Equilibrium effects of tax exemptions for low pay

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Abstract

Across the world, tax exemptions for jobs with low earnings intend to incite non-participating workers to rejoin the labor market. However, such tax exemptions may also have negative equilibrium effects. The German minijob tax exemption offers a convenient case to identify equilibrium effects as it applies to some but not to other low-wage jobs. We build and estimate a structural job search model with discontinuous taxes on German administrative data. Counterfactual policy simulations highlight distributional consequences of reforming the tax exemption. We find that 1.9 million individuals only participate in the labor market due to the tax exemption. A budget-neutral removal of the tax subsidy hurts these workers (e.g. retirees, students), but benefits those who seek small jobs independently of the tax exemption. Furthermore, a removal would result in greater variance in equilibrium wages, benefiting workers who search more (those without another job) at the cost of workers searching less (e.g. those seeking a second job).

Keywords: Tax exemptions, Income taxes, Social Security Contributions, Labor Demand, Job search, Firm responses.

JEL Codes: J64 ; J31 ; J22 ; J23

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1 Introduction

Labor market policies around the world attempt to remove barriers for workers with low earnings potential to join the labor market. In the US and UK, the Earned Income Tax Credit and the Working Family Tax Credit have been prominent programs (see Meyer and Rosenbaum (2001), Blundell (2000) and Bargain and Orsini (2006)). These programs reduce the cost of labor for low incomes by reducing taxes and other compulsory contributions. The expansion of such tax exemptions has come with increasing awareness of potential negative side effects (e.g. Bargain et al. (2010)). In Germany, jobs with earnings below a certain threshold, so-called minijobs, are exempt from both income tax and compulsory social security contributions (SSC). Side effects of tax exemptions can be split into two types. First, firms and workers might decide to reduce hours of work and/or wages for workers eligible to benefit from the policy. Second, if there are equilibrium effects, individuals beyond those directly targeted by the policy are also affected. Chetty et al. (2011) show that if firms cannot easily change the number of hours of a posted job offer, they have an incentive to package their hours-wage bundles according to average preferences of job-seeking workers. Since the same jobs were eligible for tax reduction for one group but not another in the German system of minijob tax exemption we study here, identification of the role of firm responses is particularly intuitive. This paper sets up and empirically estimates a simple equilibrium job search model with a discontinuous tax schedule in order to evaluate wage, hours and participation effects and study welfare consequences of the German minijob policy for different workers.

The German setting is well-suited for an empirical application of our equilibrium job search model: Throughout the period of analysis (1999-2002), tax exemptions in Germany were awarded to workers in minijobs only if workers did not hold a second job. Employees who held a minijob as a second job were not covered by the policy at all. While the impact of the policy on the earnings distribution of small jobs (defined throughout as a job with earnings up to €800) is less marked for them than for directly affected workers, we find indisputable bunching at the tax exemption threshold for both groups. Studying workers whose budget set is not directly affected by the tax policy allows us to identify the equilibrium effects of tax subsidies: For workers not subject to the minijob tax exemption, changes in hours and wages result only due to equilibrium effects. We estimate our model using a combination of German administrative and household survey data. We find that the minijob tax exemption provokes significant firm reactions. With our estimated

structural model we then simulate different counterfactual policies. We quantify the effect of the tax exemption by comparing the situation with a labor market with a smooth tax schedule. These simulations confirm the costs of discontinuous tax policies but also highlight how firm reactions interact with search frictions to influence different workers differentially. We make three main contributions.

First, our unique institutional setting allows for a particularly convincing identification of equilibrium effects. Tax subsidies offered to certain workers with low earnings end up affecting many other workers in the labor market. We estimate our equilibrium job search model and quantify these distorting effects. We thereby complement work discussing unintended equilibrium consequences of making work pay policies (Rothstein, 2010; Leigh, 2010; Kolm and Tonin, 2011) as well as firms' role in responses to tax reforms in general (Kopczuk and Slemrod, 2006), and bunching in particular (Best, 2014; Gudgeon and Trenkle, 2019; Chetty et al., 2011). Tazhitdinova (2020) also analyzes the German minijob policy. She proposes using the observed bunching to estimate labor supply elasticities. This approach focuses on hours responses of individuals who *reduce* their earnings due to the tax exemption. It does not allow for an estimation of the increase in employment due to the minijob tax exemption - this participation margin appears to be an important policy objective however.[1] We structurally estimate the relative importance of participation and hours margins, and find participation effects to be large, with over one third of minijobs held by individuals who would have zero earnings (rather than higher earnings) without the tax exemption.

Second, we include discontinuous taxes into a standard equilibrium job search model (Shephard (2017) includes continuous taxes). In line with the bunching literature (Saez, 2010), we find important additional welfare costs caused by the discontinuous nature of taxes. We show that these are further increased by firm responses and moderated by search frictions. In contrast to previous equilibrium job search models, we are able to rationalize

[1] Bunching estimators assume that mass points in the earnings distribution arise as a result of earnings concentrating here that - under a counterfactual scenario - would be spread over the whole earnings distribution. However, our labor market is special in that minijobs are held also by individuals who would not work in the absence of the minijob policy - partners of rich spouses, retirees and students. If the bunching estimator uses as counterfactual the generalization of tax-free earnings, the estimator uses information from prime-age males and other groups with strong labor market attachment as counterfactuals for groups which often by law are unable to increase their earnings (retirees lose their pension if their earnings exceed the minijob thresholds; students are not allowed to work full-time).

discontinuous bunching at tax thresholds in the interior of the earnings distribution. We are thus able to analyze counterfactual policy reforms that aim at removing the welfare costs induced by tax non-linearities.

Third, we empirically analyze gains and losses of a tax exemption directly affecting millions of German workers. We show how alternative tax policies could increase different groups' - and overall - welfare. Search frictions are found to be an important determinant of welfare effects across different groups of workers.

Our model is related to evaluations of tax policies based on analyses of labor supply as a discrete choice (specifically for minijobs, see Arntz et al. (2003) and Bargain et al. (2010)). Given that they lack an equilibrium framework, the wage distribution is typically taken as given. The evidence of equilibrium responses is a strong indication that individuals cannot freely choose hours, however. The models most similar to ours thus include restrictions on the free choice of hours (e.g. Van Soest et al. (1990), Bloemen (2008), Beffy et al. (2018)). Job search models provide a way of explaining some of these constraints on hours without resorting to ad-hoc restrictions on the set of labor supply choices available to individuals. A different strand of the literature has investigated the reason for the divergence between labor supply elasticities based on individual-level data from that based on more aggregate data. Chetty et al. (2011) present a simple model of firms reacting to workers' tax incentives and argue that firm responses may be a key to explaining "micro versus macro elasticities",[2] but refrain from estimating a structural search model. Their model would also be difficult to fit to the data as it generates no wage dispersion and only focuses on the intensive margin. The German tax exemption importantly affects the extensive margin however - a margin policy-makers are very often concerned with when implementing labor market policies for low-earnings groups. We here present a model that rationalizes the same mechanism in a way that allows estimation and welfare analysis of an important policy for promoting low-wage workers.

Section 2 characterizes the market for small jobs in Germany. Section 3 presents our model and simulation results. Section 4 outlines our data and shows descriptive statistics.

[2]The difference between macro and micro labor supply elasticities can be understood in our model: Assume there is a change in labor taxes. The micro elasticity corresponds to an individuals' labor supply reaction to changed net wages for a given (gross) wage offer distribution. The macro supply elasticity gives changes in volume of work after taking into account firms' changes to the gross wage distribution as a result of the tax change.

Section 5 discusses identification and estimation. Section 6 presents estimation results and counterfactual policy evaluations. Section 7 concludes.

2 Minijobs and small jobs in Germany

This study focuses on employment with low earnings, or "small jobs". Small jobs include but are not limited to minijobs. We define small jobs as all employment spells with monthly earnings below €800 per month. During the period we consider, minijobs are limited to €325. These are jobs that full-time employed workers may accept next to their current job, or pensioners and students next to their other activities - but which may also appeal to workers without any job.

We focus on the institutions as they existed during a period of relative stability between 1999-2002 with minijob regulations geared to prevent employers from converting regular employment into minijobs. In 2003, as part of the "Hartz" labor market reforms, access to minijobs for employers was simplified and the minijob earnings threshold increased. We do not analyze the post-reform period, in particular because workers who took on a minijob as second job could now also benefit from the tax exemption, making our strategy for identifying equilibrium effects less clean. Furthermore, the number of minijobs grew rapidly, especially in the form of second jobs, making an equilibrium analysis less credible. The post-reform period is however interesting because it highlights the specific role of minijobs in the wider labor market. In particular, minijobs have not been identified as a major contributing factor to the fall in German unemployment throughout the early 2000s.[3] The minijob reform occurred largely *on top* of changes in the composition of the existing labor force, in other words, "non-participation outflows entirely explain the rise of marginal and part-time employment" (Carrillo-Tudela et al. (2019)). This makes sense as minijob workers often belong to groups with low labor market attachment. A strong participation margin also makes interpreting changes in wage inequality challenging. Furthermore, low earnings are less obviously a policy concern if individuals have other income sources (retirees or transfers) and main activities (full-time education or another job). Studies of the German labor market often leave aside minijobs when analyzing the evolution of earnings inequality (e.g. Dustmann et al. (2009) or Card et al. (2013)). We here focus squarely on the market for small jobs. With around one in ten workers in a minijob

[3]Collaborative industrial relations (Dustmann et al. (2014)), increased efficiency of matching unemployed workers to jobs (Launov and Wälde (2016)) and the reform of the unemployment insurance (Krause and Uhlig (2012)) are candidates.

alone, the size of the market is considerable. The minijob tax exemption continues to this day, but identification is not as clean since a large reform in 2003: Small jobs of workers who hold another job are now also covered by the tax exemption.

In the period we study, employment contracts qualify for special minijob income tax and SSC treatment if monthly earnings do not exceed €325 and jobs have fewer than 15 hours per week.[4] First, crossing the minijob earnings threshold results in a decrease of net earnings because when an individual earns more than the threshold, her entire earnings are subject to employee SSC (around 21% of gross earnings), i.e. the budget set features a notch[5] as well as a kink. While minijobs do not create an entitlement to social security (whereas jobs with earnings above do), entitlement effects for health and pension insurance are very unlikely to play a role in the market for small jobs: Concerning health insurance coverage, individuals who only hold minijobs are mainly housewives/-men, students, pensioners and registered job-seekers (Körner et al., 2013). In Germany almost all individuals in these groups are either health-insured through their partners, the state, or have access to specific student health care provision. With respect to pension entitlements, contributions from small jobs would not suffice to increase pension benefits above the social assistance level which is available independent of contributions. We thus treat SSC in this market as a pure tax.

Second, in addition to being exempt from SSC, minijob earnings are not liable to income tax. Earnings above the minijob threshold are subject to the income tax, creating an additional tax notch the size of which varies mainly as a function of married spouses' earnings. (There is no income tax notch for singles with no other income.)

The size of the drop in net earnings for earnings above the minijob earnings threshold is thus composed of SSC and income taxation and varies across individuals. Note that employers *are* liable to pay SSC for minijobs.[6] Furthermore, they benefit from the same

[4]The monthly threshold may be exceeded for two months within a year as long as monthly earnings are on average below the threshold in that year. We do not focus on the hours constraint, as we find little bunching at 15 hours, suggesting this constraint is not often binding.

