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Essays in Public Finance

by

Alisa Tazhitdinova

A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy in Economics in the Graduate Division of the University of California, Berkeley

Committee in charge:
Professor Emmanuel Saez, Chair
Professor Alan Auerbach
Professor Hilary Hoynes

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Essays in Public Finance

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Alisa Tazhitdinova
Abstract

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Doctor of Philosophy in Economics

University of California, Berkeley

Professor Emmanuel Saez, Chair

In this thesis I explore how the elements of tax systems affect individuals’ behavior. The goal is to enhance our understanding of how tax responses are affected by search and adjustment costs, information frictions, hassle costs and behavioral biases in general.

In the first chapter, I provide theoretical and empirical evidence on the importance of statutory incidence in labor markets in presence of asymmetric frictions. Using a theoretical model I show that labor supply responses are stronger when the statutory incidence of taxes or labor rules falls on firms. The asymmetry of response stems from the assumption that firms have a greater ability to respond to incentives than workers because it is easier for firms to change working hours. The result holds even if wages adjust to equalize differences in labor costs stemming from taxes and regulations. I explore these mechanisms by studying labor responses to incentives generated by the “Mini-Job” program aimed at increasing labor supply of low-income individuals in Germany. Using administrative data, I show evidence of a strong behavioral response – in the form of sharp bunching – to the mini-job threshold that generates large discontinuous changes both in the marginal tax rates and in the total income and payroll tax liability of individuals in Germany. Sharp bunching translates into elasticity estimates that are an order of magnitude larger than has been previously estimated using the bunching approach. To explain the magnitude of the observed response, I show that in addition to tax rates, fringe benefit payments also change at the threshold. Using a large survey of businesses and a household survey, I compare wages and fringe benefits around the mini-job threshold and find that mini-job workers are paid higher gross wages but receive smaller yearly bonuses and fewer vacation days than regular workers. These results indicate that lower fringe benefits make mini-jobs attractive to employers, thus facilitating labor supply responses in accordance with the model’s predictions.

In the second chapter, I study behavioral responses to changes in marginal tax rates of social security and income taxes. I find that responses depend on individual’s employment status: whether a worker is a wage earner, self-employed, or a proprietor. In line with the existing literature I document weak (but statistically significant) bunching at kink points of the tax schedule among wage earners. Starting from 1999, wage earners accumulate
pension credits when they exceed a certain threshold, however, no contributions are due until earnings reach a second, higher threshold. Even 10 years after this reform I find no bunching to the right of the eligibility threshold, suggesting that individuals do not assign a high value to pension benefits. Lack of bunching is persistent across age groups and unlikely to be explained by friction costs as individuals are able to bunch at other kink points. I find strong responses to tax incentives among the self-employed but the responses differ by the type of kink. I find sharp bunching at the first kink, medium bunching at the top kink and weak bunching at the middle kink. Comparing responses before and after a tax reform that changed the magnitude of kinks I find that self-employed individuals aggressively reduce earnings to bunch at the lower, more salient kink points.

In the third chapter, I study information reporting, which has been argued to be an effective tool against evasion. However, even the simplest reporting requirements can prove to be costly to taxpayers. The trade-off between evasion and compliance costs suggests that reporting rules should only be imposed on a subset of the population. In this paper I address the question of how to optimally determine such reporting thresholds. In the first part of the paper I use a natural experiment to document that reporting rules are indeed costly to taxpayers but are successful at reducing evasion. I study a reform that simplified reporting rules for an income tax deduction of noncash charitable contributions in the U.S. Relying on a revealed preference approach, I find that relaxing reporting requirements led to a steady increase in reported donations but that nearly 50% of these new donations were untruthful. The tax revenue loss, however, was offset by substantial savings for taxpayers because reporting requirements impose substantial hassle costs: $90 on average per person. In the second part of the paper I develop a framework which allows me to characterize optimal reporting thresholds. I show that the determination of optimal thresholds should take into account the utility loss from reporting experienced by individuals and a loss in externality benefits from charitable giving against the tax revenue loss generated by evasion. The size of a reporting threshold is primarily governed by the type and magnitude of cheating. Calibrations of the model shows that in the case of noncash charitable donation deductions, the optimal threshold is more than twice lower than the threshold chosen by the government.
To my parents.
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Chapter 1

