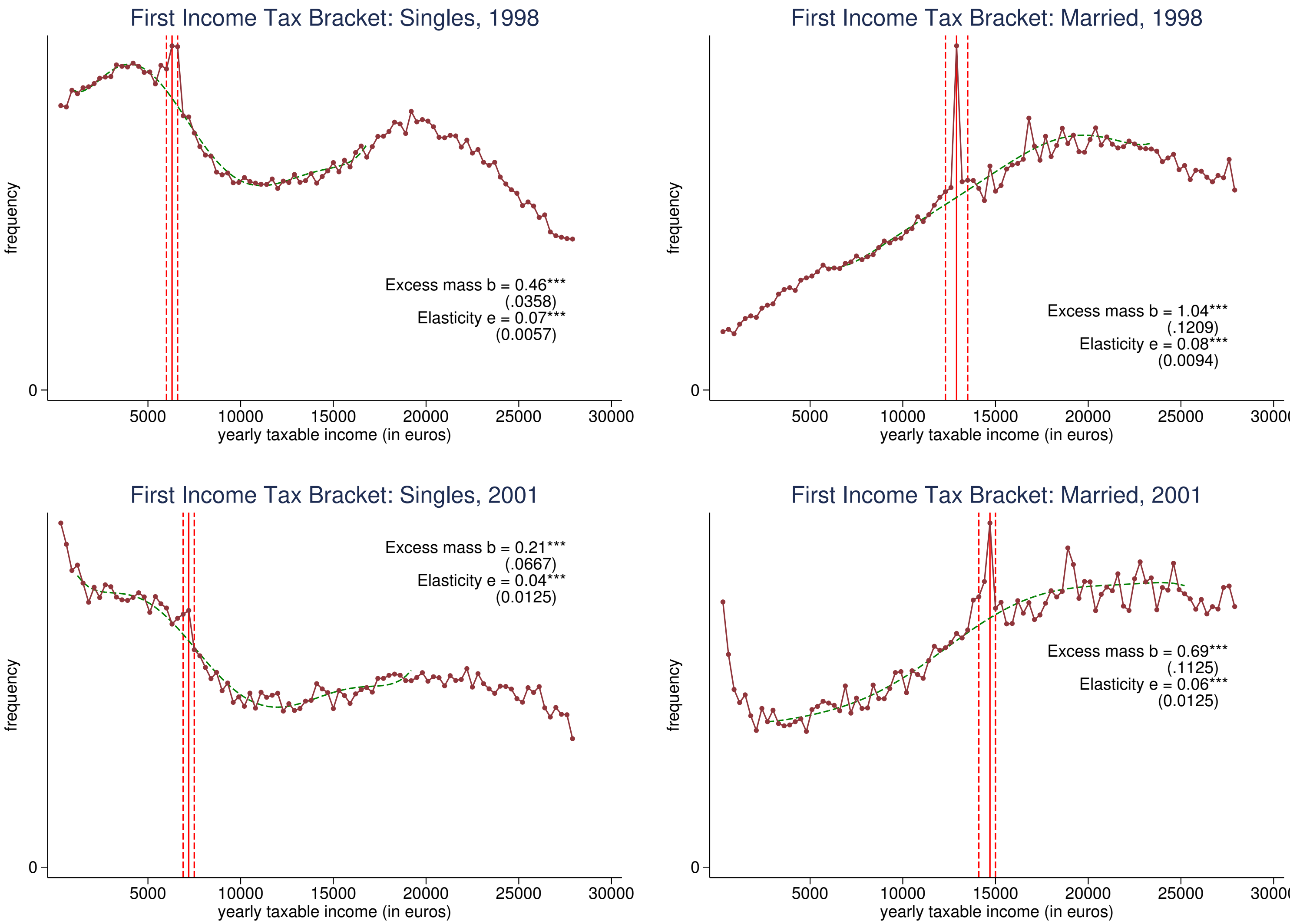
Notes: This figure shows the distribution of monthly wage earnings (posted) of men by age group in 1999-2002, 2003-2005 and 2006-2010. Each point shows the number of individuals in a €25 bin divided by the total number of males in that year group. The vertical red lines identify the mini-job thresholds: €325 prior to 2003 and €400 thereafter. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Figure 7: "Firm Bunching" – Individuals with Multiple Jobs



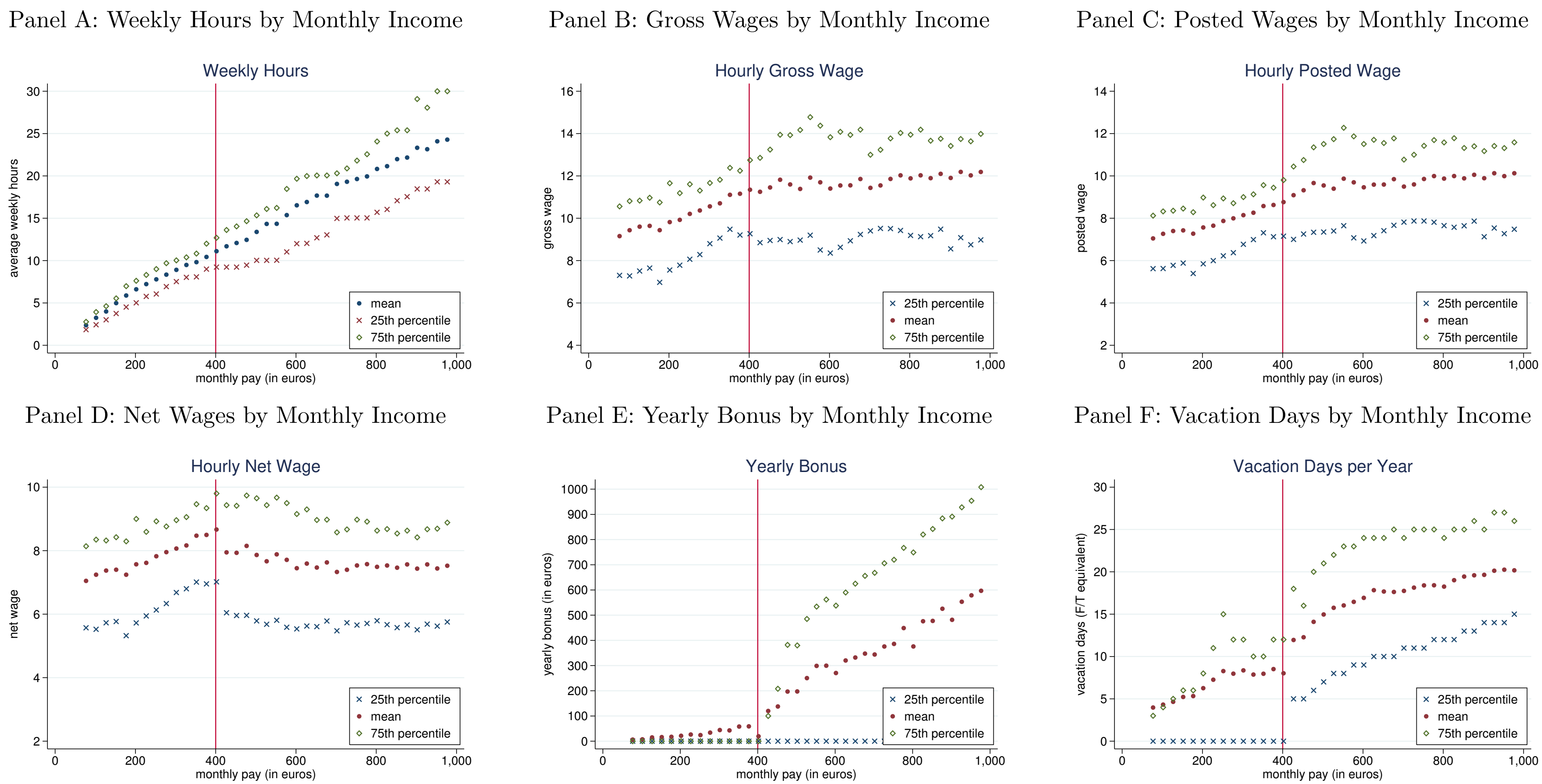
Notes: This figure shows the distribution of *posted* earnings in a secondary job for individuals who concurrently hold a second jobs in addition to "regular" job, defined as a job that pays more than €325 in 1999-2002 or more than €400 in 2004-2010. The distributions shown present averages across respective years. Only individuals who are reported to work at *two* enterprises per year are included. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Figure 8: Behavioral Responses to the First Income Tax Kink in 1998 and 2001



Notes: These figures show the distribution of posted earnings in 1998 and 2001 for single and married individuals around the start of first income tax bracket. In 1998, the marginal income tax rate increased from zero to 25.9% at €6,322 for single and at €12,644 for married individuals. In 2001, the marginal income tax rate increased from zero to 19.9% at €7,206 for single and at €14,412 for married individuals. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Lohn- und Einkommensteuerstatistik Public-Use-Files, 1998 and 2001, author's calculations.

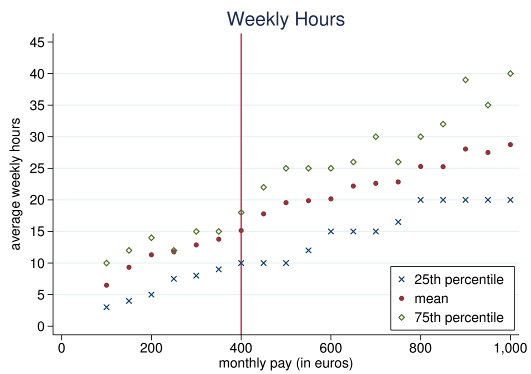
Figure 9: Earnings Distributions, Weekly Hours and Wages by Income (Firm Survey VSE)



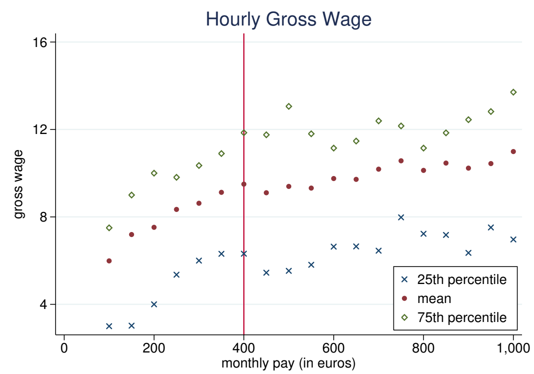
Notes: All results are based on the combined 2006 and 2010 waves of Verdienststrukturerhebung (VSE) Survey. Panel A shows the mean, as well as the 25th and 75th percentiles of weekly hours by €25 bins of monthly pay. Panel B, C and D show the mean, as well as the 25th and 75th percentiles of hourly gross, posted and net wages by €25 bins of monthly pay. Panel E and F shows the mean, as well as the 25th and 75th percentiles of yearly bonus and the number of full-time equivalent vacation days by €25 bins of monthly pay. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author's calculations.