[5]In March 2002, a policy called *Mainzer Modell* aimed at improving incentives by balancing the additional SSC due to crossing the threshold by a subsidy which was gradually withdrawn for higher household earnings. The notch with respect to income taxation remained. We limit the empirical analysis to the period before March 2002, see section 4.

[6]Employers' SSC are 10% (health insurance) and 12% (pension contributions) of minijob earnings and thus approximately correspond to employers' SSC for other employment contracts.

Figure 1: Stylized income tax schedule for small jobs as first jobs

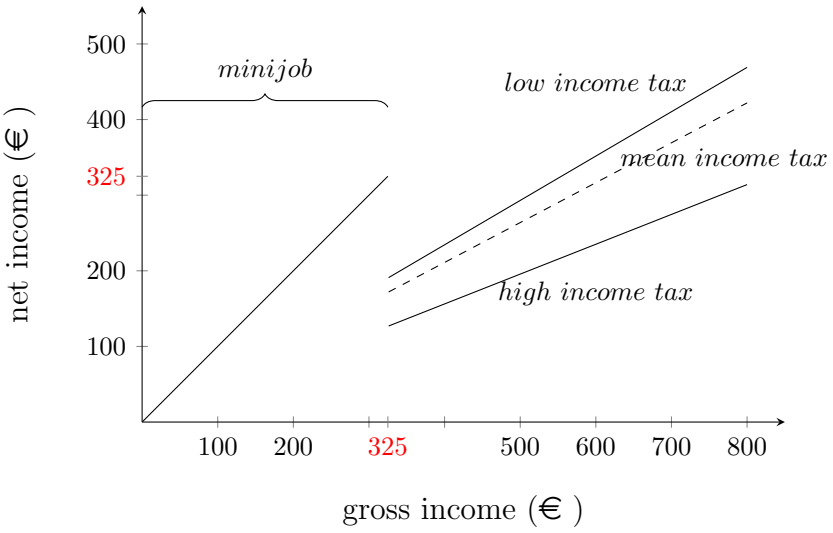
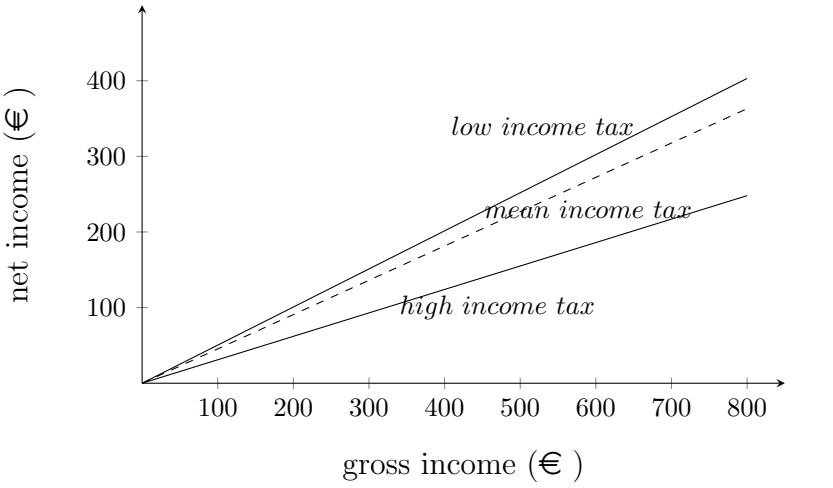


Figure 2: Stylized income tax schedule for small jobs as second jobs



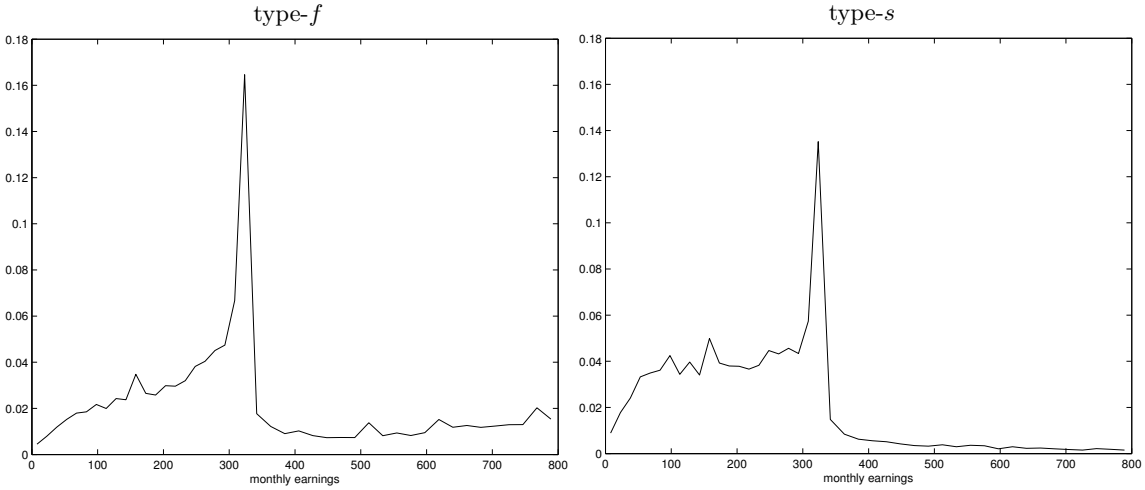
degree of employment protection, maternity leave, sick pay and paid holidays as other workers. The employment protection awarded to minijobs means that these contracts are not frequently used as entry jobs to later regular employment.

Based on these institutions, figures (1) and (2) depict the stylized tax schedules we use in this paper. For individuals with no other job, figure (1) shows that gross earnings in the range until €325 are tax-free - making earnings between €325 and around €550 very unattractive. We also see that the range in which gross earnings above the threshold are inferior to minijobs depends on individuals' income tax. Figure (2) presents a stylized tax schedule for workers for whom the small job constitutes a second job. Importantly for this study, if a worker has another job subject to SSC on top of a small job, the latter does not

qualify for the minijob tax exemption[7] and is therefore subject to full SSC and income taxation. Note that in constructing these tax schedules, we abstract from the progressivity of the income tax schedule, since marginal tax rates can be expected to be fairly stable in the range of earnings considered here.[8]

These tax schedules give rise to strong incentives: As may be expected, workers who only hold a small job (denoted *type-f workers* since their small jobs are first jobs) strongly bunch at the minijob threshold (figure (3), left panel). For workers for whom the small job is a second job, there is no incentive to bunch at the minijob threshold. Nevertheless, figure (3) reveals strong bunching of earnings for workers who also have full-time[9] jobs (in the following referred to as *type-s workers*). To explain this phenomenon, we set up an equilibrium model in the next section including firms' wage-setting and workers' job search.

Figure 3: Distribution of observed earnings by types of workers (Note: Type-s have no incentive to bunch)



Notes: Type-f workers have or seek a small job and have no other job. Type-s workers have or seek a small job as a second job. The minijob threshold is at €325/month. Data source: SIAB.

[7]Unless joint income of two minijobs does *not* exceed the threshold, a very rare case in our data.

[8]First, the largest fraction of the tax wedge is constituted by the constant rate of social security contributions. Second, workers with the lowest (zero) income tax level are unlikely to exceed their income-tax-free allowance even with the highest-paying small jobs. Third, for workers in the highest income tax bracket, the contribution of the small job to total household income is likely to be modest - variation in other household income sources (typically, spousal earnings) are likely to drive the (joint) income tax treatment much more strongly.

[9]We use the term "full time" to fix ideas and as over 80% of these first jobs of second-job holders are full-time. The remaining are part-time, see table (5).

3 The Model

The equilibrium effects of the tax exemption arise because firms do not adjust their job offers to individual job-seekers who may have different preferences or tax treatments. We model this effect using an equilibrium search model with wage posting and on-the-job search. First, job search models provide a convenient way of modeling the limited labor supply options most people face: job offers need to be sought and, once found, typically come with fixed hours and earnings. Second, by contrast to simple search models, equilibrium models endogenize the job offer distribution. If earnings could be adjusted costlessly (in a simple bargaining framework), we should expect no mass points at the thresholds for individuals who are not eligible to the tax exemption. Figure (3) strongly suggests that there is such bunching, confirming our assumption that firms make take-it-or-leave-it offers along the lines of Burdett and Mortensen (1998) and Bontemps et al. (1999).[10] The job offer distribution then reflects the preference distribution of the whole population of job-seekers. Third, on-the-job search allows us to explain the increasing wage distribution below the minijob tax exemption threshold and the mass point at the threshold without untestable assumptions about outside options.

In line with our focus on small jobs, we do not model the full-time jobs of second job holders. In other words, while these full-time jobs influence workers in the small jobs market (we allow for different rates of job offer arrivals and separations), small jobs do not influence the full-time jobs workers have. This appears reasonable as current full-time workers are unlikely to give up their full-time jobs given the large difference between full-time earnings and small jobs. Furthermore, individuals who do not hold full-time positions are unlikely to take on a full-time job since many of these individuals are pensioners, students and spouses of high earners - groups with large constraints to work full-time. Section 4.3 shows that the industries offering full-time jobs and minijobs are very different, with minijobs concentrated in cleaning, security and retail.

3.1 Model Basics

The small jobs market is composed of a continuum of workers and firms. We assume that hours vary across firms and workers care about hours and earnings.

[10] An alternative modeling choice would be to allow for negotiations for a fraction of workers along the lines of Chetty et al. (2011). In the market for small jobs, our assumption of take-it-or-leave-it offers appears particularly credible, see Shephard (2017).

Workers derive utility v from consumption and leisure and must pay taxes.

$$v = c^{\alpha}(\bar{h} - h)^{(1-\alpha)} \tag{1}$$

where α is the elasticity of v with respect to net earnings c and leisure $\bar{h} - h$ ($\bar{h}$ is the maximum number of working hours - we assume 12 hours per day).

Worker types, taxes & constraints. Workers differ by individual income tax treatment, t_i^{inc} and belong to one of three types: Second jobbers (population n^s) and two types of workers without second jobs (type f): only minijobbers (fo) and any small jobbers (fa) which we differentiate in the following paragraph. Second jobbers have a full-time job but are nonetheless active in the market for small jobs, holding or seeking a second job. Second jobbers are not qualified for the tax exemption, which is only available for workers who have no other job - i.e. type-f workers. Thus the budget set of type-f workers exhibits a notch and a kink at gross earnings $z = z^*$ while it is smooth for second jobbers. Net earnings c_i for worker i of type j are then given by

$$c_i = \begin{cases} z_i & \forall \;\; z \leq z^* \;\&\; j = f \\ z_i(1 - t^{ssc})(1 - t_i^{inc}) & \forall \;\; z > z^* \;\&\; j = f \\ z_i \; (1 - t^{ssc}) \; (1 - t_i^{inc}) & \text{for } j = s, \end{cases} \tag{2}$$

where t^{ssc} denotes employees' SSC rate and t_i^{inc} individual i's income tax rate. The SSC rate is constant for all earnings above the threshold and for type-s workers. The SSC rate is set to the average legal value over the analysis period (20.69 %). The income tax rate, t^{inc}, also depends on household characteristics and thus varies across individuals. Since these characteristics are not observed in our administrative data, we impute tax rates based on survey data and a micro-simulation model which accounts for the most important aspects of the German tax-transfer system (for details on the tax imputation, see online appendix B). Tax rates of type-s workers vary between roughly 8 % and 20 %. Tax rates for type-f workers are much lower, with many workers not liable to income tax even when they exceed the minijob threshold, since household income is low enough - but note that SSC liability ensures there is always a notch and a kink for type-f workers at the minijob threshold.