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

1.1 Introduction

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

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

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

\footnote{It has been shown in many settings that firms take advantage of customer bias, e.g. DellaVigna and Malmendier (2004), Gabaix and Laibson (2006), Ellison and Ellison (2009). See also}
mitigate frictions, e.g. by informing workers. In this paper I challenge the traditional view that the statutory incidence of taxes and other labor costs is irrelevant in labor markets. Instead, I argue that in the presence of frictions, statutory incidence matters through its effect on firm incentives. Taxes, which statutory incidence falls on firms, generate short-run incentives to hire workers of the tax-advantaged type. These incentives allow firms to act as a conduit to workers’ preferences, facilitating labor supply responses. On the other hand, taxes, which statutory incidence falls on workers, do not distort relative wages and therefore do not generate such incentives, leaving it up to workers to find their desired jobs.

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

To estimate the magnitude of the behavioral response, I extend the methodological approach of Saez (2010) and Kleven and Waseem (2013) to frameworks with large discontinuous marginal and average tax rate changes. The approach separately accounts for the bunching due to a kink and due to a notch, thus generating an unbiased estimate of the earnings elasticity. Elasticity point estimates range from 0.20 to 0.37 for women and from 0.09 to 0.25 for men, depending on the year. Calculated elasticities are 5 to 10 times larger than has been previously estimated using the bunching method and are more in line with other studies in the labor supply literature. To explain the magnitude of the observed response, I focus on firm incentives. I find that prior to 2003, when cumulative earnings were subject to the mini-job threshold, individuals with multiple jobs and at least one regular job were still bunching at the mini-job threshold. Since these individuals have no incentive to bunch, the presence of a substantial excess mass at the threshold presents direct evidence of firms’ response to mini-job rules.


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

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

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

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

Such firm response has been termed “firm bunching” and has been first documented by Chetty et al.
To better understand how firm incentives can affect the magnitude of labor supply responses, I develop a partial equilibrium tax incidence model with job search costs and endogenous hour constraints. In the model, firms offer two types of contracts: regular jobs subject to high taxes, and mini-jobs which are bound by an earnings threshold but are subject to lower taxes. Employees draw job offers from the aggregate distribution of hour-contract combinations offered by firms and accept or reject offers based on individual consumption-leisure preferences and job-search costs. I show that in the presence of search costs, the magnitude of labor supply responses depends on the statutory incidence of taxes and the elasticity of substitution between the individuals working in different tax regimes.

The theoretical model predicts that in the presence of search costs, labor supply responses will be stronger if the statutory incidence of taxes or other labor costs falls on firms rather than workers. Since the statutory incidence of mini-job tax breaks falls on workers, I consider two other types of costs which statutory incidence falls on firms. First, lax labor enforcement might allow firms to reduce fringe benefit payments to mini-job employees as compared to other workers as has been suggested by survey evidence. Second, employers might find mini-jobs attractive because they allow for more flexibility both at the extensive and intensive margins. I investigate these channels using a firm and household survey data that provide information on working hours and earnings of employees in Germany. I find that while many mini-job workers are paid substantially less than the part-time workers liable for social security contributions, at the threshold, gross wages paid to mini-job workers are approximately 6% higher than gross wages paid to regular part-time workers. In addition, I find that mini-job workers receive smaller yearly bonuses and fewer vacation days than regular employees, suggesting that higher gross wages paid to mini-job workers reflect the lower fringe benefit payments they receive. Next, I rule out the second channel (flexibility of hours) by showing that mini-job workers have more stable employment than regular part-time workers. These findings indicate that in addition to tax rates, fringe benefit payments also change at the threshold. Because the statutory incidence of fringe benefits falls on firms, differences in fringe benefit rates make mini-jobs attractive to employers, thus facilitating labor supply responses in line with the model’s predictions.