Figure 10: Earnings Distributions, Weekly Hours and Wages by Income (Household Survey SOEP)

Panel A: Weekly Hours by Monthly Income

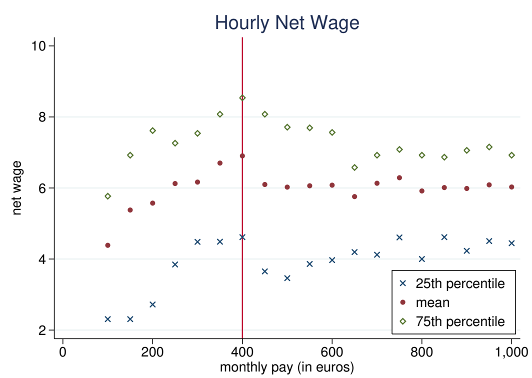


Panel B: Gross Wages by Monthly Income

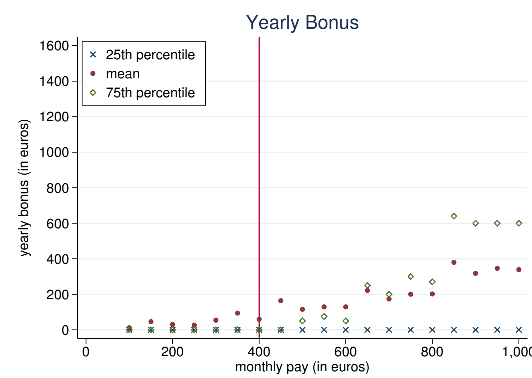


Panel C: Posted Wages by Monthly Income

Panel D: Net Wages by Monthly Income

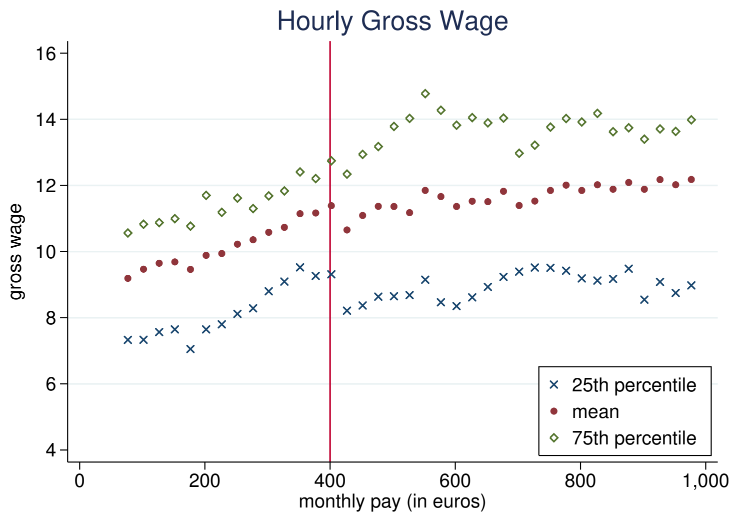


Panel E: Yearly Bonus by Monthly Income



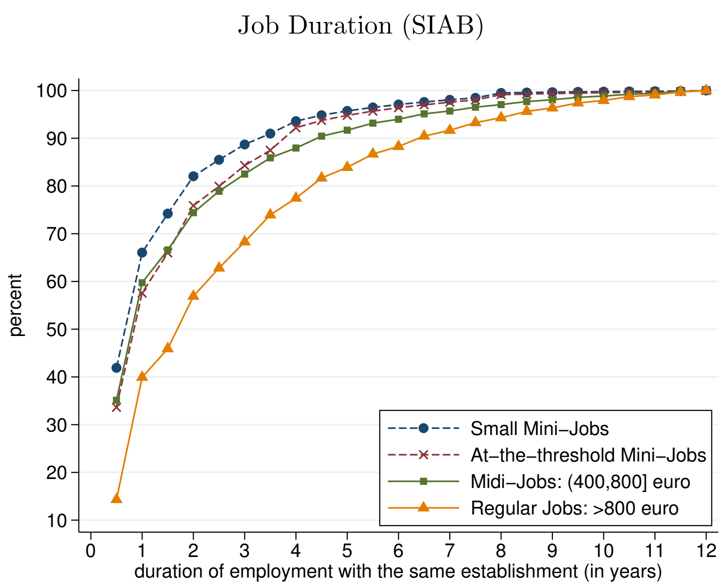
Notes: Panel A shows the mean, as well as the 25th and 75th percentiles of weekly hours by €25 bins of monthly pay. Panel B, C and D show the mean, as well as the 25th and 75th percentiles of hourly gross, posted and net wages by €25 bins of monthly pay. Panel E and F shows the mean, as well as the 25th and 75th percentiles of yearly bonus and the number of full-time equivalent vacation days by €25 bins of monthly pay. *Source*: Socio-Economic Panel (SOEP), version 30, author's calculations.

Figure 11: Hourly Gross Wage by Income: Subsample (Firm Survey VSE)



Notes: This figure shows the mean, as well as the 25th and 75th percentiles of hourly gross wage by €25 bins of monthly pay in 2006 and 2010. The sample is restricted to mini-job workers with monthly posted earnings below the mini-job threshold and regular workers with monthly posted earnings above the mini-job threshold. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author's calculations.

Figure 12: Job Duration by Type of Employment



Notes: This figure shows the cumulative distribution function of job durations (within the same establishment) based on the SIAB 1999-2010 data. Job duration is calculated as the time spent at any given establishment with employment breaks of less than 30 days. Cumulative distributions are based on monthly earnings in the first year of employment. Mini-jobs are defined as employments with monthly earnings of less than €300 before 2003 and less than €375 from 2003 on. At-the-threshold mini-jobs are defined as employments with monthly earnings of [€300,€325] or [€375,€400] respectively. Midi-jobs are defined as employments with monthly earnings of (€325, €800] or (€400,€800] respectively. Finally, regular jobs are defined as employments with monthly earnings of more than €800. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

APPENDIX

A Elasticity Estimation

A.1 SIAB Data

This study uses the weakly anonymous Sample of Integrated Labour Market Biographies (Years 1975 - 2010).[69] The SIAB data includes all notifications submitted by the employers on behalf of their employees, therefore some duplicate entries are present. Below I describe the procedure I use to obtain the final sample of labor histories used in this paper.

Since the study focuses on wage responses to payroll taxes, I focus on individuals appearing in the Employment History reports (Beschäftigten-Historik or BeH). There are a total of 29,741,469 split episode BeH observations in the SIAB and 26,312,013 unsplit episodes. First, I drop all observations from years before 1999, leaving 11,595,496 unsplit observations. Next, I drop 165,048 observations that report a zero wage. I also drop all individuals that during a year are reported to have a job of any type other than regular, part-time, or marginal employment. In other words, I drop individuals that have reported working as trainees, partially-retired, interns, student trainees, or casual workers in *that* particular year. These drops reduce the dataset to 10,076,812 observations.

Next, I remove duplicate entries. First, I delete all perfect duplicates – 99 observations. Second, I remove all duplicate observations that differ only by notification reason ("grund") – 22 observations deleted. Third, I remove all duplicate observations that differ only by employment status ("erwstat") – 3 observations. Fourth, I drop observations that differ only by occupational status and working hours ("stib") – 2 observations. Fifth, I drop observations that differ only by occupation ("beruf") – 2 observations. Sixth, I keep observations with the largest reported earnings when observations *only* differ by the amount of earnings – 13,533 deleted. Finally, I keep observations with the largest earnings when observations differ only by reason for notification ("grund") – 1,145 deleted. The remaining sample consists of 10,062,006 unsplit episode observations or 7,599,850 person-year observations, and covers 1,019,061 individuals who have worked at 1,102,561 distinct establishments.

A.2 Elasticity Estimation Procedure

I start with a guess of elasticity, e^0, and estimate predicted proportion of bunching due to the notch, $\pi^0_{notch} \equiv 1 - B^0_{kink}/B^0_{total}$ using equations (2) and (4). Next, I identify a counterfactual distribution by estimating the following regression:

$$C_j = \sum_{i=0}^{q} \beta_i \cdot (Z_j)^i + \sum_{i=z_l}^{z_u} \gamma_i \cdot \mathbf{1}[Z_j = i] + \varepsilon^0_j, \tag{24}$$

[69]For more detailed information, see IAB's webpage at
`http://fdz.iab.de/en/FDZ_Individual_Data/integrated_labour_market_biographies/SIAB_Outline.aspx`.

where C_j represents the number of individuals in income bin j described above, Z_j is the average income level in bin j, q is the order of polynomial which is fitted to the counts, z_l and z_u determine the size of the excluded region around the mini-job threshold, such that $z_l < K \leq z_u$.[70] The counterfactual distribution is defined by the predicted values from (24) omitting the dummies: $\hat{C}^0 = \sum_{i=0}^{q} \hat{\beta}_i^0 \cdot (Z_j)^i$. Excess mass $\hat{B}^0$ and missing mass $\hat{M}^0$ are calculated as the difference between observed empirical density counts C_j and estimated counterfactual counts $\hat{C}_j^0$ in the earnings intervals $(z_l, K]$ and $(K, z_u]$ respectively: $\hat{B}^0 = \sum_{j=z_l}^{K}(C_j - \hat{C}_j^0) = \sum_{j=z_l}^{K} \hat{\gamma}_j^0$ and $\hat{M}^0 = \sum_{j=K}^{z_u}(\hat{C}_j^0 - C_j) = -\sum_{j=K}^{z_u} \hat{\gamma}_j^0$. The lower bound of the excluded region z_l is estimated visually.[71] To estimate z_u, I make use of the fact that the amount of bunching due to the notch should be equal to the missing mass to the right of the threshold. I start by setting $z_u = K + 1$ and keep increasing z_u by one bin until the estimated excess mass due to the notch equals the estimated missing mass, i.e. until $\pi_{notch}^0 \cdot \hat{B}^0 = \hat{M}^0$.