Only minijobbers (fo) and any small jobbers (fa): On top of different individual income tax rates, the group of workers without another job (type-f) is also characterized by constraints on earning beyond the minijob threshold: Students may lose their student

status and pensioners their pension payments if their earnings exceed the minijob earnings threshold z^*. To take these differences into account, we assume that there is fraction θ of type-f workers with a prohibitive income tax rate above the earnings threshold - i.e. these individuals are only interested in minijobs, not other small jobs. We designate these exclusive, or "only" minijobbers type-fo,

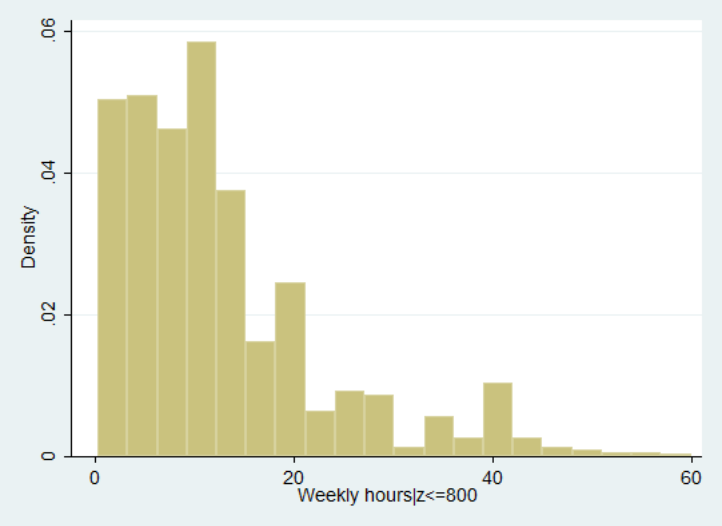
$$t_i^{inc} = \begin{cases} \hat{t}_i^{inc} & \forall \;\; z > z^* \;\&\; j = fa \\ 1 & \forall \;\; z > z^* \;\&\; j = fo, \end{cases} \tag{3}$$

Note that while we have individual heterogeneity in the level of taxes, workers are assumed to have the same level of productivity. We think this is acceptable for the market of small jobs. First, the heterogeneity in worker productivity is limited in this segment of the labor market if high-productivity workers are found in high-productivity firms - since this combination will be unlikely to generate the low earnings that characterize our market. Sorting of worker and firm types has been found to be important in recent studies of the German labor market (Card et al., 2013).[11] Second, even where such heterogeneity exists, it is unclear whether it translates to higher wages, since workers' bargaining power is particularly low for these types of jobs (Cahuc et al. (2006)). Third, note that the literature includes heterogeneity in productivity precisely because of difficulties of fitting the earnings distribution. In this market, we fit the earnings distribution fairly well without such heterogeneity: Other factors appear more relevant here, in particular tax policies and whether workers have a second job or not.

Firms in the market have a fixed working hours requirement h. Following Chetty et al. (2011) we assume that hours of work are not a choice variable of firms but predetermined by technology. We stress differences in firm-side constraints on working hours for several reasons. First, minijobs are highly concentrated in very specific industries and occupations. Second, we find consistent evidence in our SOEP data that full-time workers have unmet demand for lower working hours. Third, while many workers in small jobs would prefer to work more hours, this is less so for workers in minijobs. This is consistent with the idea that not all firms can package their labor demand in a way that is suitable for minijobs. These exogenous hours requirements could arise as a result of different

[11] Borovickova and Shimer (2018) confirm strong sorting and an important role for firm effects in Austrian data. Note this does not imply worker effects are not important, which is an active research question. In a recent study, Bonhomme et al. (2019) find a high contribution of worker effects to wage variation in Sweden. However, they also find that firm effects are most important for the lowest-type workers, among whom many minijob workers may be counted.

Figure 4: Hours distribution of small jobs



Data source: SOEP wave 2001

fixed costs of employment combined with firms choosing working hours as a compromise between making attractive offers to workers and spreading fixed costs over a maximum amount of hours. We can find a distribution of fixed costs such that the optimal hours under the fixed cost equals our exogenous hours requirement. While it may appear overly simplistic to load all heterogeneity across firms on to hours, it should be remembered that we are dealing with a specific market for small jobs where differences in labor productivity may be limited. We further assume that required hours of work vary continuously across firms.[12] Equal wage offers of different firms thus correspond to different utility levels.[13]

Firms seek to maximize profits $\pi = [p - w]\ hl(v)$ where p is hourly productivity, $w = \frac{z}{h}$ is the gross hourly wage rate and $l(v)$ the size of the labor force of a firm offering jobs with utility v (each firm offers one type of job). While the fundamental trade-off described by Burdett and Mortensen (1998) holds - higher wages increase the size of a firm but reduce the profit margin per worker - there is a limit to the incentive to increase wages: Offers with earnings exceeding z^* attract up to n^f individuals less than offers with earnings less than z^*. As we shall see, the endogenous offer distribution may then include a mass point

[12] Allowing for discrete variation in hours is a non-trivial complication since this may generate numerous mass points and associated gaps, corresponding to the minijob earnings threshold with different working hours. An online appendix demonstrates the simplest case for a two-type hours distribution without productivity heterogeneity and shows that for many hours categories, the model quickly becomes intractable.

[13] This is true unless workers' marginal utility of leisure is zero, such that the utility function is independent of hours. We do not consider this trivial case.

because firms do not have an incentive to offer slightly higher earnings. Online appendix A presents a stylized model with no variation in working hours that is sufficient to clearly demonstrate the equilibrium effect: non-eligible workers take on jobs targeted at other workers who are eligible. The model thereby rationalizes the observed mass point in the earnings distribution.[14]

In the following and with a slight abuse of notation we write the equilibrium distribution of workers' welfare implied by the offer distribution of wages and hours as $F^v(v(w,h))$. In more detail, the distribution of utilities actually varies as a result of individuals' differential taxation, i.e. $\int_i^N F^v(v(c(z(w\ h), t_i^{inc}), h))$. It should be remembered that firm decisions take into account the full distribution of taxes in the population, and that attractiveness of job offers varies across individuals in line with differences in individual income taxes.

3.2 Job search & match

Job acceptance of only minijobbers (type-fo) is conditional on obtaining the tax exemption. The remaining type-f workers (fa) move to any offered job with higher utility. Their budget set exhibits a notch at the minijob threshold which varies across individuals. Both groups of type-f workers thus generate an incentive for firms to offer earnings below or at the threshold.

Job search. Workers receive job offers when they are job-seeking and when they have a small job, i.e. we allow for on-the-job search. Job-to-job transitions are not only a feature of the data, on-the-job search is also a way of explaining why firms offer workers job offers which generate utility beyond the reservation level - higher wages make jobs more attractive for workers in employment who may be tempted to change jobs. An alternative modeling choice would be to include workers with different reservation wages. This would also increase the incentives for firms to offer higher wages. Identifying reservation wages (in a fairly limited sample window) is however challenging and complicates an already challenging numerical estimation. Also, heterogeneity in reservation wages alone has not been found to fit the data very well (see Eckstein and Wolpin (1990)). The large mass point at the threshold is a sign of the competitive pressure, which we believe is consistently modeled

[14] Compared to the version of the model without variation in working hours, this version *can* account for the fact that there is no gap in the offer distribution below the minijob threshold. Requirements for some workers to work longer hours can also explain why not even more firms make use of minijobs.

by on-the-job search. The job offer arrival rate (λ) is allowed to differ across workers with and without full-time jobs (types s and f respectively). By contrast, offer arrival rates are independent of whether or not a worker already has a small job: First, the standard argument for different rates is based on workers having time constraints when searching on the job - in our setting, time constraints will be much more importantly influenced by whether workers have a full-time job next to their small job. This is why we differentiate job offer arrival rates across workers with and without full-time jobs. Second, our estimation strategy would be numerically much heavier as we could no longer separately estimate job offer arrival rates in a first stage independently of the wage offer distribution. This has considerable computational cost, since the parameter space then needs to be enlarged in the second stage of estimation, in which firms iteratively choose their wages.

Wage determination. Workers draw job offers consisting of a wage and a working hours requirement from the endogenous job offer distribution $F^v(.)$. This offer distribution is endogenous to the parameters of the model since the fraction of the workforce working in different firms varies and thus the incentive for firms to post different wages. We could further endogenize labor demand (e.g. via a matching function), but this would mainly replace the given underlying hours distribution by a distribution of costs of vacancy creation. Workers lose their job at an exogenous rate δ which we also allow to differ depending on whether workers have a full-time job or not. Workers seek to maximize expected steady-state future utility v. Individuals seeking a small job accept job offers based on their individual tax treatment and on whether the job exceeds their reservation utility v^r. Employed workers accept offers which generate higher instantaneous utility than their current job. To be viable in equilibrium, the lowest-utility offer must exceed the reservation utility of job-seekers without a small job. We therefore assume that job-seekers without a small job accept all offers in equilibrium.

Characterization of Equilibrium

We cannot solve analytically for the wage distribution, but we can characterize the equilibrium solution.

Workers' equilibrium strategy. Given that the dynamic environment is stationary,[15] the workers' problem is an optimal stopping problem. Given that job offer arrival

[15]This assumption is more realistic here than in most job search models, as we focus on a group of

rates on the job and in unemployment are equal, workers forego no opportunity value of searching when accepting a job. Thus workers' job offer acceptance is solely governed by the value of outside options.

Firms' equilibrium strategy. In equilibrium, firms with different hours requirements set earnings to maximize their profits given the value of other firms' offers. They take into account the trade-off between higher profits per worker on the one hand and larger firm size on the other hand. The latter firm size effect depends on the relative size of different groups in the labor market: the more people are only willing to accept a minijob, the more likely it is that firms avoid offering earnings beyond the minijob-threshold. Firms' incentives also depend on the full distribution of marginal tax rates in the population of job-seekers resulting from variation in income taxes since these determine the utility ranking of different job offers (since these are packages of hours and gross wages).

Equilibrium offer distribution. First, continuous variation in hours implies that the *utility offer distribution* will be smooth. The utility distribution will not exhibit a mass point or gap: If there was a mass point in the utility distribution, a firm could increase profits by slightly increasing the offered wage - and therefore utility - the same strategic arguments apply as in the case with no variation in hours, detailed in online appendix A. The loss in profit margin would be small while the firm size would increase discontinuously. Utility at the minijob threshold $v\left(\frac{z^*}{h}, h\right)$ varies across firms with different hours of work. The attractiveness of firms' offers will depend importantly on whether or not a job offer pays above or below $w^*(h)\ h \equiv z^*$: For workers of type-fa utility decreases discontinuously at z^* and a positive number of workers (the exclusive minijobbers, type-fo) do not accept any offers above. Given a smooth utility offer distribution this implies that there will be a gap in the distribution of earnings above z^* because firm size drops discontinuously when earnings offers exceed the threshold.[16]

Note that despite no heterogeneity in firm productivity, we do not obtain an increasing earnings distribution (see Bontemps et al. (1999) why this would be a problematic prediction). This is because differences in hours create differences in optimal earnings.

workers who receive no unemployment benefits which mostly decrease over time.