The results of this study are policy relevant for two reasons. First, understanding the seeming popularity of mini-jobs is important because similar types of policies have been proposed in other countries. It has been further argued that the flexibility of the German labor market system, and the existence of mini-jobs in particular, are the reasons why...
CHAPTER 1. FIRM INCENTIVES AND LABOR RESPONSES TO TAXES

Germany fared in the Great Recession better than other countries. Second, since the statutory incidence of taxes is relatively easy to change, the results in this paper suggest that statutory incidence can be used as a policy tool and the choice of statutory incidence should depend on the outcomes the government is trying to achieve. If the policymakers would like to reduce distortions arising from taxes and labor rules, taxes and rules should apply to workers. The results of this paper caution against policies that give employers incentives to hire certain tax-advantaged groups. Mini-jobs in their current form incentivize people to enter the labor force but then stay locked in in low-paying jobs. On the other hand, if the government wishes to stimulate job creation, giving incentives directly to firms might lead to faster employment, because such policies generate immediate incentives to hire workers, instead of relying on workers’ ability to put downward pressure on equilibrium wages.

This paper contributes to several literatures. An emerging literature in public finance shows that adjustment frictions and search costs (Chetty et al. (2011), Chetty (2012), Gelber et al. (2013), Kleven and Waseem (2013)), as well as information frictions (Chetty and Saez (2013) and Chetty et al. (2013)) can affect the magnitude of responses to taxes. This paper is the first to show how the interrelationship between the statutory incidence of labor costs and search costs affects labor supply responses to taxes. Several papers show the economic incidence of taxes and the tax revenue collected may vary with the statutory incidence and remittance mechanism if the ability to evade or avoid taxes varies across economic agents (Slemrod (2008) and Kopczuk et al. (2013)) or if the salience of taxes depends on the statutory incidence (Chetty et al. (2009)). This paper contributes to the literature by explaining the mechanism through which statutory incidence of labor costs can affect the magnitude of labor supply responses to taxes and provides empirical evidence supporting the model’s predictions.

This paper also contributes to a small literature that studies the role of firms in workers’ earnings responses to taxes. Kopczuk and Slemrod (2006) stress that firms’ central role in the tax collection process should not be overlooked. Chetty et al. (2011) show that firms help workers respond to taxes by tailoring the distribution of hours offered to workers’ preferences. Similar evidence has been found by Best (2014) in Pakistan. This paper argues that when the statutory incidence of labor taxes falls on employers, firms will offer more jobs of the tax-advantaged type and as a result the distribution of offered hours is more likely to resemble the distribution of hours preferred by workers. This paper shows that firms’ incentives are important even in circumstances where wages are able to adjust freely and the economic incidence of taxes does not change with the statutory incidence.

This paper also closely relates to the vast literature that estimates how measures of labor supply respond to taxes and to various programs that aim at increasing labor supply of low-income workers. While the approach taken in this work is closest to stud-

\[ \text{See Burda and Hunt (2011) for a review.} \]

\[ \text{A related literature argues for superiority of the value-added tax (VAT) over the retail sales tax. The efficiency of VAT stems not only from the differences in ability to evade, but also from the self-enforcing nature of the VAT payment and refund process. See de Paula and Scheinkman (2010) and Pomeranz (2013).} \]
CHAPTER 1. FIRM INCENTIVES AND LABOR RESPONSES TO TAXES

ies that estimate elasticity of taxable income (e.g. Saez (2010), Chetty et al. (2011), and Kleven and Waseem (2013)), I estimate an elasticity of wage earnings, which can be directly compared to other labor studies that measure changes in hours (e.g. MaCurdy (1981), Eissa and Hoynes (2006), Blundell et al. (1998) and Ziliak and Kniesner (1999)). This paper makes a methodological contribution by showing how the elasticity of earnings can be estimated in the presence of large kinks and notches. By looking at a subset of single individuals, who only experience changes in social security taxes at the mini-job threshold, this study also contributes to a smaller literature that estimates responses to payroll taxes specifically (Gruber (1997), Saez et al. (2012), Liebman and Saez (2006), Lehmann et al. (2013) and Tazhitdinova (2015)). The results in this paper suggest that it is unlikely that workers value social security benefits at actuarially fair rates. This paper also provides evidence on the distortionary nature of tax notches and suggests that a policy that is effective at increasing labor supply at the extensive margin may lock in workers in low-paying jobs due to strong phase-out incentives. I argue that this lock-in effect may be very strong when the statutory incidence of some tax breaks falls on the employers.