The resulting counterfactual, $\hat{C}_j^0$, does not account for the fact that the excess mass due to the kink comes from the individuals moving from points of the distribution to the right of the threshold, and therefore $\hat{B}^0$ resulting from (24) may over- or underestimate the true excess mass. To correct for this I adjust the estimated counterfactual distribution rightward until the area under the counterfactual equals the area under the empirical distribution.[72] The final estimate of bunching for the elasticity guess e^0 is then calculated as $\hat{B}^0 = \sum_{j=z_l}^{K}(C_j - \hat{C}_j) = \sum_{j=z_l}^{K} \hat{\gamma}_j$ where $\hat{C}_j = \sum_{i=0}^{q} \hat{\beta}_i (Z_j)^i$ are the adjusted fitted values from regression (24). In line with the previous research, see Chetty et al. (2011) and Kleven and Waseem (2013), I define a measure of total excess bunching $\hat{b}$:

$$\hat{b}^0 \equiv \frac{\hat{B}^0}{\hat{h}(K)} = \frac{\hat{B}^0}{\sum_{j=z_l}^{K} \hat{C}_j/(K - z_l + 1)}. \tag{25}$$

The elasticity of earnings with respect to the net-of-tax rate can then be calculated by substituting $\frac{\hat{B}_{notch}^0}{\hat{h}(K)} = \pi_{notch}^0 \cdot \hat{b}^0$ into equation (2). The described calculations provide an elasticity estimate $\hat{e}^0$ based on the original guess e^0. Provided the estimated elasticity does not match the guess, i.e. $\hat{e}^0 \neq e^0$, I update the guess to $e^1 = \hat{e}^0$ and repeat the calculations for the new guess. I proceed with these iterations until a fixed point is achieved, such that $\hat{e}^k = e^k$ for some k.

A.3 Income Tax Notch and Marginal Tax Rate Calculations

Let τ_{Mini} denote the prevailing mini-job social security rate that employers must pay on mini-job earnings, τ_{Full} determines the full social security tax rate that is split equally between employers and employees, τ_{Income} refers to the marginal income tax rate and ΔT_{Income} to the lump-sum change

[70] Here I assume that bunching will fall into the interval $[z_l, K]$ because individuals are unable to precisely locate at the threshold. Because having income just above the threshold would still subject a worker to a lump-sum tax notch, the excess mass will be located strictly to the left of the threshold. The interval $(K, z_u]$ determines the interval of earnings where the observed distribution will lie below the counterfactual distribution.

[71] This is a standard approach in bunching methodology. While such selection might sound ambiguous, in practice it is not. Bunching around the threshold is very sharp, and with well-defined bounds.

[72] Recall Figure 2: the original density shifts leftward, reflecting weaker incentives to supply labor. This adjustment effectively corrects for the shift of the counterfactual due to the kink.

in income tax liability at the mini-job threshold K.[73] Note that legally the threshold K applies to *posted* earnings – wages paid to the workers by firms before income taxes and the employee portion of social security taxes are withheld. However, because the employer taxes differ below and above the threshold, I focus on changes in gross earnings. The budget constraint (1) in terms of *gross* earnings prior to April 1, 2003 can be summarized as

$$T(X_g) = \begin{cases} \frac{\tau_{Mini}}{1+\tau_{Mini}} \cdot X_g & \text{if } X_g \leq \bar{K} \\ \\ \Delta T_{income} + \frac{(\tau_{Full}+\tau_{Income})\bar{K}}{1+0.5\tau_{Full}} - \frac{(\tau_{Mini}+\tau_{Income})\bar{K}}{1+\tau_{Mini}} & \\ \qquad + \frac{\tau_{Mini}}{1+\tau_{Mini}} \cdot \bar{K} + \frac{\tau_{Full}+\tau_{Income}}{1+0.5\tau_{Full}}(X_g - \bar{K}) & \text{if } X_g > \bar{K}, \end{cases} \tag{26}$$

where $\bar{K} \equiv (1+\tau_{Mini})K$. Equation (26) shows that mini-jobs are exempt from income and employee-paid social security taxes, while both types of taxes are due upon crossing the mini-job threshold.[74]

After the 2003 reform, the tax schedule (1) becomes

$$T(X_g) = \begin{cases} \frac{\tau_{Mini}}{1+\tau_{Mini}} \cdot X_g & \text{if } X_g \leq \bar{K} \\ \\ \Delta T_{Income} + \left(\frac{1}{1+0.5\tau_{Full}} - \frac{1}{1+\tau_{Mini}}\right)(2\tau_{Full} - \tau_{Mini} + \tau_{Income})\bar{K} & \\ \qquad + \frac{\tau_{Mini}}{1+\tau_{Mini}}\bar{K} + \frac{2\tau_{Full}-\tau_{Mini}+\tau_{Income}}{1+0.5\tau_{Full}}(X_g - \bar{K}) & \text{if } X_g > \bar{K}, \end{cases} \tag{27}$$

where $\bar{K} \equiv K(1 + \tau_{Mini})$. Equation (27) shows a decrease in the size of the notch at the mini-job threshold because the social security liability has been reduced.[75]

Equations (26) and (27) thus specify how marginal and average tax rates change at the mini-job threshold. To calculate the average income tax notches and marginal tax rates presented in Table 1 I use a 95% extract from the longitudinal version of the Socio-Economic Panel (SOEP), version 30.[76] There are a total of 592,864 non-duplicate year-person observations for years 1984 through 2013 with nonempty and nonzero household and personal weights covering 72,842 individuals (including children and elderly). I restrict my sample to individuals who reported posted wage earnings

[73] I separate the income tax into a lump-sum and marginal tax rate portions because Germany has continuously progressive marginal tax rates. Therefore income tax rate τ_{Income} is not fixed. Thus, ΔT_{Income} gives the true value of income tax due when *posted* income equals the mini-job threshold K, while τ_{Income} approximates the marginal tax rate at the threshold.

[74] Since jobs with monthly *posted* earnings below the mini-job threshold are exempt from income taxes and the employee portion of social security contributions, *gross* wages X_g below the mini-job threshold are subject to a total tax $T(X_g) = \tau_{Mini} \cdot X_p = \frac{\tau_{Mini}}{1+\tau_{Mini}} \cdot X_g$. Prior to April 1, 2003, posted wages X_p above the mini-job threshold were subject to a total tax $T(X_g) = \Delta T_{income} + \tau_{Full} X_p + \tau_{Income} \cdot (X_p - K) = \Delta T_{income} + \tau_{Full} \frac{X_g}{1+0.5\tau_{Full}} + \tau_{Income}\left(\frac{X_g}{1+0.5\tau_{Full}} - K\right)$, where ΔT_{Income} is the lump-sum amount of income tax a person must pay when earning precisely K, and τ_{Income} is the MTR at K.

[75] Starting from April 1, 2003, employees pay reduced social security rates when their earnings exceed the mini-job threshold, but remain under €800. The total tax liability for posted wages X_p is $T(X_g) = [K\frac{\tau_{Mini}}{\tau_{Full}} + (2 - \frac{\tau_{Mini}}{\tau_{Full}})(X_p - K)] \cdot \tau_{Full} + \tau_{Income} X_p = \frac{2\tau_{Full}-\tau_{Mini}+\tau_{Income}}{1+0.5\tau_{Full}} X_g - 2K(\tau_{Full} - \tau_{Mini}) + \Delta T_{Income} - \tau_{Income} K$.

[76] In accordance with the German law only a 95% random sample can be provided to researches from outside the European Union.

between [€300,€325] in 1996–2003 or [€375,€400] in 2004–2013. I restrict my sample to workers in mini-jobs earning in a narrow €25 bracket below or at the threshold for two reasons. First, we are interested in estimating the tax notch and marginal tax rate at the threshold, therefore the narrowest window should offer the most accurate estimates of tax incentives. Second, despite the self-reported nature of the data, most individuals report earning the threshold amount, closely resembling distributions observed in the SIAB data. Third, increasing the size of the bracket to €50 or €75 decrease the size of the estimated notch. Therefore elasticity calculations present a lower bound on labor earnings elasticities with respect to net of social security and income tax rates. To calculate the income tax notch, I first calculate the amount of income tax the household must pay if the individuals remain in mini-jobs, i.e. $T(12 \cdot Y_i^{spouse})$. Second, I calculate the amount of income tax due should the individual get a regular job that pays a salary equal to the mini-job threshold, i.e. $T(12 \cdot (Y_i^{spouse} + K))$ and the corresponding marginal tax rate associated with income $12 \cdot (Y_i^{spouse} + K)$. The income tax notch is then calculated as the difference between the two tax amounts, $T(12 \cdot (Y_i^{spouse} + K)) - T(12 \cdot Y_i^{spouse})$.

Ideally, one would want to observe the spousal income of all mini-jobbers in every year and calculate tax notches and marginal tax rates accordingly. Unfortunately, such administrative data is not available. The SOEP data contains spousal earnings but sample sizes are small, with only 170-350 observations per year. To improve the quality and consistency of estimates across years I consider three approaches to calculating income tax notches and MTRs. First, I calculate the true average in year j by restricting the sample to mini-job workers in year j only. Next, I expand the sample to also include mini-job workers in recent years. Under the second approach, I calculate income tax notch based on spousal incomes of individuals who held mini-jobs in 1999-2002 for years 1999 through 2002, 2003-2005 for years 2003 through 2005 and 2006-2010 for years 2006 through 2010 (preferred specification). The third approach mimics the second approach but further expands the sample by including mini-job workers from 1999 through 2010. All three approaches use actual tax schedules in the target year to calculate income tax rates.