[16]Without variation in hours, attractiveness depends only on the ranking of earnings offers. Then there will also be a gap *below* the threshold. The mass point at z^* then implies that if firms were to offer $z^* - \varepsilon$ they would attract discontinuously fewer workers than those offering z^*, meaning such offers are dominated (see online appendix A).

The decision between offering earnings below, at or above the threshold will depend on firms' hours requirements: A firm that offers earnings above the threshold must be able to attract enough additional individuals who already hold a job (type-s) as well as individuals without a job who accept any job (type-fa) to balance the loss in marginal profit *as well as* the loss of workers who only accept minijobs (type-fo workers), i.e. $\frac{\partial F^v(v(w,h))}{\partial w}$ needs to be sufficiently high for $w > w^*$. Firms with sufficiently small hours ($h \leq h' = \frac{z^*}{p}$) will offer earnings below the threshold. By contrast, firms with sufficiently high hours requirements ($h > h'' = v^{-1}(w^*, \underline{v})$) will offer earnings above the threshold.[17] For firms with hours requirements between these two thresholds ($h'' > h > h'$), the Burdett and Mortensen (1998) trade-off holds: Higher marginal profits per worker (the first term in equation (4) representing the first order condition of profit-maximization for a firm with hours requirement h) may be offset by a smaller firm size (the second term in equation (4)). Recall that given the discontinuity of the tax schedule, an offer's attractiveness (and therefore the number of employees a firm can attract by offering it) is not monotonously increasing in the offered wage rate. Offering earnings above the threshold might lead to a decrease in firm size as type-f workers either suffer a utility drop at the threshold (any jobbers, type-fa) or do not accept any jobs with $z > z^*$ (exclusive minijobbers, type-fo).

$$\begin{aligned}\frac{\partial \pi(v(w,h))}{\partial w} =& -h\left(\frac{n^s\kappa^s}{(1+\kappa^s(1-F^v(v(w,h))))^2}+\frac{(1-\theta)n^f\kappa^f}{(1+\kappa^f(1-F^v(v(w,h))))^2}\right)\\ &+(p-w)\,h\left(\frac{2n^s\kappa^{s\,2}\frac{\partial F^v(v(w,h))}{\partial v(w,h)}\frac{\partial v(w,h)}{\partial w}}{(1+\kappa^s(1-F^v(v(w,h))))^3}+\frac{2(1-\theta)n^f\kappa^{f\,2}\frac{\partial F^v(v(w,h))}{\partial v(w,h)}\frac{\partial v(w,h)}{\partial w}}{(1+\kappa^f(1-F^v(v(w,h))))^3}\right) \qquad (4)\\ &\forall\ w : w < \frac{z^*}{h}\end{aligned}$$

where $\kappa^f \equiv \frac{\lambda^f}{\delta^f}$ and $\kappa^s \equiv \frac{\lambda^s}{\delta^s}$.

The change in firm size by increasing the wage rate crucially depends on $\frac{\partial v(w,h)}{\partial w}$, which varies across firms with different hours in line with workers' preferences over consumption and leisure. We can designate those firms as "better" for whom at a given w, $\frac{\partial v(w,h)}{\partial w}$ is greater - or profits at the threshold are larger. Assuming a Cobb Douglas utility function, for a given level of working hours, $v(w,h)$ is a monotonously increasing concave function in w in all points except at the earnings threshold z^* where $v(w,h)$ drops discontinuously with w. Profit-maximizing earnings of 'better' firms are thus more likely to be high and above the threshold. Firms with low hours requirements need to offer a high wage rate to

[17] This holds as long as the reservation utility level is strictly positive. As $v(.)$ is monotonously increasing in w in all points except at the threshold $v(w^*,h) < \underline{v}$, this implies that a firm with h or more will not attract any workers by offering $w \leq w^*$.

reach threshold earnings.

We see that variation in hours plays a similar role here to productivity heterogeneity in Bontemps et al. (1999). In both settings, there is a one-to-one mapping between firm heterogeneity and the utility firms offer in equilibrium. Our model implies that there is an optimal wage level yielding the largest expected profit for every hours requirement. Different firms have different optimal wage levels and offer different utility-levels. As in models where attractiveness of firms varies as a result of heterogeneity in productivity, firms follow pure strategies and profits differ across firms with different hours requirements. This implies that the wage distribution is not necessarily increasing as it would be with identical firms. As in models with heterogeneity in productivity, firms do not make equal amounts of profit. Firms may make better and worse draws from the hours distribution: For every α and distribution of types and taxes in the population, firms with certain hours requirements make larger profits than other firms.

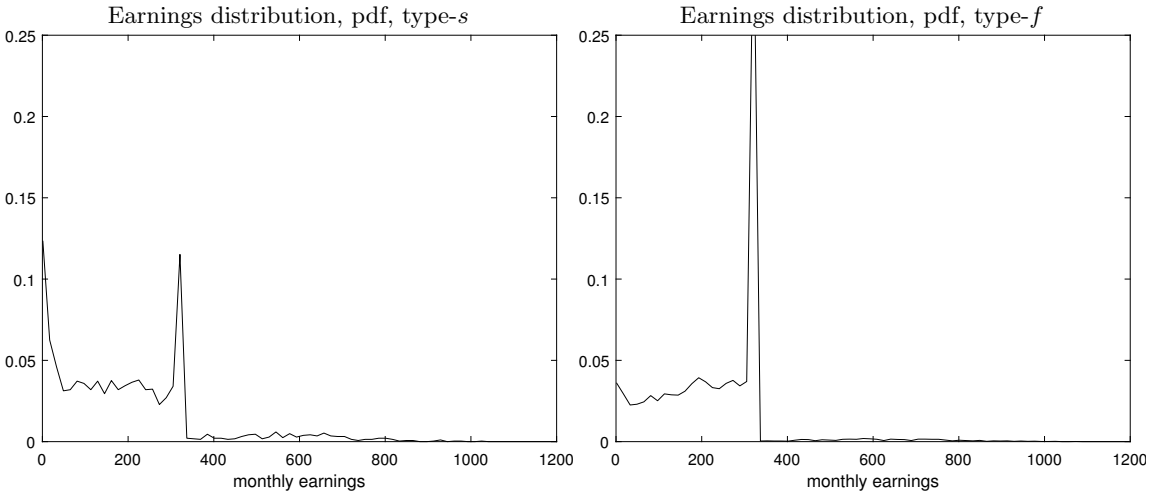
In the end, whether a firm offers earnings above the threshold depends on the equilibrium distribution of instantaneous utility that other firms' job offers imply $\int_i^N F^v(v(c(z(w\ h), t_i^{inc}), h))$. When setting their earnings, firms will thus take into account the minijob threshold, but also the joint distribution of worker types and taxes.

Solving the Model

Since we have no analytic solution for the equilibrium earnings distribution, we solve for it as the solution to a fixed-point problem in which profit-maximizing firms position themselves strategically given other firms' offers, see online appendix D. Figure (5) presents a simulated equilibrium earnings distribution to discuss the implications of the model (here based on the parameter values reported in section 5). The jump at z^* implies a mass point in the density for both types of worker - those for whom the threshold has large consequences, but for the others also. This is a striking equilibrium effect that the specific institutional setting allows us to see directly in the data. Our simple model appears well-suited to investigate the role of the minijob threshold in creating a mass point in the market for all workers. Above the threshold, the simulated offer distribution exhibits a small gap. Earnings in this range are "dominated" by earnings at the minijob threshold for all first-jobbers (see the tax schedule in figure (1)). Our simulation suggests that incentives emanating from this group are so large that no job offers are made with

earnings just above €325. However, the presence of second-jobbers in the market creates incentives for firms to make offers above that level, but within the dominated range of first-jobbers. We predict that certain firms will post earnings of around €400-450 for example, with increasing earnings density above that. Finally, note that given the search frictions in our model, first-jobbers without a small job or in very low-utility employment may accept jobs with earnings in their own dominated range.

Figure 5: Simulated earnings distribution of different types of workers



Notes: Type-f workers have or seek a small job and have no other job. Type-s workers have or seek a small job as a second job. The minijob threshold is at €325/month. Simulation based on 100 firms and 13,000 individuals. Simulation based on estimated parameter values reported in section 6.

4 Data

We use administrative data collected by the German social security system and household survey data from the German Socio-Economic Panel (SOEP). The Sample of Integrated Labor Market Biographies (SIAB) is a representative two percent sample of administrative records of all employees in the private sector.[18] For the present analysis, SIAB is the most appropriate data set. First, accurate total gross earnings for a period of an employment spell are observed. Second, with approximately 1.6 million sampled employees, the sample is large enough to include a substantial number of individuals holding second jobs. By contrast, the sample of small jobs, and especially second jobbers, in SOEP is too small for our analysis. Third, SIAB includes complete employment biographies of the sampled individuals. This allows us to differentiate between first and second jobs. It also includes

[18]It does not include civil servants and self-employed workers. We use the weakly anonymized version of the data via on-site use at the research data center of the IAB in Berlin.

unemployment spells. Fourth, tax-exempt minijobs constitute a separate job category. We can rule out that bunching of second job earnings at the minijob threshold is driven by misclassification. Fifth, we observe important individual and firm characteristics: age, sex, occupation, and education, and for firms, industry sector, size and wage structure. The data have two main limitations. First, the number of hours worked is not precisely measured. Hours information only exists in broad categories. Second, we do not observe information about earnings of spouses or from other income sources. This information is useful to precisely calculate individual income tax rates of married couples. While SSC constitute a greater part of non-wage labor cost (in fact, many individuals pay no income tax), we also reconstitute individuals' income tax. We use household survey data to complement our administrative data and impute hours and individual tax rates (see section 4.2). The German Socio-Economic Panel (SOEP) is a yearly representative household survey which includes information on labor market status, earnings, hours and all tax-relevant individual and household information.

4.1 Sample definition

We restrict the sample to employees aged 17 to 65 years.[19] For individuals with two simultaneously held or overlapping employment spells, the second job is defined as the one with lower earnings (very few individuals have more than two jobs, these spells are dropped). We do not classify very short overlaps between jobs (less than 5 days) as parallel employment spells. Interruptions of less than one month of the small number of similar spells are ignored. We exclude individuals who receive benefits from unemployment insurance (this affects 13,083 unemployed, or 5.33% of individuals). These individuals face one-for-one reduction in benefits when earnings exceed €165, i.e. they have a threshold not dissimilar to the minijob tax exemption, but at a different point in the earnings distribution. We refrain from including this second discontinuity in our analysis to keep the model tractable. Figure (3) provides suggestive evidence that similar mechanisms may operate at this threshold too: The earnings density in our sample (which excludes benefit recipients) appears to show a small spike at the €165 -threshold for benefit recipients. We include spells which ended after April 1999 or started before March 2002 in the analysis. We distinguish two types of workers:

- Type-f workers currently hold or seek only a small job with earnings below €800 monthly. In the absence of information on job search intensity, we classify individuals

[19] We exclude trainees, interns and employees in the military.

as type-f workers if they currently have no small job but held a job paying up to €800 at least once in the sample period.