Finally, the paper makes several contributions to a literature that specifically studies mini-jobs in Germany. First, this paper documents a large bunching at the mini-job threshold. Second, it calculates the magnitude of behavioral responses by estimating an elasticity of earnings with respect to net-of-tax rate. Third, this paper provides compelling empirical evidence that mini-jobs are attractive to firms because of the lower fringe benefit costs. Previous studies, see Bachmann et al. (2012) and Wippermann (2012), relied on small surveys of mini-job workers and found that mini-job workers are less likely to receive benefits such as vacation, holiday and sick day pay. These studies, however, surveyed mini-job workers only, providing no evidence as to whether the benefits are not given to mini-job workers specifically, or part-time workers in general.

The rest of the paper is organized as follows. Section 2 explains the institutional setting and provides an overview of the labor market in Germany. In Section 3 I provide evidence of behavioral responses to the mini-job threshold and estimate earnings elasticities with respect to net-of-tax rate. Section 4 presents a partial equilibrium tax incidence model with job search costs and endogenous hour constraints. I show how the statutory incidence

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

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

16 Several other papers study the substitutability of regular and mini-jobs. For example, Bauer and Riphahn (2002) study the effect of payroll taxes and mini-job rules on labor demand using dynamic factor models and found little effect of payroll taxes on employment levels. Freier and Steiner (2010) estimate that the own-wage elasticities for marginal employment range between 0.13 for male workers and 1 for women. Jacobi and Schaffner (2008) study substitutability of regular employment by mini-job positions. They detect high substitution elasticities with respect to three skill categories of regular employment in both time periods and find that the substitutability of unskilled full-time workers increased significantly after the reform.
of taxes affects labor responses in presence of search costs. Section 5 provides empirical support to the assumptions of the model and shows that in addition to tax rates, fringe benefit payments also change at the threshold. Section 6 concludes with policy implications.

1.2 Institutional Setting

Marginal employment\footnote{In German: \textit{Geringfügige Beschäftigung}.} or, as they are more commonly known, \textit{mini-jobs}, have existed in Germany since 1977. From 1999 until April 2003 mini-jobs were defined as jobs in which employees earned less than €325 per month and worked less than 15 hours per week\footnote{There are two types of marginal employment in Germany: employments with earnings below the mini-job threshold (which are the focus of this paper) and short-term marginal employments, in German \textit{kurzfristige Beschäftigung}, which are not subject to an earnings limit but are limited in duration to 50 working days or two months per year. This second type of employment is significantly less popular than mini-jobs and is not the focus of this paper.}. The employer paid 22% social security tax while the employee was exempt from \textit{both} social security and income taxes. Marginal employment thus offered substantial savings compared to regular jobs that were subject to approximately 40% social security tax which was equally split between the employees and employers. If individuals hold several mini-jobs, the threshold applied to the sum of earnings. If earnings exceeded the mini-job threshold, employees were subject to the usual rules – both in terms of social security contributions and income taxes – on the entire earnings. Because the employer portion of regular social security tax fluctuated around 20%, crossing the €325 threshold had negligible effects on the employer’s tax liability. On the other hand, the €325 threshold represented a large notch for employees: workers immediately incurred the full employee portion of social security taxes (roughly 20%) on the entire amount of earnings and could be liable for large income taxes if married\footnote{In Germany, married couples are taxed based on the joint income, though there is no marriage penalty. The income schedule for married couples is based on brackets that are twice the size of single individuals. However, spouses may elect, if they choose, to be taxed separately.}. For mini-job workers with high-earning spouses, the €325 threshold represented a very large notch, since the entire earnings were subject to the spouse’s top marginal tax rate.