I further consider four definitions of spousal income. The first, and simplest, only includes spouse's labor earnings, including those from self-employment. The second definition includes social security pensions in addition to labor earnings: old-age, disability, and widowhood. Note that prior to 2005, statutory pensions were not subject to income tax. Starting from 2005, 50% of the pension is subject to income tax, and this percentage share increases by 2% percentage points every year. While the majority of pensioners in Germany rely on statutory pension only, some individuals also receive income from private pensions. Thus, the third definition of income further includes private pensions: supplementary civil servant pension income, company pensions, private pensions and pension income from "other" sources as reported in SOEP. Taxation of private pensions vary, but for simplicity I assume that the entire amount of pension is subject to income tax. I also include household asset income: from interest, dividends, and rent. Once again, taxation of financial income depends on income but for simplicity the entire amount is assumed to be subject to income tax. Whenever any of the additional income information is missing, it is set to zero, however, observations with missing spousal labor income have been dropped. My preferred definition of income is the second specification, that includes both labor and social security income. I choose not to include financial earnings and private pensions since these are not accurately reported in the survey data and thus are likely to introduce more bias. Following Doerrenberg et al. (2017), I assume that individuals can claim 20% of their earnings as deductions. As a robustness check, I also consider a more conservative assumption that individuals only take advantage of the wage-related expenses deduction ("Werbungskosten") and other deductible expenses deduction ("Sonderausgabenpausch-betrag"), see Table C.4.

Tables C.1 and C.2 compare notches and tax rates by definition of income, relying on the 2nd sample approach (using 1999-2002, 2003-2005, 2006-2010 samples). As expected, the notch and marginal tax rate are smallest when only labor earnings are included. The magnitude of the notch increases as pension and asset incomes are included. Nevertheless the differences are very small and have negligible effect on the magnitude of elasticities. Note that the income definition matters more for women than men, since spouses of women are more likely to have various types of income.

Table C.3 compares income tax notches and marginal tax rates by sample selections using the preferred definition of income (labor plus social security earnings minus 20% deductions). The first column shows calculations of the "true income" notches and tax rates. The results are very volatile across years. The second column is based on spousal earnings of mini-job workers in corresponding groups of years: 1999-2002, 2003-2005 and 2006-2010. Finally, the third column includes all mini-job workers from years 1999-2010. Table C.3 show that the estimated tax rates and notches are very similar across all three specifications for both men and women, despite chosen samples. The estimates for men rely on very small sample size. Perhaps for this reason, the estimates in the first two samples appear to be very small in 2003-2005. For robustness, I use the "All Years" estimates for these years in my elasticity calculations (see Table 1).

A.4 Counterfactual Fits Robustness Checks

The elasticity estimation procedure relies on several parameters: (a) the bin width used to generate the observed distribution, (b) the degree of the polynomial that is fit to the observed distribution, (c) the width of the estimation window, and (d) the width of the bunching window. Of these parameters, (a)– (c) are chosen by the researcher, while (d) is estimated visually is often practically unambiguous. For empirical distributions in €25 bins, $z_l = 4$ in 1999–2002, $z_l = 7$ in 2003–2005, $z_l = 6$ in 2006–2010 for women, and $z_l = 3$ in 1999–2002, $z_l = 5$ in 2003–2005, $z_l = 4$ in 2006–2010 for men. For empirical distributions in €12.5 bins, $z_l = 8$ in 1999–2002, $z_l = 14$ in 2003–2005, $z_l = 12$ in 2006–2010 for women, and $z_l = 6$ in 1999–2002, $z_l = 10$ in 2003–2005, and $z_l = 8$ in 2006–2010 for men. Parameter (c) – the width of the estimation window – identify which part of the observed distribution is used to estimate the counterfactual distribution. A window that is too short will make estimation of the counterfactual imprecise, while too large of a window can put too much emphasis on the global, rather than local fit of the counterfactual. In this study, the estimation window is bounded on the left by zero – since no individuals report earning negative wages. I choose to limit the estimation window to the right by €1750 for men and women, but the results are not sensitive to most choices of estimation window.

In Table C.4 I show how elasticity estimates vary with (a) the bin width used to generate the observed distribution and (b) the degree of polynomial fitted. For convenience, specification (1) repeats the results from Table 2. Specification (1), (2) and (4) show the amount of bunching b (recall definition (25)) and elasticity e estimated using an empirical distribution of €25 bins, while specifications (3) uses distribution of €12.5 bins.[77] Specifications (1), (2) and (3) use a 7th degree polynomial to construct counterfactual, while (4) uses a 6th degree polynomial. Finally, specifications (1), (3) and (4) use the preferred definition of income (labor plus social security minus 20% deductions), while specification (2) assumes that individuals can only claim basic deductions "Werbungskosten" and "Sonderausgabenpauschbetrag". Overall Table C.4 confirms that the elasticity estimates are robust across specifications, though some variation is present.

B Wage Differential Robustness Checks

A natural concern is whether the results in Table 4 are driven by outlier observations within the 1st to 99th percentiles of gross wages. Table C.8 presents several robustness checks by repeating specifications (3), (4) and (9) of Table 4. In columns (1), (2) and (7) I consider a different definition of gross wage, which includes overtime hours and pay. Since overtime hours are paid at a higher rate and are more likely to be reported for regular employees, we would expect a smaller wage differential. This is precisely what we observe in columns (1), (2) and (7) (which can be directly compared to columns (3), (4) and (9) of Table 4). The wage differential decreases by approximately 1 percentage point. Next, I restrict the sample to individuals earning gross wages of more than €6 in columns (3), (4) and (8). The results remain unchanged. Finally, I restrict the sample to individuals earning a gross wage of more than €6 but less than €15 per hour in columns (5), (6) and (9). The coefficients decrease slightly, by approximately 1 percentage point. In addition to results shown in Table C.8 I have verified that the results are not sensitive to the earnings interval studied and inclusion of higher order wage trends. Robustness checks confirm that the results in Table 4 are not driven by the definition of hours used or due to sample selection.

The quality of the household data is of substantial concern because so many individuals report earning less than €5 per hour (especially among regular workers) and more than €21. Therefore the large wage differential observed in Table 5 and Figure 10 could be driven by outlier observations. As a robustness check, I repeat specifications (3), (5), (8) and (9) from Table 5 in Table C.9 but restrict the interval of allowed gross wages. Requiring the gross wage to be at least €3 does not have a strong effect on the estimates (see columns (1)-(2) and (7)-(8)). Requiring wages to be at least €5 per hour removes the wage differential. This result is not surprising in light of Panel B of Figure 10: more regular workers report larger gross wages (€15 and more) than mini-job workers.

[77] Note that the amount of bunching b is inversely proportional to the bin size, therefore to compare bunching amounts, the result of specification (3) should be divided by 2 to be comparable to the amount of bunching from specifications (2)–(4).

Finally, restricting the sample to individuals earning between €5 and €15, makes the coefficient statistically insignificant in columns (5) and (6) and marginally significant in columns (11) and (12). The coefficients are positive but smaller than in Table 5. The smaller magnitude of the coefficients is consistent with the presence of the negative bias due to measurement errors and with our inability to control for firm selection.[78] These robustness checks suggest that while the magnitude of the wage differential estimated using household data is inaccurate, the wage differential between mini-job and regular jobs is positive and statistically significant.

[78]Recall that adding firm fixed effects increases the wage gap between mini-job and regular gross wages.

C Appendix Tables and Figures

Table C.1: Income Tax Notches and MTRs. Women: Comparison of Income Definitions

		Deductions: 20% of Gross Income						**Deductions: Basic**	
		Labor Only		**Labor + SS**		**Labor + SS Pensions + Assets**		**Labor + SS**	
Notch	MTR	Notch	MTR	Notch	MTR	Notch	MTR	Notch	MTR
by year:	1999	80	24	80	25	81	25	83	25
	2000	76	23	76	24	77	24	81	25
	2001	71	21	71	22	72	22	75	23
	2002	71	21	71	22	72	22	75	23
	2003	87	21	87	22	90	23	92	23
	2004	82	20	82	21	84	22	88	22
	2005	80	20	80	20	83	21	86	22
	2006	88	22	88	24	90	24	94	25
	2007	88	22	88	24	90	24	94	25
	2008	88	22	88	24	90	24	94	25
	2009	87	22	87	24	88	24	94	25
	2010	86	21	86	24	88	24	92	25
1998-2002:	under 25	35	10	35	12	34	11	35	12
	25–40 years old	78	24	78	24	79	24	78	24
	40–60 years old	67	20	67	22	68	22	67	22
	over 60	37	11	37	12	38	12	37	12
2003-2011:	under 25	32	8	32	10	30	9	30	9
	25–40 years old	87	21	87	22	90	22	90	22
	40–60 years old	75	19	75	20	78	21	78	21
	over 60	30	8	31	8	32	8	32	8

Notes: This table shows the average income tax notch and marginal tax rates experienced by women at the mini-job threshold. *Notch* is the average lump-sum payment of income tax an individual must make upon exceeding the mini-job threshold. *MTR* is the average marginal tax rate at the mini-job threshold. For single individuals, spousal income is set to zero. For further details see Appendix A.3. *Source*: Socio-Economic Panel (SOEP), version 30.