- Second jobbers have a full-time job[20] and have or seek a small job as a second job. In the absence of information on job-seeking for the whole sample, we restrict our sample to individuals who had at least one second job with earnings up to €800 in the sample period. (Online appendix H tests an alternative definition of job-seeking.) The market of small jobs is dominated by workers who have no other job (type-f). Type-s workers account for around 10 % of all employment spells in our sample (table (1)).

Small jobs end in job separations (60.90 % for type-s and 51.91 % for type-f) and job-to-job transitions (5.8 % for type-s and 8.73 % for type-f). While a high fraction of job-seeking spells are right-censored (69.32 % for type-s and 58.87 % for type-f, table (1)), by far the most frequent reason for censoring is the end of the analysis period. The probability of being right-censored is considerably lower for employment spells (33.31 % for type-s and 39.35 % for type-f). As minijobs are only included in the data as of April 1999, spells which started before April 1999 are considered to be left-censored. This is the case for roughly 20 % of the sample.

Table 1: Total number of spells by type and employment

	small job as second job (type-s)	no other job (type-f)
Job-seeking spells	49,956	55,602
of these: post-spell destination		
- job-seeker found small job	16,303	19,286
- right-censored	33,653	36,316
of these: pre-spell origin		
- left-censored	11,171	6,484
Employed in small job	30,133	287,279
of these: post-spell destination		
- small job to small job	1,693	23,801
- small job separation	17,417	138,862
- right-censored	11,023	124,616
of these: pre-spell origin		
- left-censored	10,509	80,808

[20] We use all employment spells with earnings above €1,000. We choose this figure to be clearly above the maximum earnings in the market of small jobs, to avoid individuals switching between markets when earnings vary.

4.2 Hours and taxes

While SSC rates are homogeneous in Germany, income tax rates depend on household characteristics. This implies that the size of the notch at the threshold varies between workers. In particular, marital status and spousal income are crucial. Since we have no information on these characteristics in our administrative data, we impute tax rates using detailed information on all tax-relevant characteristics in the SOEP following Junge (2017). We use this imputation to allocate individuals into three tax groups. Table (2) shows that full-time workers with (or seeking) small jobs face higher tax rates than type-f workers - mainly due to the earnings of their first job. Online appendix B provides details on the tax imputation. Figures (1) and (2) show the impact of different income taxes: The group with the highest income tax are not better off earning €800 than in a minijob. The lowest income tax group is not liable to income tax at all such that the tax wedge we see is entirely driven by social security contributions. For these individuals, gross earnings must be greater than €550 to exceed net earnings at the minijob threshold.

Since our administrative data do not include hours of work, we use the SOEP to impute these based on variables included in the SIAB: sex, gross earnings, sector, and education. As the hours distribution resembles a log-normal distribution (see figure (4)), a generalized linear model with log link is used for imputation. We then predict individual hours of work in our sample and let firms draw from the smoothed predicted empirical hours distribution. Based on this imputation, type-s workers work on average 8.95 hours per week, and type-f workers 12.84 hours (table (2)). The average estimated hourly wage rate is approximately €5.50 for both worker types.[21] We relegate details on the imputation of hours to online appendix C.

Table 2: Imputed hours, wage and tax rates

	small job as second job (type-s)		no other job (type-f)	
	mean	std	mean	std
weekly hours	8.95	4.61	12.84	7.66
wage rate	5.56	1.48	5.76	1.37
SSC & income tax (%)	32.61	3.27	28.03	6.02

Note: SSC are 20.69 percentage points for all workers. *Data source*: SIAB, SOEP wave 2001

[21] Note that this may appear low given the current German national minimum wage. However, the minimum wage was only introduced a decade later.

4.3 Descriptives

There is a large earnings response to the tax exemption. The observed earnings distribution of type-f workers features a large point mass at the threshold for minijobs (figure (3) in section 2, left panel). This group of workers (type-f) is subject to the minijob threshold implying a strong incentive to locate below the €325 threshold. Note that this is true independent of the degree of labor supply elasticity (Kleven and Waseem, 2013): In a certain interval above the minijob threshold, it is the dominant strategy to reduce earnings to the minijob threshold independent of workers' preferences (if leisure and consumption are normal goods). For second job earnings there is no incentive to locate at the €325 threshold as the minijob regulations do not apply. Nevertheless, the earnings distribution of type-s workers features a point mass at the minijob threshold and hardly any mass beyond (right panel of figure (3)), suggesting large equilibrium effects.[22]

This evidence suggests that both types of workers indeed draw from the same take-it-or-leave-it job offer distribution. Our model explains this by firms offering small job contracts based on the preferences of those job-seekers who have no full-time employment and can benefit from the tax exemption. Furthermore, the earnings densities of both types increase gradually up to the mass point which is of similar relative size. The fraction of employees below the threshold is higher for type-s ($\approx$ 90 %) than for type-f workers ($\approx$ 75 %). We therefore allow the offer arrival rate to vary between types in our model. This is consistent with observed differences in job-seeking spells, which are shorter for type-f workers (see table (3)).

The distributions of sectors are fairly similar for small jobs across types (see table (4), columns I & II): The dominant sectors are "cleaning, security and other firm services" as well as wholesale/retail, with the former more frequent as a second job and retail more common as a first job. The average duration of a small job is also similar for both types. These facts support the assumption that both types draw offers from the same job offer distribution. By contrast, in line with our assumption that small jobs constitute a separate labor market, full-time jobs are different: Here manufacturing is the largest sector (column III in table (4)).

[22] Interestingly, the small spike slightly below €200 is also an indication of an equilibrium effect. Workers receiving unemployment benefits have an incentive to earn at most €165. Although our sample excludes these workers, we see a small spike at €165.

Table 3: Spell durations in months

small job	as second job (type-s)		no other job (type-f)	
	mean	N (spells)	mean	N (spells)
Duration job-seeking	9.40	49,956	4.61	55,602
of these:				
- uncensored	5.76	8,157	4.14	15,964
- only right-censored	9.34	30,628	4.21	33,154
- only left-censored	12.74	8,146	9.42	3,322
- left & right-censored	10.86	3,025	6.20	3,162
Duration of job spell	10.74	30,133	10.84	287,279
of these:				
- uncensored	5.55	12,217	5.44	118,081
- only right-censored	10.82	7,407	10.31	88,390
- only left-censored	10.33	6,893	12.19	44,582
- left- & right-censored	28.89	3,616	28.09	36,226
Duration in employment	6.10	10,788	8.48	76,077
of these:				
- uncensored	6.10	10,788	8.48	76,077
- only right-censored	11.19	6,311	11.62	53,988
- only left-censored	11.95	6,893	17.71	44,581
- left- & right-censored	29.32	3,615	29.04	36,222

Data source: SIAB; *Note*: Duration in employment measures the duration of sequences of jobs uninterrupted by job loss.

Table 4: Distribution of industry sectors, 2000-2002

Sector	small job: no other job (type-f)		small job: as 2nd job (type-s)		full-time job of type-s	
	pct.	spells	pct.	spells	pct.	spells
Manufacturing	10.85	30,405	9.91	2,882	28.56	8,556
Wholesale & retail	22.18	61,405	13.93	4,050	14.39	4,311
Hotels & restaurants	10.67	29,536	11.05	3,215	2.88	864
Transport	5.07	14,045	8.58	2,494	6.43	1,926
Cleaning, security & business services	22.48	62,252	30.05	8,740	11.29	3,383
Public admin	1.88	5,216	2.48	720	6.48	1,943
Health	9.17	25,398	8.02	2,333	12.98	3,890
Other services	7.13	19,748	9.09	2,643	4.22	1,265
All other sectors	5.38	14,903	4.24	1,234	7.40	2,219

Data source: SIAB. Percentages in terms of non-missing observations. Missing values: 10,474 for column 2; 1,050 for column 3; 185 for column 5

Table (5) shows that women and East Germans are slightly over-represented in our sample. Over 90% have at most vocational training. Job-seeking type-f workers are relatively more likely male, East German and not highly educated. Survey data shows that type-f workers are predominantly housewives/-men, students, pensioners and registered job-seekers, with housewives constituting the largest and registered job-seekers the smallest group (Körner et al., 2013). Only roughly one quarter say that they do not work more because they cannot find a suitable position, in line with our differentiation between workers willing to gain higher earnings and workers exclusively seeking minijobs. The gender ratio of workers holding or seeking side jobs is fairly balanced (table (5)). The share of East German workers is smaller and type-s workers are slightly better educated than type-f workers. The age distribution is roughly similar across types.

Table 5: Socio-demographic characteristics of sampled individuals (by type)

	small job as 2nd job (type-s)				no other job (type-f)			
	job-seeking		employed		job-seeking		employed	
	mean	N(pers)	mean	N(pers)	mean	N(pers)	mean	N(pers)
Total		14,514		10,941		22,350		184,150
of these								
Female	47.20	6,851	48.57	5,314	51.57	11,527	69.85	128,628
Age (years)	35.46		39.72		33.88		35.95	
East German	11.27	1,636	8.15	892	29.24	6,535	14.67	27,014
Highest Educational level								
Total (non-missing)		9,254		10,848		10,068		157,251
of these								
Secondary school	13.18	1,220	15.34	1,664	30.05	3,026	28.30	44,508
Vocational training	74.86	6,928	72.87	7,905	63.03	6,346	63.34	99,603
Upper 2ndary / A-level	6.34	587	5.74	623	3.48	351	4.78	7,518
University	5.57	515	6.07	658	3.42	345	3.57	5,622
Full-time job of 2nd jobbers								
Total (non-missing)		14,510		10,940				
of these								
Monthly earnings (euro)	2,003.94		2,136.03					
Part-time	18.11	2,629	20.35	2,226				

Data source: SIAB. Employment status based on first observation in sample. Missing observations: 5,260 in column 2, 93 in column 4, 12,282 in column 6, 26,899 in column 8.

5 Identification and Estimation

In this section we first discuss identification of the model parameters (section 5.1) before presenting our two-step maximum likelihood (ML) estimation procedure (section 5.2). Note that no single parameter summarizes the equilibrium effects of the minijob policy.

Equilibrium effects arise endogenously as firms set wage offers according to individual preferences of the workers who may be interested in their offers. Parameters governing labor market frictions, workers' preferences and the proportion of individuals who do not accept jobs above the threshold all play a role in determining the size of equilibrium effects. Section 6 presents results. To quantify the distributional consequences of equilibrium effects, section 6 also performs counterfactual simulations.

5.1 Identification

We seek to estimate eight parameters: Two job offer arrival rates (λ^s and λ^f), two job destruction rates (δ^s and δ^f), the relative weight of consumption and leisure in utility (α), the fraction of type-f workers who do not accept jobs with earnings exceeding the threshold (θ) and the standard deviation of measurement error. Note that the job search framework generates labor elasticities endogenously, we need no additional parameter for this.[23] We observe individuals accepting jobs with very low utility, so that the level of reservation utility must be very low and would not importantly influence job offer acceptance. For simplicity, we set it to zero. The upper bound of support of the wage distribution identifies the underlying productivity of jobs. The productivity level p could be estimated in the model but is very closely related to the highest point in the wage distribution. We choose a value of productivity consistent with the maximum earnings limit in the market for small jobs that we have set.