The Hartz II reforms introduced on April 1, 2003 made mini-jobs more attractive by abolishing the hour constraint and increasing the monthly earnings limit to €400\footnote{For a comprehensive review of the Hartz reforms in English see \cite{jacobi2006}. For a review of the labor market policy in Germany in 1991–2005 see \cite{ebbinghaus2007}.}. The employer’s social security tax rate on mini-jobs was increased from 22% to 25%. In addition, the reform smoothed the social security notch at the new threshold by introducing \textit{midi-jobs}. Upon exceeding the €400 threshold workers enter midi-employment which subjects them to lower social security taxes than regular jobs\footnote{The total amount of tax to be paid when one earns between €400 to €800 is equal to \[400 \cdot \frac{\tau_{\text{Mini}}}{\tau_{\text{Full}}} + (2 - \frac{\tau_{\text{Mini}}}{\tau_{\text{Full}}})(X - 400)\] · \(\tau_{\text{Full}}\), where \(X\) is individual’s income, \(\tau_{\text{Mini}}\) denotes the prevailing mini-job tax rate and \(\tau_{\text{Full}}\) denotes the prevailing full social security tax rate. Because employers are still responsible for their usual share of taxes, the employees’ tax amounts to \[400 \cdot \frac{\tau_{\text{Mini}}}{\tau_{\text{Full}}} + (2 - \frac{\tau_{\text{Mini}}}{\tau_{\text{Full}}})(X -)\].}. The reduced tax liability is fully phased out
up on reaching €800, at which point both employees and employers are subject to regular social security taxes. The mini-job rules thus substituted the notch in the total amount of social security tax due (by employees and employers) with a kink. The reform, however, did nothing to smooth the tax notch in the income tax liability of married individuals: the reduced mini-job rate does not apply to income taxes.

The mini-job threshold, social security tax rates and average income tax rates are summarized in Tables 1.1 and 1.2. The budget constraints of individuals are shown in Figure 1.1.

The 2003 reform also allowed workers in regular employment to hold one mini-job tax-free. While multiple mini-jobs are still added up to determine one’s social security tax liability, individuals who hold at least one job subject to regular social security taxes, i.e. earning more than €400, can now hold an additional mini-job that would be subject to the mini-job rules. The reform thus made mini-jobs an attractive addition to workers in regular employment, allowing them to earn extra income without paying social security or income taxes on that income. The mini-job contribution rate was further increased from 25% to 30% on July 1, 2006, but the €400 threshold remained intact until April 1, 2012, at which point the €400 and €800 thresholds were increased to €450 and €850 respectively.

It is worth noting that while employers pay “social security” taxes on mini-job earnings, these contributions do not qualify mini-jobbers for social security benefits. In other words, employees in marginal employment do not earn pension and unemployment credits and do not qualify for medical insurance on their own record. Only upon exceeding the €325 or €400 respectively, do employees qualify for medical insurance and start earning credits. However, there are several ways mini-jobbers can obtain social security benefits while in marginal employment. First, spouses of workers in regular employment qualify for medical insurance on their spouse’s behalf; a similar rule applies to children under age 18 and students under age 25. Second, all individuals qualify for unemployment assistance or means-tested social support. Both types of assistance, which were merged in 2005 into a means-tested, flat-rate unemployment benefit II, provide individuals with monthly stipends and medical insurance. Contrary to unemployment insurance which is contributory-based, unemployment assistance and social support, were and remain to be non-contributory.

400)] \cdot \tau_{Full} - 0.5 \cdot \tau_{Full} X.\) Once the earnings exceed €800, individuals pay regular social security taxes, i.e 0.5 \cdot \tau_{Full} X each.

\(^{22}\)In German: Arbeitslosenhilfe and Sozialhilfe respectively.

\(^{23}\)In German: Arbeitslosengeld I.

\(^{24}\)The aforementioned reform of unemployment benefits was introduced on January 1, 2005. Prior to 2005, individuals receiving unemployment benefits or unemployment assistance were allowed to keep their benefits as long as they worked less than 15 hours per week. Earnings below the larger of €165 per month or 20% of one’s previous earnings did not affect one’s unemployment insurance payments, but earnings above that limit were withdrawn at a 100% rate. After the 2005 reform, individuals receiving contributory-based unemployment benefits continued to be subject to the €165 limit. At the same time, those receiving newly created unemployment benefits II were subject to a lower limit of €100. Any earnings above the €100 limit, however, were subject to an 80% withdrawal rate up to a gross income of €800 and 90% above. Besides changing the exemption limits, the unemployment benefit reform has also decreased the generosity
CHAPTER 1. FIRM INCENTIVES AND LABOR RESPONSES TO TAXES

It is important to point out that prior to January 1, 2015 Germany did not have a universally applicable minimum wage. Instead industry-specific minimum wages were established through bargaining by respective labor unions. These bargaining agreements covered a large number of full-time workers, however, were not necessarily applicable to part-time workers and especially mini-job workers because coverage depends on workers’ union membership. As I show in Section 1.5 most mini-job employees work less than 15 hours per week and earn between €7 to €10 per hour. However, some mini-job employees report working nearly full-time hours and earning less than €4 per hour.25