Table C.2: Income Tax Notches and MTRs. Men: Comparison of Income Definitions

		Deductions: 20% of Gross Income						Deductions: Basic	
		Labor Only		**Labor + SS**		**Labor + SS Pensions + Assets**		**Labor + SS**	
Notch	MTR	Notch	MTR	Notch	MTR	Notch	MTR	Notch	MTR
by year:	1999	31	10	31	11	31	11	34	11
	2000	29	10	29	11	29	10	32	11
	2001	25	9	25	10	24	9	28	10
	2002	25	9	25	10	24	9	28	10
	2003	13	4	13	4	12	4	15	5
	2004	11	3	11	3	9	3	13	4
	2005	10	3	10	3	9	3	12	3
	2006	34	10	34	11	33	11	39	12
	2007	34	10	34	11	33	11	39	12
	2008	34	10	34	11	33	11	39	12
	2009	33	9	33	10	32	10	38	12
	2010	34	9	34	10	33	10	36	12
1998-2002:	under 25	4	1	4	1	5	1	4	1
	25–40 years old	27	10	27	10	27	10	27	10
	40–60 years old	26	9	26	10	24	10	26	10
	over 60	13	5	13	5	16	6	13	5
2003-2011:	under 25	2	1	2	1	2	1	2	1
	25–40 years old	11	3	11	3	9	3	11	3
	40–60 years old	13	4	13	4	12	3	13	4
	over 60	15	4	15	4	14	4	15	4

Notes: This table shows the average income tax notch and marginal tax rates experienced by men at the mini-job threshold. *Notch* is the average lump-sum payment of income tax an individual must make upon exceeding the mini-job threshold. *MTR* is the average marginal tax rate at the mini-job threshold. For single individuals, spousal income is set to zero. For further details see Appendix A.3. *Source*: Socio-Economic Panel (SOEP), version 30.

Table C.3: Income Tax Notches and MTRs. Comparison of Sample Selections

	Women:											
	True Average				**1999-02, 2003-05, 2006-10**				**All Years**			
	Notch	MTR	N	Income	Notch	MTR	N	Income	Notch	MTR	N	Income
1999	83	27	119	2260	80	25	892	2274	81	26	2322	2494
2000	74	23	254	2161	76	24	892	2274	78	25	2322	2494
2001	72	22	259	2294	71	22	892	2274	73	24	2322	2494
2002	70	21	260	2355	71	22	892	2274	73	23	2322	2494
2003	82	21	207	2334	87	22	562	2497	90	24	2322	2494
2004	83	21	174	2511	82	21	562	2497	85	23	2322	2494
2005	85	22	181	2708	80	20	562	2497	83	22	2322	2494
2006	86	22	193	2660	88	24	868	2722	83	22	2322	2494
2007	86	25	188	2660	88	24	868	2722	83	22	2322	2494
2008	86	24	177	2632	88	24	868	2722	83	22	2322	2494
2009	92	25	167	2904	87	24	868	2722	82	22	2322	2494
2010	87	23	143	2761	86	24	868	2722	80	22	2322	2494
	Men:											
	True Average				**1999-02, 2003-05, 2006-10**				**All Years**			
	Notch	MTR	N	Income	Notch	MTR	N	Income	Notch	MTR	N	Income
1999	12	4	10	276	31	11	49	778	32	12	133	836
2000	20	8	14	567	29	11	49	778	30	11	133	836
2001	50	17	14	1532	25	10	49	778	25	10	133	836
2002	24	11	11	713	25	10	49	778	25	10	133	836
2003	32	9	8	773	13	4	25	326	32	10	133	836
2004	10	4	7	309	11	3	25	326	28	9	133	836
2005	0	0	10	71	10	3	25	326	27	9	133	836
2006	35	11	13	1093	34	11	59	1036	27	9	133	836
2007	47	19	11	1418	34	11	59	1036	27	9	133	836
2008	39	10	12	1108	34	11	59	1036	27	9	133	836
2009	27	8	12	874	33	10	59	1036	26	9	133	836
2010	27	7	11	914	34	10	59	1036	26	8	133	836

Notes: This table shows the average income tax notch and marginal tax rates experienced by women, age 31 through 54 inclusive, at the mini-job threshold. *Notch* is the average lump-sum payment of income tax an individual must make upon exceeding the mini-job threshold. *MTR* is the average marginal tax rate at the mini-job threshold. *N* is the number of observations used to calculate the average marginal tax rate, income notch and average spousal income. *Income* is the average income of a spouse of a mini-job worker earning [€K-25,€K] per month, where *K* denotes the mini-job threshold. For single individuals, spousal income is set to zero. Spousal income includes labor earnings as well as social security payments. For further details see Appendix A.3. *Source*: Socio-Economic Panel (SOEP), version 30.

Table C.4: Elasticity Estimates Robustness Check

Year	(1) Baseline				(2) Basic Deductions				(3) Bins €12.5				(4) Degree 6			
	b	s.e.(b)	e	s.e.(e)	b	s.e.(b)	e	s.e.(e)	b	s.e.(b)	e	s.e.(e)	b	s.e.(b)	e	s.e.(e)
								Women:								
1999	14.35	0.98	0.08	0.02	14.35	1.06	0.07	0.02	23.69	1.10	0.02	0.02	12.66	0.92	0.04	0.02
2000	15.08	1.68	0.11	0.04	15.08	1.67	0.09	0.04	27.04	1.74	0.07	0.02	14.17	1.80	0.09	0.03
2001	16.48	1.82	0.16	0.04	16.48	1.81	0.15	0.04	27.64	1.52	0.10	0.02	14.25	0.84	0.11	0.02
2002	14.59	1.16	0.12	0.03	14.59	1.17	0.10	0.03	28.67	1.64	0.11	0.02	13.80	0.79	0.10	0.02
2003	12.67	1.06	0.08	0.02	12.67	1.06	0.07	0.02	23.90	1.36	0.07	0.01	12.89	0.84	0.09	0.02
2004	15.16	1.80	0.15	0.03	15.16	1.81	0.13	0.03	24.33	1.45	0.09	0.02	15.36	1.13	0.15	0.02
2005	14.28	1.24	0.14	0.02	14.28	1.25	0.12	0.02	23.68	1.11	0.09	0.01	15.69	0.87	0.17	0.02
2006	14.29	1.36	0.14	0.02	14.29	1.36	0.12	0.02	25.78	1.39	0.11	0.02	14.32	0.59	0.14	0.01
2007	14.24	1.05	0.14	0.02	14.24	1.05	0.12	0.02	30.88	1.53	0.16	0.02	14.50	1.66	0.14	0.02
2008	13.78	1.87	0.13	0.05	13.78	1.87	0.11	0.04	27.98	4.55	0.13	0.02	14.97	0.70	0.15	0.02
2009	16.18	2.49	0.18	0.03	16.18	2.49	0.16	0.03	30.01	2.04	0.16	0.02	15.75	2.91	0.17	0.05
2010	15.31	1.29	0.17	0.02	15.31	1.29	0.15	0.02	29.89	1.29	0.16	0.02	19.21	4.00	0.26	0.07
								Men:								
1999	8.36	1.89	0.07	0.04	8.36	1.54	0.06	0.05	16.05	2.40	0.06	0.03	8.11	0.94	0.06	0.03
2000	8.81	1.53	0.09	0.05	8.81	1.53	0.08	0.05	16.14	2.15	0.07	0.04	7.29	1.17	0.04	0.03
2001	8.83	2.01	0.11	0.07	8.83	1.77	0.10	0.06	16.05	2.94	0.08	0.05	7.51	1.74	0.06	0.05
2002	8.58	1.79	0.10	0.06	8.58	1.79	0.09	0.06	18.35	2.30	0.12	0.04	7.30	1.16	0.05	0.04
2003	12.69	2.65	0.32	0.09	12.69	2.46	0.29	0.08	20.73	3.28	0.24	0.06	9.08	1.27	0.20	0.04
2004	11.28	2.48	0.30	0.09	11.28	2.89	0.27	0.10	30.02	5.07	0.44	0.09	7.59	1.43	0.16	0.05
2005	9.07	1.50	0.22	0.06	9.07	1.66	0.20	0.06	19.93	2.90	0.26	0.05	8.39	1.02	0.20	0.04
2006	8.10	1.23	0.17	0.05	8.10	1.07	0.15	0.04	14.95	1.71	0.14	0.03	9.15	0.97	0.21	0.04
2007	10.65	1.35	0.27	0.06	10.65	1.49	0.24	0.06	16.77	2.31	0.18	0.05	10.55	0.91	0.27	0.04
2008	10.84	3.50	0.28	0.14	10.84	3.13	0.25	0.12	24.30	3.02	0.33	0.06	14.45	2.06	0.43	0.09
2009	12.51	2.17	0.37	0.10	12.51	2.15	0.32	0.09	17.55	2.51	0.20	0.05	12.30	1.55	0.36	0.07
2010	11.99	2.13	0.34	0.09	11.99	1.54	0.31	0.06	21.32	2.88	0.28	0.06	10.61	2.36	0.28	0.10

Notes: Excess bunching and elasticities are estimated using the procedure outlined in Section 2.1. In specification (1) and (2) I fit 7th degree polynomial to an empirical distribution of *gross* earnings of €25 bins. In specifications (3) I fit a 7th degree polynomial to an empirical distribution of *gross* earnings of €12.5 bins. In specification (4) I fit a 6th degree polynomial to a distribution of €25 bins. Bootstrap standard errors are based on 100 iterations. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Table C.5: Heterogeneity of Elasticities by Firm Size

		1999-2002		2003-2005		2006-2010	
		e	s.e.(e)	e	s.e.(e)	e	s.e.(e)
Women:	All	0.09	(0.03)	0.13	(0.02)	0.14	(0.02)
	$\geq$ 5 employees	0.08	(0.02)	0.09	(0.01)	0.11	(0.01)
	$\geq$ 10 employees	0.06	(0.01)	0.07	(0.01)	0.09	(0.01)
	$\geq$ 20 employees	0.04	(0.01)	0.05	(0.01)	0.08	(0.01)
Men:	All	0.09	(0.05)	0.28	(0.07)	0.33	(0.06)
	$\geq$ 5 employees	0.11	(0.05)	0.28	(0.08)	0.29	(0.05)
	$\geq$ 10 employees	0.11	(0.04)	0.21	(0.07)	0.25	(0.05)
	$\geq$ 20 employees	0.12	(0.03)	0.22	(0.06)	0.26	(0.05)

Notes: This table shows elasticities of earnings with respect to net-of-tax rate by firm size. The results show that responses are stronger at firms with fewer employees, but differences are not very large. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Table C.6: Summary Statistics (Firm Survey VSE)