While the arguments for identification we present here are largely constructive, we implement a more efficient maximum likelihood procedure to estimate the model (see below). The frictional parameters are identified by observed durations in employment or job-seeking. Since type-s workers accept all offers, their job offer arrival rate λ^s is identified by the observed duration of job-seeking. An unobserved fraction of type-f workers also accepts all offers if they have no small job - we denote this group as type-fa. Type-f workers who accept jobs above the threshold are necessarily of type fa. The duration of job-seeking of this observed group identifies the job offer arrival rate of type-f workers, λ^f. Duration in employment (for different types, and including job-to-job mobility) identifies δ^s and δ^f. The job offer distribution is non-parametrically identified from the distribution of accepted earnings by formerly job-seeking type-s workers who accept all jobs.

[23] Labor supply and demand elasticities cannot be calculated separately in our framework. Job creation elasticities could be calculated numerically by simulating changes in the tax rate. We refrain from doing this due to space limitations.

The distribution of realized earnings (in particular, the proportion of earnings below, at, or above the threshold) is informative about the preference parameter α and the proportion of individuals who exclusively accept minijobs, θ. A high θ implies a high fraction of workers who do not accept offers with earnings $z > z^*$, increasing the incentive for firms to offer earnings at or below the threshold. The same is true for a low α, implying a low relative weight of earnings (vis-à-vis leisure) in the utility function. Differences in time spent job-seeking across worker types are also informative of θ. For job-seekers who only accept minijobs (type-fo workers) the probability of a match in any one period is limited by the number of offers below the threshold $\int F^v\left(v(\frac{z^*}{h'}, h')\right) dF^h(h')$, as well as the job offer arrival rate λ^f. For other workers, job finding depends only on λ^f and λ^s, respectively. Conditional on λ^f and the offer distribution, differences in job-seeking durations between type-s and f, and between type-f workers observed to accept wage offers above the threshold and other type-f workers, are then informative about θ.

5.2 Estimation procedure

We use a two-step maximum likelihood procedure. In a first step, the frictional parameters λ^s, λ^f, δ^f and δ^s are estimated based on durations in employment and unemployment. In a second step, the parameters governing the consumption leisure trade-off α, the fraction of type-fo workers θ and the variance of measurement error σ are estimated using a combination of data on durations and earnings. We describe these in turn.

For the **first step** we use workers' duration of job-seeking and workers' duration in employment, i.e. in any sequence of jobs connected by job-to-job transitions and uninterrupted by job loss. The duration in employment is used to estimate the job separation rates following the likelihood contribution in equation (5), which consists of the probability that an employment spell is drawn and the exponentially distributed duration of employment, t_{emp}, with transition rate δ,

$$L^j_{e1}(t_{emp}; j) = \left(1 - \frac{\delta^j}{\delta^j - \lambda^j}\right) (\delta^j)^{1-d} exp[-\delta^j(t_{emp})] \quad \text{for } j \in (s, f), \tag{5}$$

where d is a dummy for censored observations (left- or right-censored). We estimate job offer arrival rates using the duration of job-seeking (see equation (6) where t is spell length). Exclusive minijobbers (type-fo workers), of course, do not accept jobs with $z > z^*$. Their job-seeking duration depends on the whole offer distribution. We therefore only use type-f workers who accept earnings above the threshold.

$$L^j_{u1}(t;j) = \frac{\delta^j}{\delta^j - \lambda^j}(\lambda^j)^{1-d} exp[-\lambda^j(t)] \quad \text{for } j \in (s, fa) \tag{6}$$

The **second step** uses information on durations as well as the distributions of wages and earnings to estimate θ, α and σ. The likelihood of observing jobs with characteristics h, w gives us information about preferences over consumption and leisure, α. The earnings distribution that jobs with these characteristics give rise to informs us about firms' latent offer distribution. Since profit-maximizing firms consider the share of different job-seekers in the population when setting their wages, their offer distribution depends on θ, the share of type-f workers who do not accept any jobs with $z > z^*$. While we know that the endogenous job offer distribution F^v depends on θ, we have no analytic expression for this distribution. In contrast to the non-parametric two-step procedure proposed by Bontemps et al. (1999) we calculate the offer distribution numerically as the solution to the joint profit-maximizing problem firms face and which we solve using a grid-search algorithm (online appendix E provides more details).[24] The resulting endogenous offer distribution then enters as one of the inputs into the likelihood contributions in the second stage.

The likelihood contribution of a small-job seeker without a small job is composed of the probability of having a small job, the spell duration and the realized wage of the following employment spell (if observed, i.e. $d_r = 0$).

$$\begin{aligned} L^j_{u2}(t, \tilde{z}, h; j) = & \frac{\hat{\delta^j}}{\hat{\delta^j} - \hat{\lambda^j}}(D^j_u)^{1-d} exp[-D^j_u\ t] \\ & \left(\int_{-\infty}^{\infty} f^v \left(\frac{z + \eta'}{h}, h \right) dF^\eta(\eta') \right)^{(1-d_r)} \quad \text{for } j \in (s, fa, fo), \end{aligned} \tag{7}$$

where D^j_u denotes the estimated arrival rate of acceptable offers. For $j \in (s, fa)$ it holds that $D^j_u = \hat{\lambda}_j$. For $j = fo$, $D^j_u = \int \hat{\lambda}^j \hat{F^v}\left(v\left(\frac{z^*}{h'}, h'\right)\right) dF^h(h')$. The third part of (7) gives the probability that the accepted job has observed earnings $\tilde{z_u} = z_u + \eta$ where

[24] While Bontemps et al. (1999) similarly have no analytical expression for the job offer distribution they apply the following two-step procedure: First non-parametrically estimate the cdf and pdf of the realized joint wage distribution (G and g). Using these estimates and their relation to the offer distribution, the likelihood contributions can be expressed in terms of the realized wage distribution and the model parameters. Once the transition parameters are estimated from workers' mobility patterns, these are used to transform the realized wage distribution $G(.)$ to the offer distribution $F(.)$ which is the object required in the likelihood. This strategy only exploits equations with respect to *workers'* behavior, the offer distribution is basically treated as exogenous. The endogenous offer distribution is however key to our identification argument, therefore we cannot adopt their strategy.

$\eta \sim N(0, \sigma^2)$ represents measurement error.[25]

The likelihood contribution of a small-job holder is then

$$L^j_{e2}(t, \tilde{z}, h; j) = \left(1 - \frac{\hat{\delta^j}}{\hat{\delta^j} - \hat{\lambda^j}}\right) (\hat{D^j_e}\ (v))^{1-d} exp[-\hat{D^j_e}\ (v)t]$$
$$(\delta^{1-J2J} \hat{\lambda^j} (\hat{D^j_e}\ (v))^{J2J})^{(1-d_r)}$$
$$\left(\int_{-\infty}^{\infty} \hat{g_z}(z_e + \eta') dF^{\eta}(\eta')\right)^{(1-d_r)} \quad \text{for } j \in (s, fa, fo), \tag{8}$$

where $J2J$ indicates whether an uncensored employment spell ends with a job-to-job transition ($J2J = 1$) or a separation ($J2J = 0$). It holds that $\hat{D^j_e}(v) = \hat{\delta^j} + \hat{\lambda^j}(1 - \hat{F}(v))$ for $j \in (s, fa)$. For $j = fo$, $D^j_e(v) = \hat{\delta^j} + \hat{\lambda^j}(1 - \hat{F}(v|z \leq z^*))\hat{F}(z^*)$. The third part is the probability of a separation (δ) or a transition to a better small job ($\hat{D^j_e}(v)$), if observed (i.e. if $d_r = 0$). The last part is the probability that the current job has true earnings $\tilde{z_e} = z_e + \eta$. The joint density of realized wages and hours, g, can be derived from the estimated offer distribution using an appropriately adapted version of the standard relationship between offer and sample distribution, see equation (3) in online appendix A. We observe whether an individual is of type s or f, but we cannot distinguish whether or not a worker would be willing to accept an offer above the threshold (whether she is type-fa or fo) if observed wages are below the threshold or not observed. For $k \in (u, e)$ the likelihood for type-f workers is therefore

$$L^f_{k2}(t, \tilde{z}, h) = \begin{cases} \theta L^{fo}_{k2}(t, \tilde{z}, h) + (1 - \theta) L^{fa}_{k2}(t, \tilde{z}, h) & \text{for } \tilde{z} \leq z^* \\ L^{fa}_{k2}(t, \tilde{z}, h) & \text{for } \tilde{z} > z^* \end{cases} \tag{9}$$

We estimate α, θ and σ by maximizing the likelihood contributions (see online appendix E for further details).

[25] We do not allow for the case that true earnings are below the threshold while observed earnings are above or vice-versa: Intuitively, the observed distribution of earnings drops very sharply at exactly the threshold while it decreases much more gradual to the left (figure 3). We argue that measurement errors are much less likely at the threshold. The earnings level here is very salient and both firms and the social security system face particularly strong incentives to avoid reporting errors here as they may lead to misclassification of workers' SSC & tax status.

6 Results & Counterfactual Simulations

This section presents estimation results, model fit and simulates counterfactual policy reforms. The distributional effects of the minijob policy are highlighted. We predict the effect of removing the minijob tax exemption that benefits only certain workers or smoothing the subsidy rate to reduce the incentive for firms to post offers at the specific minijob threshold. Online appendix G focuses specifically on the externalities implied by equilibrium effects, i.e. how specific groups of workers influence other workers: We contrast our model that includes different types of workers to one in which we only have one type.

We estimate that 37 % of workers without a full-time job (type-f workers) in the market do not accept offers with earnings exceeding the threshold: Roughly 2 million individuals are only in the market due to the tax exemption - an estimate that depends on who exactly we count as market participants, as online appendix H finds.[26]. At first sight the minijob policy thus seems to achieve its main objective of facilitating job creation. Conversely, this also implies that more than 60 % of workers whose main job is a small job would also work if there were no subsidy (the mass of type-fa workers). From the government's point of view the increase in employment thus comes at the expense of less labor supply and lower tax and SSC revenues from this group.

The estimated job separation rate for small jobs is larger for workers who also have a full-time job (type-s) than for workers who only have a small job (type-f, table (6)). Small jobs as second jobs are terminated every 18 months, small jobs of individuals without a full-time job last on average 26 months. Type-s workers receive an offer on average every 30 months while type-f workers receive three job offers per year - workers seeking second jobs may have less time to search for a job.

The elasticity of consumption with respect to utility is 0.86, not statistically different from unity (in line with other studies, see Evans (2005)). The standard deviation of measurement error is estimated to be €71/month. This implies, for example, that about 15 % of jobs with observed earnings of less than €250 actually have true earnings at the threshold. While we could attempt to estimate productivity p from the data, we choose to

[26]While the estimated fraction of type-fo workers may appear large, the composition of individuals who hold minijobs as their only job in the SOEP lends credibility to this figure: We find that 7.7% of minijobbers are retired, 23.0% attend school or university and a further 24.0% have partners with full-time jobs paying at least €2,000. These groups are likely to face strong explicit and implicit costs of exceeding the minijob tax threshold.

calibrate it to the upper tail of our wage distribution for two reasons. First, our definition of the market for small jobs sets the upper earnings limit in the market, which creates a close link to the productivity p. Second, estimating p is numerically costly.[27] We therefore calibrate p to equal the 95th quantile of the observed wage distribution, around €8/hour. The transition parameters are estimated very precisely. Standard errors are larger for the remaining parameters (table (6)). The reason is that standard errors for the latter include the uncertainty rooted in the random elements of the estimation procedure (see section 5).[28]

Table 6: Parameter estimates

	p.e.	s.e.
δ^s	0.0570	0.0005
δ^f	0.0379	0.0002
λ^s	0.0329	0.0002
λ^f	0.2506	0.0028
θ	0.3715	0.0775
α	0.8648	0.1121
σ	71.212	6.963

Notes: p.e. – point estimate, s.e. – bootstrapped standard deviation, λ^j – arrival rate for worker type j, δ^j – job destruction rate of worker type j, α – relative weight of consumption and leisure in the utility function, θ – fraction of type-f workers who do not accept jobs with earnings exceeding the threshold, σ – standard deviation of measurement error

6.1 Model Fit

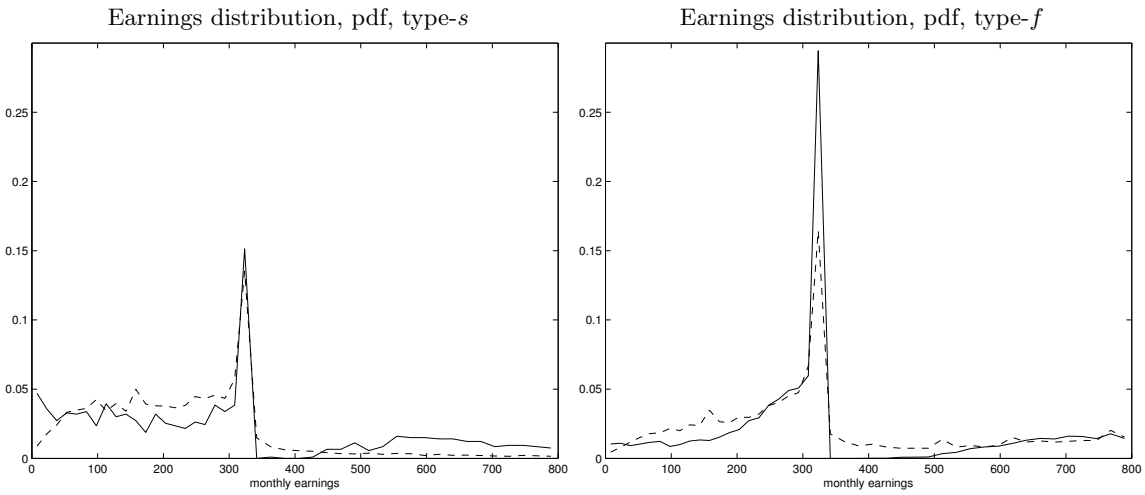
We simulate the market for small jobs based on the estimated parameter values. The predicted earnings distribution reflects the main characteristics of its observed counterpart (figure (6)). For type-f workers it increases gradually up to a discontinuous mass point where it drops sharply. The mass beyond the threshold is relatively small. This is perfectly consistent with the observed distribution. Overall, the mass point is slightly smaller in the data than our model predicts, while for type-s workers the size of the mass point in the predicted and observed distribution almost exactly coincide. Our model also correctly predicts that the earnings distribution is fairly flat to the left of the threshold. By contrast, our model does not predict any mass just above the minijob tax exemption threshold although some workers report earnings here. Given the search frictions in the model, we can account for both first and second-jobbers *accepting* offers here. However,

[27] Estimating p jointly with the other parameters would increase the state space by a further parameter. This is costly in terms of computing time, which is limited at the on-site use of the data provider (see online appendix E).

[28] Precision can be increased by basing these random procedures on more repetitions, e.g. when calculating the offer distribution. Increasing this number of repetitions increases precision but is numerically costly, and computing resources are limited by the on-site use of our data provider.

given the large share of first-jobbers for who these offers are dominated by lower gross earnings, our model predicts that firms should prefer offers with higher or lower earnings. We investigated this phenomenon and find that in the immediate vicinity (€325 - €350) three quarters of spells are actually declared to be tax-exempt despite reporting above-threshold earnings. This is legal for up to three months in case of "unforeseen circumstances". The share of these minijob spells with above-threshold earnings falls rapidly to 30% for the range €350 - €450, and below 10% above that. This can account for some of the mass here that our model fails to predict. For type-f workers that are tax-liable, we found that spells with earnings in the dominated range often reported considerably higher earnings just one year later, suggesting that we are often dealing with a very temporary phenomenon.

Figure 6: Earnings distribution by types of workers



Notes: Type-f workers have or seek a small job and have no other job. Type-s workers have or seek a small job as a second job. The minijob threshold is at €325/month. The solid line represents the predicted distribution, the dashed line the observed one.

The employment probability is fit very well for both worker types (table (7)). The model also correctly predicts that hours, wages and earnings are higher for type-f than type-s workers. The fit of earnings is relatively good.

6.2 Counterfactual Simulations: Remove or smooth tax exemption

We evaluate two policy reform scenarios which remove the discontinuity induced by the minijob tax exemption. First, we simulate completely removing the tax exemption. We find large distributional consequences and assess welfare effects across workers, including as a result of different search behavior. Second, we replace the minijob regulation by a

Table 7: Fit of moments

	small job as second job (s)		no other job (f)	
	Mean		Mean	
	obs	pred	obs	pred
employment ($Pr(e)$)	37.60	37.36	83.79	86.11
earning (z)	223.62	279.91	320.16	365.97
wages (w)	5.56	4.25	5.76	4.54
hours (h)	8.95	13.94	12.84	18.41

Notes: w =hourly wage, h = weekly working hours, z = gross earnings, $Pr(e)$ = employment probability; obs - observed distribution; pred - distribution predicted by simulated model

smoother subsidy schedule which retains the objective of generating employment. Our simulations underline that distortions induced by discontinuous tax policies are not only inefficient, but very unequal. The group that policy-makers may want to help most - workers without any job - may gain most from a budget-neutral removal or smoothing of the tax exemption.

For these policy simulations we need to consider labor demand. When tax exemptions are reduced, all exclusive minijobbers (type-fo workers) leave the market. How many of these jobs are offered to other workers? While some of the workload may be shifted to other workers, this need not always be the case: Jobs may also be lost because the productivity of the activity is too small to allow for an acceptable wage in the absence of the tax exemption. To test the sensitivity of our analysis to labor demand we make two very different assumptions. In the first scenario, we assume that job-finding, alongside job destruction and other transitions, is not affected. This implies that jobs that were offered as minijobs are removed from the market. The number of vacancies in the economy falls in response to the increase in labor costs and the reduction in labor supply - resulting in a constant job-finding rate. In a second scenario (relegated to online appendix F), we assume that the total number of offers per month stays constant. The workload that the minijobbers had carried out is completely shifted to other types of contract. This means that the offer arrival rate increases for the remaining workers.[29]

[29]We do not allow employers to shift their labor demand to the market for full-time employment. If removing the tax exemption does result in a transfer of labor demand from minijobs to full-time jobs, this would tend to make our baseline scenario more likely compared to to the scenario presented in online appendix F. Further alternative scenarios are possible, e.g. assuming fixed and exogenous hours for given firms. The relative size of firms with different hours might then respond to a change in financial incentives. When tax rates increase, for example, leisure becomes relatively more attractive and so firms with smaller hours requirements expand.

Removing the minijob tax exemption

Removing the minijob tax exemption affects workers in several ways: Most obviously, many minijobs are destroyed. Workers who remain in the market must now pay higher taxes. Firms' responses are significant: The earnings offer distribution becomes smooth when the tax exemption is removed (left panel of figure (7)). The first effect is expected: Since jobs with earnings above the threshold become relatively more attractive for workers, firms offer more of these jobs. Average gross earnings and hours of remaining workers increase (table (8)) as lower-paid only-minijobbers (fo workers) leave the market for small jobs. There is a second effect: The fraction of offers *below* the threshold increases as well. Why are there more offers with low earnings? Our results show that workers who additionally hold a full-time job (type-s workers) receive fewer offers of small jobs than type-fo workers (see table (6)). Since the latter have now left the market, there is now less to be gained by posting relatively high utility offers below the threshold. The likelihood that another firm outbids a job offer has decreased. In this sense, the new equilibrium is less competitive.

Total hours and gross earnings decrease by roughly 23 % and 16 %, respectively (table (8)). Tax revenues increase by €110 million, creating scope for compensation. When the additional tax revenue is equally distributed to all individuals by tax-free lump-sum transfers, net earnings and utility of remaining workers in the market (types s and fa) would increase strongly (table (8)). The tax exemption has redistributive effects: Workers who would not otherwise work (in particular, individuals with rich spouses, students and pensioners) gain at the expense of workers seeking small jobs independent of any tax exemption.

Table (8) highlights the different effects that removing the tax exemption has for the different groups. First, when the tax exemption is removed, a fraction of minijobbers (governed by θ) leave the market - we estimate that this concerns 1.9 million jobs - their welfare is naturally strongly negatively affected by such a reform, (see column IV of table (8)).[30]

[30]Note that our strategy contrasts to two frequently used methods to analyze tax exemptions such as minijobs: First, often the total number of minijobs is taken as the extent of the job creation due to the exemption. This assumes that *all* minijobs would be destroyed. Second, bunching estimators assume that tax exemptions only affect earnings and not participation.

Second, column II shows the effects on workers for whom the small job is a second job (type-s). These individuals are only affected via equilibrium responses. While average hours increase slightly, the broader distribution of gross earnings leads to lower average earnings for this group characterized by strong search frictions. (We note below that this earnings distribution is found to be beneficial to the group of workers who have no other job (type-fa)). Nevertheless, if the increased tax payments are redistributed across the participating workers, the group of second jobbers can also be made better off as a result of the reform.

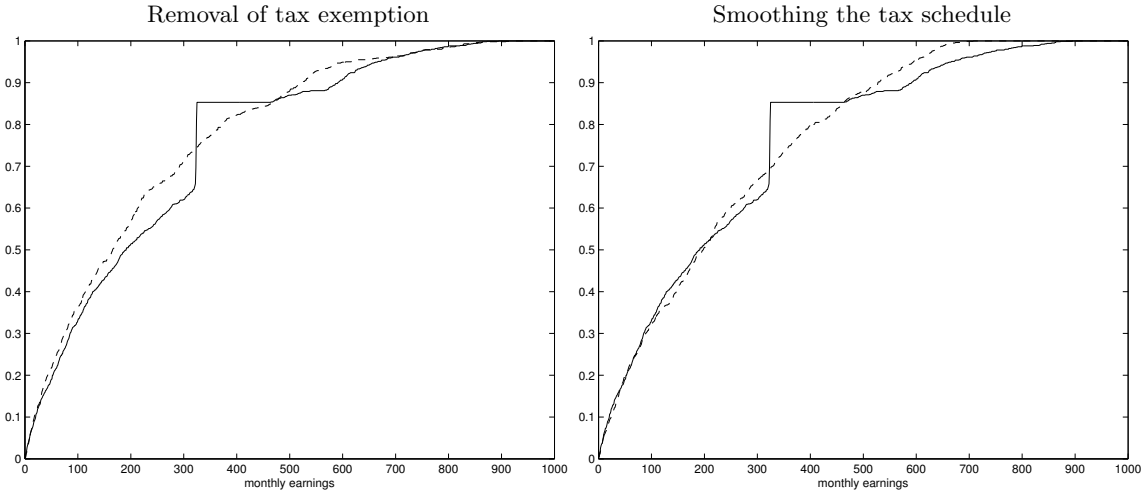
Third, for the group of individuals who accept small jobs beyond the threshold (type-fa), the tax exemption constituted a windfall gain. Thus column III of table (8) shows that while gross earnings increase by 11.65%, net earnings c and welfare decrease. Why are workers who are searching for a second job (type-s) affected so differently from those without (type-fa)? Without the minijob threshold, firms offer more low-paying jobs with earnings below the threshold. Starting earnings (and wages) out of unemployment decrease, opportunities of career advancement increase, though, as firms offer more jobs with earnings above the threshold as well. The latter is mainly beneficial for workers with no full-time job who accept offers above the threshold (type-fa workers), as they move up the income ladder quicker (benefiting from a higher job offer arrival rate).