	Income: [€50,€375] N=210,273			Income: [€375; €400] N=86,157			Income: [€400, €500] N=21,082			Income: [€500, €1000] N=186,503			Income: [€1000, €1500] N=379,117		
	mean	sd	p50	mean	sd	p50	mean	sd	p50	mean	sd	p50	mean	sd	p50
Male	0.35	0.48	0.00	0.35	0.48	0.00	0.26	0.44	0.00	0.17	0.37	0.00	0.27	0.44	0.00
Age: 26-40 year old	0.25	0.43	0.00	0.29	0.45	0.00	0.33	0.47	0.00	0.32	0.47	0.00	0.32	0.47	0.00
Age: 40-60 year old	0.36	0.48	0.00	0.39	0.49	0.00	0.45	0.50	0.00	0.54	0.50	1.00	0.54	0.50	1.00
Age: 60-65 year old	0.07	0.26	0.00	0.06	0.24	0.00	0.05	0.21	0.00	0.04	0.18	0.00	0.03	0.17	0.00
Age: > 60 year old	0.10	0.30	0.00	0.12	0.32	0.00	0.05	0.22	0.00	0.02	0.13	0.00	0.00	0.07	0.00
No HS, No Voc. Tr.[a]	0.18	0.38	0.00	0.13	0.34	0.00	0.18	0.39	0.00	0.19	0.39	0.00	0.16	0.37	0.00
No HS + Voc. Tr.	0.22	0.42	0.00	0.29	0.45	0.00	0.32	0.47	0.00	0.45	0.50	0.00	0.58	0.49	1.00
HS, No Voc. Tr.	0.06	0.24	0.00	0.02	0.15	0.00	0.04	0.19	0.00	0.02	0.14	0.00	0.01	0.09	0.00
HS + Voc. Tr.	0.01	0.11	0.00	0.02	0.14	0.00	0.02	0.14	0.00	0.03	0.16	0.00	0.03	0.18	0.00
Fachhochschule	0.01	0.08	0.00	0.01	0.09	0.00	0.01	0.10	0.00	0.02	0.13	0.00	0.02	0.13	0.00
College/University	0.01	0.08	0.00	0.01	0.10	0.00	0.01	0.11	0.00	0.01	0.10	0.00	0.01	0.12	0.00
Educ. Unknown	0.51	0.50	1.00	0.52	0.50	1.00	0.42	0.49	0.00	0.28	0.45	0.00	0.19	0.39	0.00
Company Tenure[b]	47.04	67.17	24.00	44.03	58.51	25.00	73.33	98.51	37.00	94.69	107.04	57.00	105.35	110.33	66.00
Salaried Employees	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.02	0.15	0.00	0.10	0.30	0.00
Homeworkers	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.00	0.03	0.00	0.00	0.02	0.00
Part-time <18 h/w	1.00	0.04	1.00	1.00	0.06	1.00	0.88	0.33	1.00	0.35	0.48	0.00	0.05	0.23	0.00
Part-time ≥18 h/w	0.00	0.04	0.00	0.00	0.06	0.00	0.12	0.32	0.00	0.54	0.50	1.00	0.52	0.50	1.00
Skilled Hourly Employee	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.02	0.15	0.00	0.11	0.32	0.00
Civil Servants	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.01	0.11	0.00	0.02	0.14	0.00
Monthly Hours	33.25	14.14	33.00	48.11	12.15	47.00	53.38	18.71	51.50	90.49	34.44	86.60	128.17	37.34	130.35
Posted Hourly Wage	7.94	2.53	7.84	8.76	2.50	8.37	9.37	3.16	8.72	9.84	3.45	9.21	10.80	3.47	9.65
Gross Hourly Wage	10.29	3.28	10.17	11.34	3.24	10.84	11.50	3.93	10.76	11.85	4.16	11.10	13.00	4.17	11.61
Net Hourly Wage	7.88	2.57	7.72	8.66	2.51	8.26	7.97	2.96	7.54	7.50	2.70	6.95	7.73	2.42	6.96
Yearly Bonus	34.29	124.55	0.00	20.00	115.08	0.00	156.85	328.63	0.00	441.67	574.39	230.00	763.81	877.49	591.00
Vacation Days[c]	7.09	8.47	4.00	8.03	8.50	6.00	13.13	12.49	10.00	18.78	10.68	16.00	21.86	7.29	23.00
Subcompany[d]	0.41	0.49	0.00	0.32	0.47	0.00	0.39	0.49	0.00	0.44	0.50	0.00	0.47	0.50	0.00
Handcraft Business	0.05	0.21	0.00	0.08	0.27	0.00	0.05	0.22	0.00	0.05	0.21	0.00	0.04	0.21	0.00
N. of Male Empl.[e]	289.13	1714.66	26.00	68.11	396.71	21.00	225.63	1652.06	22.00	414.39	3036.00	22.00	575.93	3679.26	29.00
N. of Female Empl.[e]	334.27	1416.63	41.00	97.47	552.98	26.00	604.52	2804.48	42.00	929.78	4260.35	51.00	1402.95	5637.35	46.00

Notes: This tables shows summary statistics (mean, standard deviation and median) for the combined 2006 and 2010 waves of the VSE Survey. The following categories have been omitted: 25 year old or younger, unskilled salaried workers. [a] HS stands for High School, Voc. Tr. stands for Vocational Training. [b] Company tenure is measured in months. [c] Vacation days represent the full-time equivalent number of vacation days per year based on a 5-day working week. [d] Subcompany refers to establishments that are part of larger firms. [e] Number of male and female employees at the establishment of the employee, rather than the larger firm.
Source: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author's calculations.

Table C.7: Summary Statistics (Household SOEP)

	Income: [€50,€375] N=11,404			Income: [€375; €400] N=2,965			Income: [€400, €500] N=2,509			Income: [€500, €1000] N=20,622			Income: [€1000, €1500] N=34,114		
	mean	sd	p50	mean	sd	p50	mean	sd	p50	mean	sd	p50	mean	sd	p50
Male	0.17	0.38	0.00	0.18	0.39	0.00	0.17	0.37	0.00	0.19	0.39	0.00	0.38	0.48	0.00
Age: 26-40 year old	0.32	0.47	0.00	0.35	0.48	0.00	0.36	0.48	0.00	0.38	0.49	0.00	0.39	0.49	0.00
Age: 40-60 year old	0.38	0.49	0.00	0.42	0.49	0.00	0.43	0.50	0.00	0.41	0.49	0.00	0.40	0.49	0.00
Age: 60-65 year old	0.08	0.27	0.00	0.06	0.23	0.00	0.04	0.20	0.00	0.03	0.17	0.00	0.02	0.15	0.00
Age: > 65 year old	0.06	0.23	0.00	0.06	0.23	0.00	0.03	0.16	0.00	0.01	0.10	0.00	0.00	0.05	0.00
Married	0.66	0.47	1.00	0.72	0.45	1.00	0.65	0.48	1.00	0.64	0.48	1.00	0.55	0.50	1.00
Partner (Not married)	0.05	0.22	0.00	0.05	0.23	0.00	0.09	0.29	0.00	0.08	0.27	0.00	0.11	0.31	0.00
No HS[a]	0.02	0.15	0.00	0.02	0.12	0.00	0.02	0.13	0.00	0.02	0.15	0.00	0.03	0.17	0.00
HS, No Voc. Tr.	0.17	0.37	0.00	0.14	0.35	0.00	0.20	0.40	0.00	0.15	0.35	0.00	0.12	0.33	0.00
HS + Voc. Tr.	0.31	0.46	0.00	0.30	0.46	0.00	0.31	0.46	0.00	0.33	0.47	0.00	0.35	0.48	0.00
Further Voc. Tr	0.38	1.11	0.00	0.42	1.14	0.00	0.38	1.07	0.00	0.40	1.03	0.00	0.41	1.00	0.00
Fachhochschule	0.02	0.14	0.00	0.03	0.17	0.00	0.03	0.16	0.00	0.02	0.13	0.00	0.02	0.14	0.00
College/University	0.05	0.21	0.00	0.06	0.23	0.00	0.05	0.22	0.00	0.07	0.25	0.00	0.06	0.24	0.00
Company Tenure[b]	68.33	88.24	33.60	69.29	86.94	36.00	83.99	91.85	48.00	85.65	95.91	48.00	99.74	100.81	64.80
Monthly Hours	57.85	38.38	43.33	70.17	37.13	65.00	95.09	48.44	86.67	124.29	44.35	117.00	155.02	34.36	173.33
Posted Hourly Wage	5.79	3.44	5.21	7.15	3.62	6.15	6.37	3.95	5.31	7.22	3.43	6.29	8.76	3.02	7.90
Gross Hourly Wage	7.14	4.30	6.40	9.14	4.64	8.00	7.62	4.75	6.29	8.63	4.13	7.51	10.46	3.65	9.38
Net Hourly Wage	5.37	3.27	4.88	6.53	3.30	6.15	4.72	2.96	3.85	4.93	2.34	4.38	5.85	1.99	5.39
Yearly Bonus	71.51	265.25	0.00	78.57	383.66	0.00	181.27	388.16	0.00	381.54	486.06	204.00	796.77	722.54	716.00
Full Time Experience	8.62	10.49	5.00	8.34	10.15	5.00	8.12	9.46	5.00	9.76	9.94	6.70	12.56	10.91	9.00
Part Time Experience	6.06	6.78	3.60	7.31	7.13	5.10	7.22	8.20	4.20	5.50	7.15	2.50	3.13	5.87	0.00
Training Matching	0.29	0.46	0.00	0.30	0.46	0.00	0.34	0.47	0.00	0.47	0.50	0.00	0.52	0.50	1.00
Firm Size: <20	0.48	0.50	0.00	0.51	0.50	1.00	0.39	0.49	0.00	0.34	0.47	0.00	0.26	0.44	0.00
Firm Size: 20-200	0.21	0.41	0.00	0.27	0.44	0.00	0.27	0.44	0.00	0.29	0.45	0.00	0.31	0.46	0.00
Firm Size: 200-2000	0.09	0.29	0.00	0.08	0.28	0.00	0.15	0.35	0.00	0.17	0.38	0.00	0.21	0.41	0.00
Firm Size: >2000	0.07	0.26	0.00	0.06	0.23	0.00	0.10	0.30	0.00	0.15	0.36	0.00	0.18	0.39	0.00

Notes: This tables shows summary statistics (mean, standard deviation and median) for the combined 2004–2011 waves of the Socioeconomic Panel (SOEP). The following category has been omitted: 25 year old or younger. [a] HS stands for High School, Voc. Tr. stands for Vocational Training. [b] Company tenure is measured in months. *Source*: Socio-Economic Panel (SOEP), version 30.