In summary, equilibrium effects of the minijob policy go beyond inciting firms to post wages below the threshold: While the population of exclusive minijobbers creates a particular incentive for firms to offer minijobs rather than higher-paying jobs, the increased competition in the market also creates an incentive for firms to offer higher wages *up to* the minijob threshold. In particular, workers with second jobs benefit more from the positive externality of receiving more offers than they lose due to many offers being tailored to people who benefit from the minijob threshold. The minijob threshold is particularly costly for those workers who do not additionally have a full-time job and are willing to earn more than a minijob. This is problematic as this may be the group that policy-makers would most want to encourage working more.

Smoothing the tax schedule

Tax exemption policies can be designed to increase labor market participation without the costs involved in discontinuous thresholds, in particular the large marginal taxes this

Figure 7: Cumulative earnings offer distribution - status quo vs. counterfactual



Notes: The solid line represents the status quo, the dashed line the counterfactual. The minijob threshold is at €325/month where the solid lines feature a jump. The left panel analyzes the entire removal of the tax exemption; the right panel the replacement of the notch by a kink. Data source: SIAB

Table 8: Counterfactual policy simulations

	Removal of tax exemption				**Smoothing the tax schedule**			
	I	II	III	IV	V	VI	VII	VIII
Change in	overall	type-s	type-fa	type-fo	overall	type-s	type-fa	type-fo
mean hourly wages $\bar{w}$ (€)	**0.23**	-0.20	0.34	.	**0.08**	0.08	0.16	-0.04
mean weekly hours of work $\bar{h}$	**11.92**	0.96	2.13	.	**7.57**	1.02	0.91	21.49
total hours of work $\sum_i^N h_i$ (%)	**-22.58**	0.44	1.67	-100	**10.04**	1.69	0.98	38.87
mean monthly gross earnings $\bar{z}$ (€)	**91.70**	-4.56	52.81	.	**37.97**	5.30	8.99	99.97
total earnings $\sum_i^N z_i$ (%)	**-15.62**	-2.74	11.65	-100	**10.94**	1.89	2.10	40.03
mean net earnings $\bar{c}$ (€)	**18.79**	-2.66	-7.55	.	**41.54**	3.50	28.43	77.23
mean utility $\bar{v}$	**6.34**	-3.72	-6.47	-199.34	**28.45**	3.58	20.67	36.08
jobs (1000s)	**-1644**	0	0	-1644	**13.5**	0	0	13.5
total monthly taxes (€ million)	**110.56**	-2.39	199.17	-86.21	**23.13**	1.54	-50.08	71.67
After lump-sum transfers - budget neutral								
$\bar{c}$	**35.51**	14.06	9.16	.	**45.04**	7.00	31.92	80.73
$\bar{v}$	**53.00**	40.02	41.48	-174.02	**71**	36.56	64.64	78.32

Notes: $\bar{w}$, $\bar{h}$, $\bar{z}$, and $\bar{c}$ conditional on employment; utility $\bar{v}$ not conditional on employment; Estimates of changes in number of jobs and tax revenues based on extrapolations from the sample to the population; Type-s workers have or seek a small job as a second job. Type-fa workers have or seek a small job, have no other job and would accept any small job. Type-fo workers have or seek a small job, have no other job and accept only minijobs.

generates. In the following we simulate a reform which replaces the minijob regulations by a smooth subsidy schedule, which again only applies to workers without a full-time job. Average tax rates increase gradually in the interval between €325 and €800 up to their full values. The complete tax exemption below €325 remains. The notch is thus replaced by a kink. The objective is to prevent additional distortions induced by a discontinuous tax schedule while retaining positive employment effects. Note that the withdrawal of the subsidy implies high implicit marginal tax rates in the interval between €325 and €800.

This hypothetical reform makes the tax schedule more generous, raising the possibility that additional workers (akin to type-fo) participate in the market. We make two assumptions regarding labor supply. We assume, first, that no individuals enter the labor market due to tax subsidies beyond €325. Second, we postulate that the group of exclusive minijobbers (type-fo workers) gradually choose not to participate in the labor market when earnings – and therefore average taxes – increase. In the status quo, type-fo workers do not accept any jobs with earnings above the threshold. Now, the average tax rate only increases gradually with earnings beyond the threshold. Type-fo workers will thus also accept some jobs above the threshold. We assume a uniform distribution of new earnings cut-offs beyond which different workers choose no longer to participate. Formally, $\theta\,(1-H(z))\,n_f$ workers accept a job offer with earnings z, where $H(.)$ is defined as follows:

$$H(z) = \begin{cases} 0 & \text{for } z \in (0, 325) \\ \frac{z-325}{800-325} & \text{for } z \in (325, 800) \\ 1 & \text{for } z > 800 \end{cases} \tag{10}$$

The resulting earnings offer distribution is smooth (right panel of figure (7)). Most firms that offered jobs at the threshold in the status quo now offer jobs with higher earnings. The profile of the offer distribution is now steeper; the highest earnings offer is considerably lower than in the status quo. The reason is twofold. First, the high implicit marginal tax rate induced by the withdrawal of the subsidy creates an incentive for workers to reduce earnings. Second, a marginal increase in offered earnings now results in a marginal decrease of exclusive minijobbers (type-fo workers) also above the threshold.

Relative to the status quo minijob threshold, all types of workers increase their average gross earnings (table (8), right panel). This is driven by both wage rates and hours. Gross earnings of type-fo workers increase most, the average monthly increase (€9) for type-fa workers is fairly modest, especially compared to the increase resulting from the removal of the tax exemption (€52.81). Despite removing the threshold, a high implicit marginal tax rate remains and has a negative impact on labor supply, as has been found for other policies that incite labor market participation (Bargain et al., 2010).

In terms of utility, all workers without full-time jobs benefit substantially from the reform. Besides the modest increase in gross earnings, workers who accept jobs above the threshold (type-fa workers) benefit from the additional tax subsidies beyond €325 leading to substantially higher net earnings. Exclusive minijobbers (type-fo workers)

benefit from a slight increase in acceptable offers below the threshold. As workers with an additional full-time job (type-s workers) are not eligible to the new tax reductions, their increase in utility is much smaller but still positive. The smoothing of the discontinuity is beneficial for workers not directly affected. Overall hours and gross earnings increase by approximately ten percent. Although taxes have been reduced, total tax revenue increases by €23 million per month. From the government's point of view, the positive behavioral responses more than compensate for the increase in generosity of the tax schedule. A budget neutral version of the reform redistributes the additional tax revenues evenly to all individuals as lump-sum transfers, increasing net earnings and utility for all types of worker (table (8)). Beyond underlining how inefficient the discontinuity of the minijob policy is, the burden is higher for workers we may care most about, i.e. those who would be willing to work more and have no second jobs. A smoother tax schedule would benefit all those who do not only seek minijobs.

7 Conclusion

We present a simple equilibrium job search model to analyze an important discontinuous tax policy. Profit-maximizing firms tailor their take-it-or-leave-it offers such that they are attractive to the substantial group of workers in this market who benefit from a tax exemption on low earnings. This also affects people whose labor costs are not directly affected by the policy. We apply our model to a setting where we observe strong reactions to a tax exemption for workers with low earnings. In Germany, earnings below a threshold are exempt from income tax and employees' SSC, generating a substantial discontinuity in the budget set. The so-called minijob policy aims at increasing employment but is found to have significant equilibrium effects and distributional consequences, presumably at odds with policy-makers' intentions.

We set-up an equilibrium job search model which shows how a discontinuous tax schedule can rationalize an earnings distribution which features mass points in earnings for workers to whom the tax exemption does not apply. We structurally estimate our model exploiting this specific institutional setting. We find that 1.9 million people only take on a small job due to the tax exemption.

Lower earnings of already employed individuals are a well-known side effect of tax policies promoting labor market participation like the Earned Income Tax Credit in the US or the Working Family Tax Credit in the UK (Blundell, 2000; Bargain et al., 2010).

We show that firms contribute crucially to these negative side effects, that firms' reactions are not uniform and that distributional consequences are moderated by search frictions. Firms' responses represent reactions to labor supply preferences. We thus complement other work which discusses how unintended consequences of making work pay policies unfold in equilibrium (Rothstein, 2010; Leigh, 2010; Kolm and Tonin, 2011; Tazhitdinova, 2020).

Our counterfactual policy reforms show that apart from creating jobs, the tax exemption has substantial equilibrium effects on other workers. A first scenario completely removes the tax exemption. Workers only interested in minijobs (e.g. students, retirees) drop out of the market. Remaining workers include those without any job and those looking for a second job. Because workers without any job search more, they benefit from the greater variance in earnings, with average earnings increasing by around 11%. By contrast, earnings of workers seeking a second job decline after the reform. In a second reform scenario, we replace the minijob tax threshold by a smooth subsidy schedule. This prevents the distortions generated by a discontinuous tax schedule while retaining the positive employment effect. This reform prevents a mass point in earnings at the threshold, increasing total earnings by over ten percent and - although the new tax schedule is more generous - increasing total tax revenues as well, improving welfare for all groups of workers. Workers who have no other job again gain more than workers seeking a second job.

The minijob policy creates an abundance of job offers at the threshold which benefits some while hurting others. First and most obviously, individuals who only seek minijobs (e.g. students, retirees and spouses of rich partners) benefit at the cost of workers who would want to work more. Second, and contrary to simpler models of bunching, firms do not respond to the tax exemption by uniformly decreasing earnings. The greater variance in earnings that we find as a result of removing the tax exemption affects people differentially according to their search effort. The tax exemption studied here was reformed in 2003. However, the strong discontinuity has remained, such that equilibrium effects and their welfare consequences across different groups can be expected to perdure.

The assumptions underlying our analysis should be kept in mind when interpreting these results. Small job workers may differ along more dimensions than those we allow for. In particular, we do not consider how workers' earnings in full-time jobs or other

household income may influence their preferences over small jobs. Also, non-financial considerations may play a role for certain holders of small jobs: For example, retirees may be happy to remain active on the labor market, implying different leisure preferences compared to other small-job holders. These limitations explain why our welfare analysis focuses on comparisons across groups and why we do not attempt to determine an optimal tax schedule. We leave this, alongside an integrated analysis of both the markets for small jobs and full-time employment, to further research.

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