Table C.8: Robustness Checks (Firms Survey VSE)

	Monthly Income €375–€500						Monthly Income €50–€1500		
	Incl. Overtime		**Wage > €6**		**Wage ∈ (€6,€15]**		**Incl. Overtime**	**Wage > €6**	**Wage ∈ (€6,€15]**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable: Log(Hourly Gross Wage)									
Mini-Job	0.0485***	0.080***	0.057***	0.085***	0.052***	0.074***	0.057***	0.042***	0.055***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Linear Wage Trend	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Quadratic Wage Trend	No	No	No	No	No	No	Yes	Yes	Yes
Number of Observations	107,239	107,239	105,637	105,637	93,760	93,760	887,183	862,420	674,859

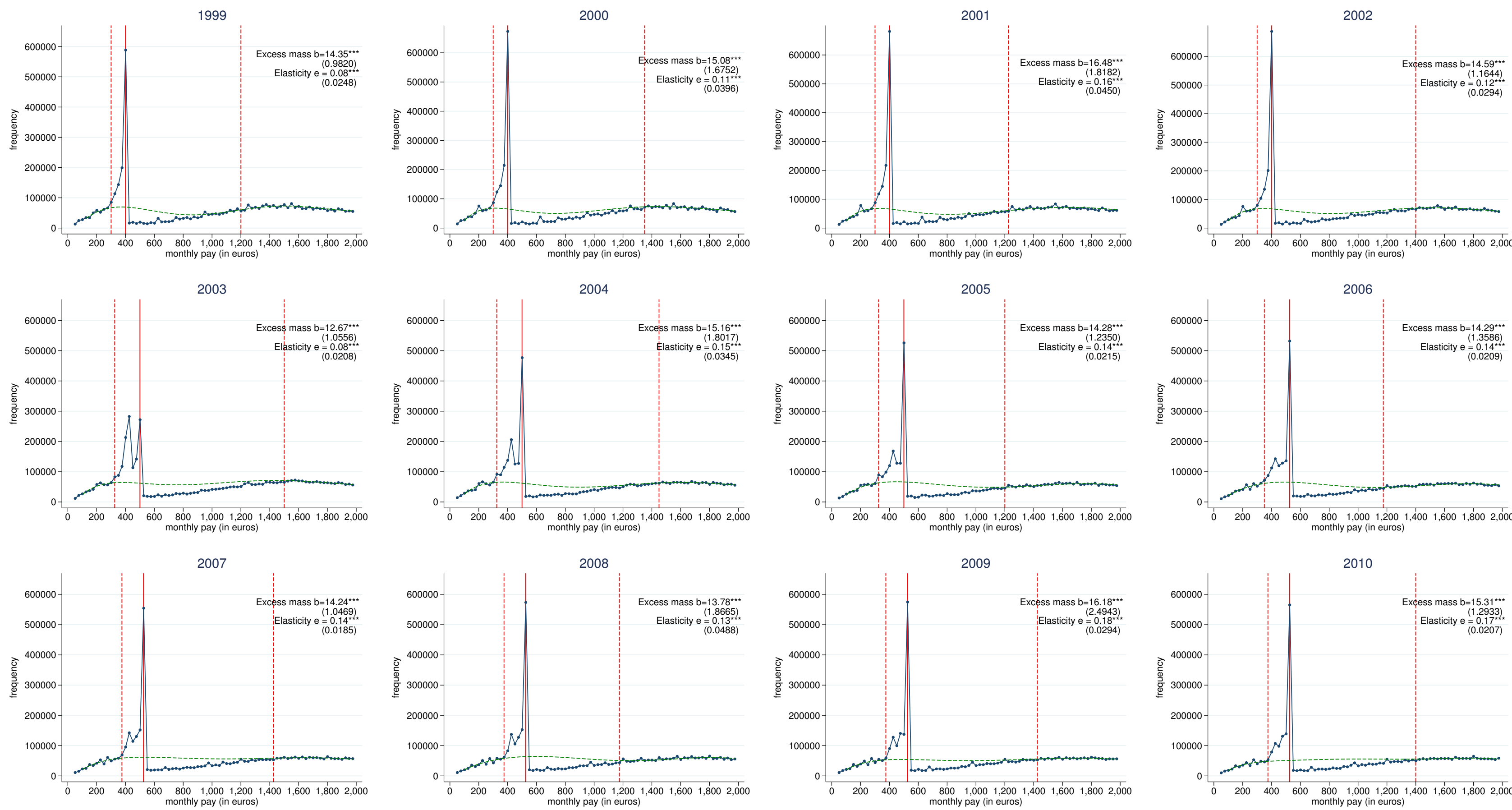
Notes: This table shows the coefficients from regressing the logarithm of gross wage on a mini-job indicator variable. Standard errors are clustered by firm. In columns (1), (2) and (7), gross wage is calculated as all monthly income (including overtime pay) divided by total hours worked (including overtime). In columns (3), (4) and (8), the sample is restricted to individuals with gross wages of more than €6 per hour. In columns (5), (6) and (9), the sample is restricted to individuals with gross wages of more than €6 per hour but less than €15 per hour. Individual controls include male indicator, age group indicators, company tenure, education indicators, occupational status and occupation indicators. Linear and quadratic trends include both linear/quadratic terms and their interactions with the mini-job indicator. *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author's calculations.

Table C.9: Robustness Checks (Household Survey SOEP)

	Monthly Income €375–€500						**Monthly Income €50–€1500**					
	Wage > €3		**Wage > €5**		**Wage ∈ (€5,€15]**		**Wage> €3**		**Wage > €5**		**Wage ∈ (€5,€15]**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent Variable: Log(Hourly Gross Wage)												
Mini-Job	0.084**	0.067**	-0.017	-0.025	0.027	0.022	0.106***	0.102***	-0.002	0.003	0.038*	0.039**
	(0.033)	(0.033)	(0.029)	(0.031)	(0.023)	(0.023)	(0.029)	(0.028)	(0.026)	(0.026)	(0.020)	(0.020)
Indiv. Notch		-0.001		-0.001		0.000		0.003***		0.003***		0.002***
		(0.001)		(0.001)		(0.001)		(0.001)		(0.000)		(0.000)
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indiv. Controls (subset)	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Indiv. Controls (full)	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Linear Wage Trend	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Quadratic Wage Trend	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Number of Observations	3,264	2,934	2,933	2,648	2,662	2,417	20,007	18,436	18,893	17,455	15,857	14,695

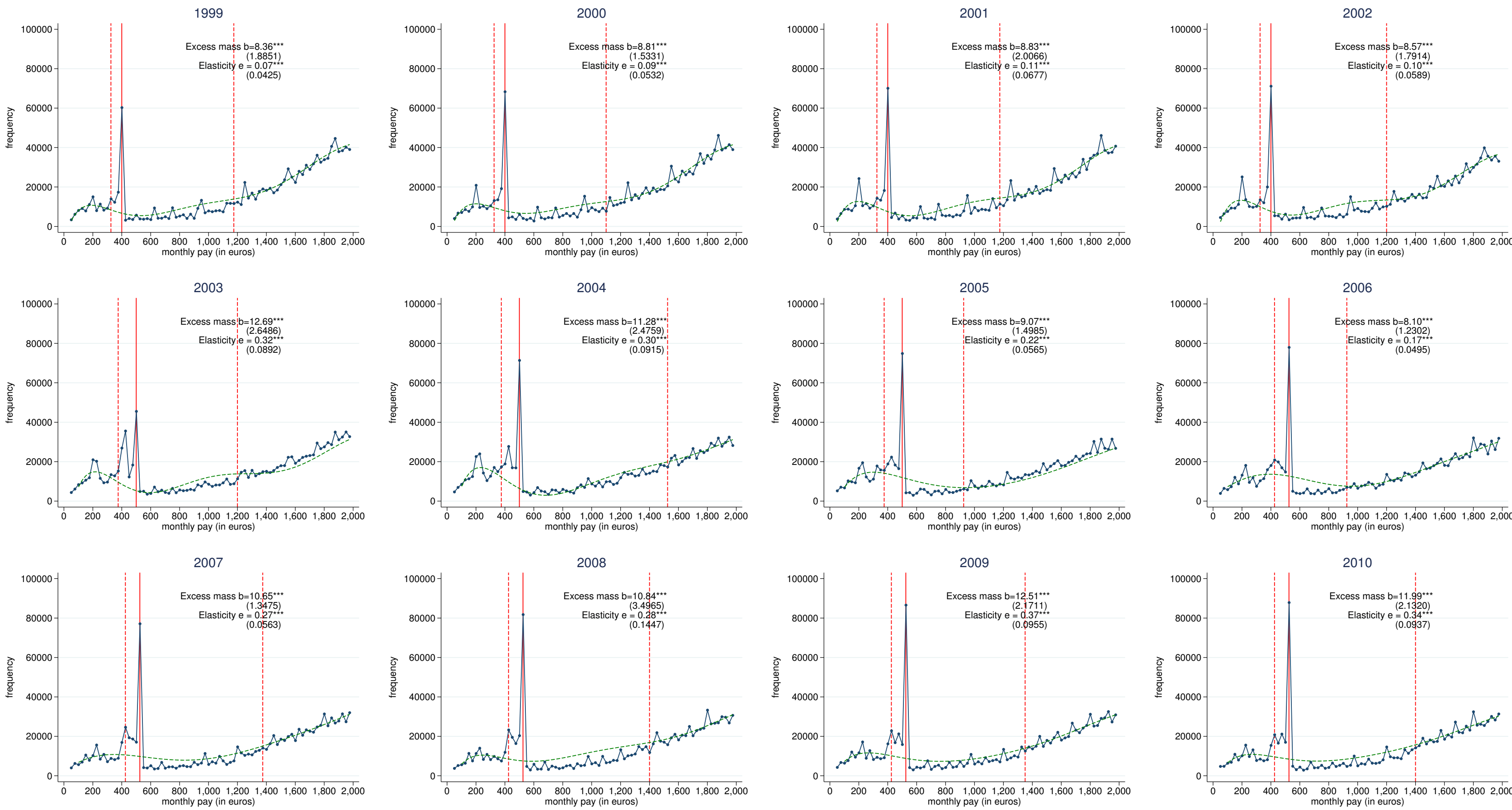
Notes: This table shows the coefficients from regressing the logarithm of gross wage on a mini-job indicator. Standard errors are clustered by individual. In columns (1), (2) and (7), the sample is restricted to individuals with gross wages of more than €3 per hour. In columns (3), (4) and (8), the sample is restricted to individuals with gross wages of more than €5 per hour. In columns (5), (6) and (9), the sample is restricted to individuals with gross wages of more than €5 per hour but less than €15 per hour. Individual controls (subset) include male indicator, age group indicators, company tenure, education indicators and occupation indicators. In addition to above controls, the full set also includes marital status, presence of a partner (if not married), citizenship indicator, indicator of whether a job matches completed training, experience working full time and experience working part time. Firm controls include industry indicators and indicators of size (by number of employees). Linear and quadratic trends include both linear/quadratic terms and their interactions with the mini-job indicator. *Source*: Socio-Economic Panel (SOEP), version 30.

Figure C.1: Counterfactual Fits: Women



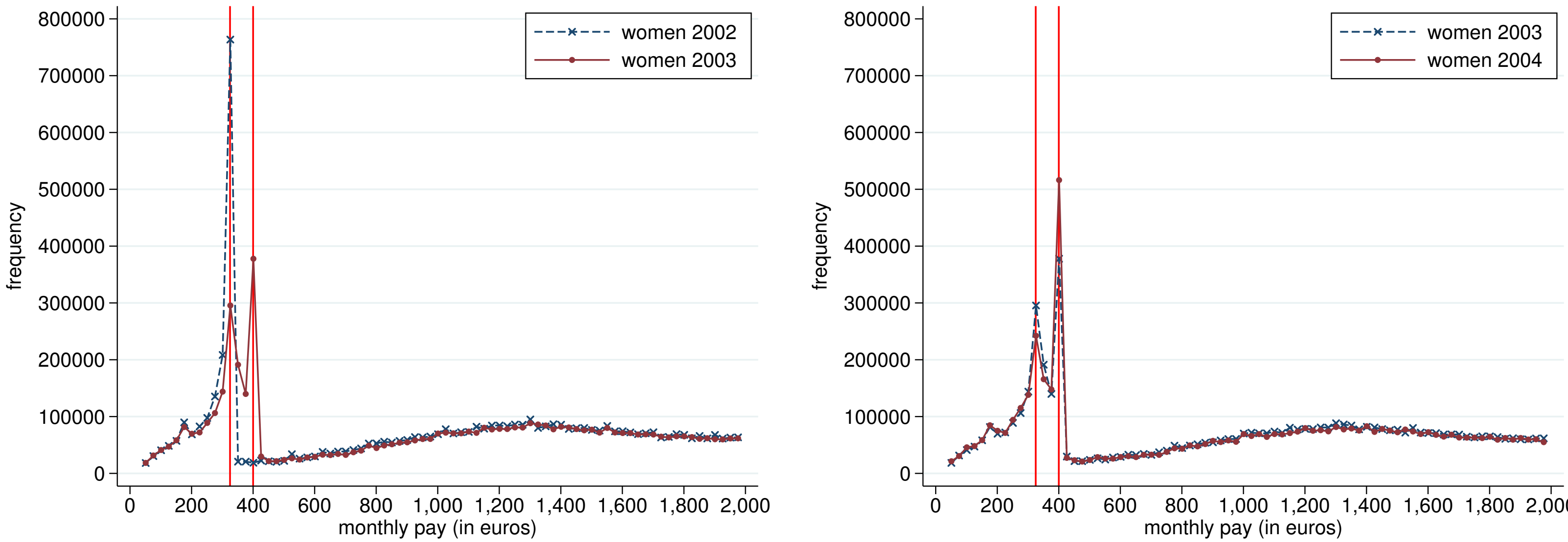
Notes: Excess bunching and elasticities are estimated using the procedure outlined in Section 3. I fit 7th degree polynomial to empirical distribution of *gross* earnings, by €25 bins. Lower exclusion region z_l is determined visually: for women $z_l = 4$ in 1999–2002, $z_l = 7$ in 2003–2006, $z_l = 6$ in 2007–2010. Estimation procedure starts with an initial guess of elasticity $e_0 = 0.01$ and iterates until a fixed point is reached. Bootstrap standard errors are based on 1000 iterations. Solid red line marks the mini-job threshold and dashed red lines identify the exclusion region $[z_l, z_u]$. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Figure C.2: Counterfactual Fits: Men



Notes: Excess bunching and elasticities are estimated using the procedure outlined in Section 3. I fit 7th degree polynomial to empirical distribution of *gross* earnings, by €25 bins. Lower exclusion region z_l is determined visually: for men, $z_l = 3$ in 1999–2002, $z_l = 5$ in 2003–2005, $z_l = 4$ in 2006–2010. Estimation procedure starts with an initial guess of elasticity $e_0 = 0.01$ and iterates until a fixed point is reached. Bootstrap standard errors are based on 1000 iterations. Solid red line marks the mini-job threshold and dashed red lines identify the exclusion region $[z_l, z_u]$. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

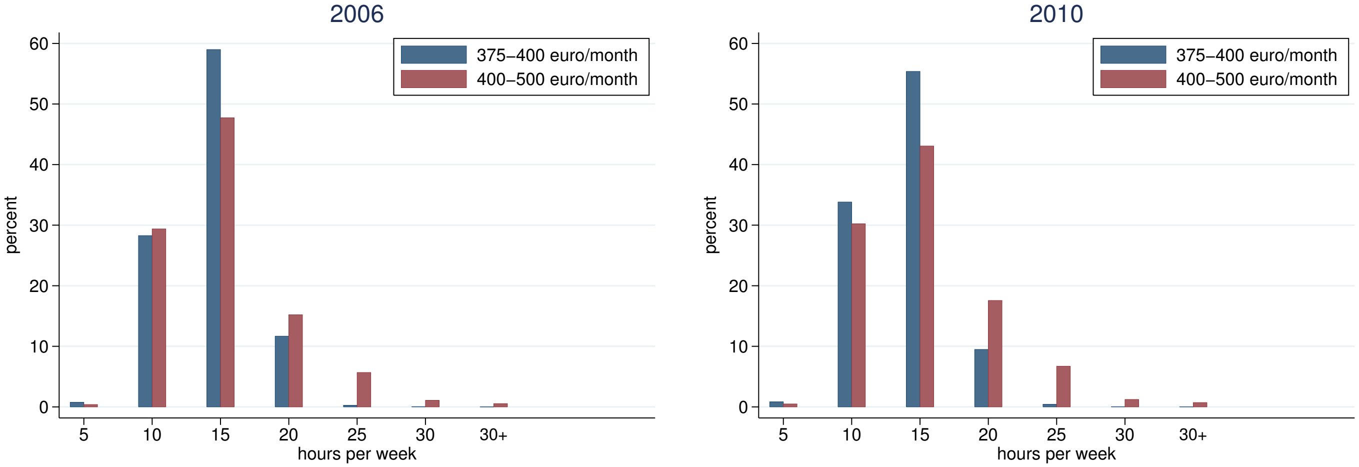
Figure C.3: Earnings Distributions in 2002, 2003 and 2004



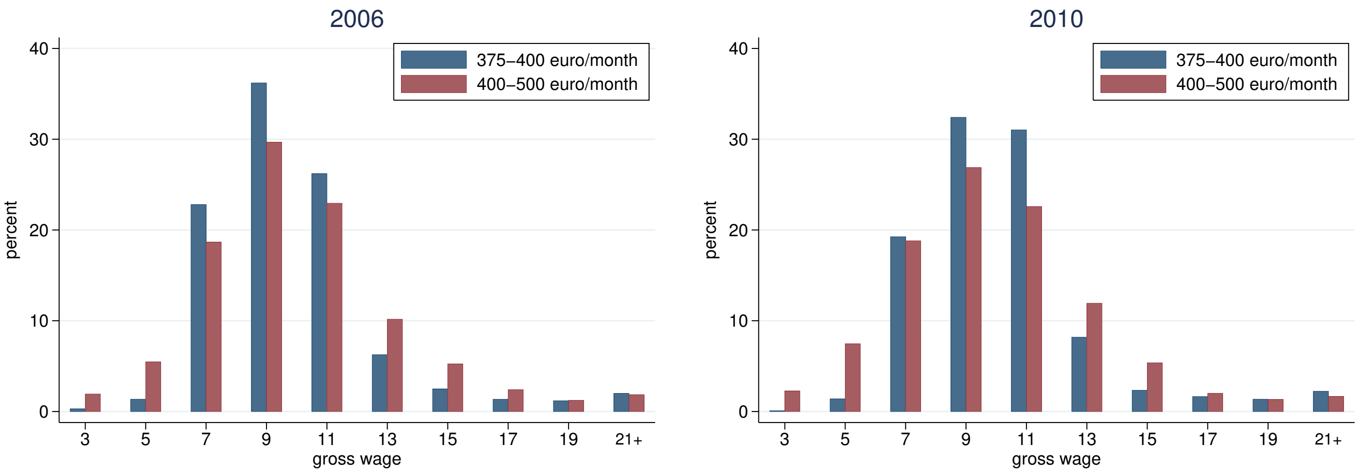
Notes: These figures show the overlapping distributions of posted earnings in 2002, 2003 and 2004 for women. *Source*: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.

Figure C.4: Hour and Wage Distributions in 2006 and 2010

Panel A: Hour Distributions below/above the Threshold



Panel B: Gross Wage Distributions below/above the Threshold



Notes: Panel A shows the distribution of weekly hours for mini-job workers and regular workers earning between €375 and €500 per month (posted earnings). Panel B shows the distribution of hourly gross wage for mini-job workers and regular workers earning between €375 and €500 per month (posted earnings). *Source*: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author's calculations.