1.3 Behavioral Responses to the Mini-Job Threshold

Conceptual Framework

Previous studies have treated kinks, discrete changes in marginal tax rates, and notches, discrete jumps in the overall tax liability, in isolation. The bunching approach pioneered by Saez (2010) allows researchers to calculate the elasticity of taxable income with respect to the net-of-tax rate by estimating the excess mass at the kink of the tax schedule. The approach relies on the fact that the definition of elasticity implies a proportional relationship between the elasticity and the amount of excess mass at the tax threshold in the distribution of earnings. Saez (2010) applies the method to study responses to kinks in the personal income tax and Earned Income Tax Credit schedules in the U.S. Kleven and Waseem (2013) have extended the bunching method by applying it to small notches in the personal income tax schedules in Pakistan. Both approaches rely on the ability of a researcher to credibly estimate the counterfactual distribution – hypothetical earnings distribution in the absence of tax change – and therefore bunching at the kink or notch. But while kinks and notches both lead to bunching at the threshold they have different implications on the shape of the counterfactual earnings distribution. A kink leads to a leftward shift in the distribution of the earnings, resulting in no missing mass to the right of the threshold.26 A notch, on the other hand, generates a strictly dominated region of earnings to the right of the threshold and therefore leads to a missing mass. Therefore, kinks and notches require different approaches to recover the counterfactual distribution. When estimating elasticities, Kleven and Waseem (2013) explicitly assume that the entire response is driven by the notch and therefore the entire bunching could be redistributed to the right of the threshold to recover the counterfactual earnings density. Because the authors study small discrete changes in the proportional of unemployment benefits (both type I and type II) and decreased the duration of type I unemployment benefits. Overall, the reform incentivized the return to the labor force.

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

26 While there will be no missing mass, there could be a discontinuous jump or a drop in the distribution of observed earnings depending on whether the counterfactual distribution is increasing or decreasing.
tax rates – tax rates increase by 2.5% percentage points – this assumption is reasonable. The assumption is no longer valid in case of mini-jobs in Germany. At the mini-job threshold the marginal tax rate increases by roughly 20 percentage points for single individuals and even more for married. In addition, individuals experience a large discontinuous jump in the total tax liability, ranging from €28 to €145 depending on year and marital status. Because of such dramatic changes in tax liability at the threshold, it is necessary to separately account for the effect of the changing marginal tax rate and a discrete change in tax liability in order to generate an unbiased estimate of earnings elasticity.

In this section I extend the framework of Saez (2010) and Kleven and Waseem (2013) to consider large changes in marginal tax rates and large discrete jumps in tax liability at the thresholds. I assume individuals maximize utility functions \( u(c, z) \) that are increasing in consumption \( c \) and decreasing in before-tax income \( z \) subject to a budget constraint \( c = z - T(z) \). The crucial assumption of the framework is that under a flat tax \( t \), individuals’ density of incomes \( h(z) \) is smooth and continuous. For simplicity of exposition, I assume that the heterogeneity in incomes \( z \) stems only from the heterogeneity in abilities imbedded in utility functions \( u(c, z) \). I will return to the more generous case, where individuals’ labor supply elasticities vary with ability, at the end of the section. Suppose that individuals’ actual tax liability \( T(z) \) depends on an individuals’ gross income \( z \):

\[
T(z) = \begin{cases} 
    t_1z & \text{if } z \leq K \\
    \Delta T + t_1K + t_2(z - K) & \text{if } z > K,
\end{cases}
\]

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

Figure L2 illustrates the effects of kinks and notches on labor supply separately. Panel A shows the resulting budget constraint, drawn in bold. The increase in the tax rate from \( t_1 \) to \( t_2 \) rotates the budget constraint at the threshold, resulting in a dashed line. Individuals who wish to earn between \( K \) and \( z_{\text{kink}} \) under the tax rate \( t_1 \) would instead bunch and earn income \( K \) when the tax rate increases to \( t_2 \). Thus, the kink will generate some bunching as shown in Panel B and lead to a parallel leftward shift of the distribution of earnings. The discrete increase in the tax liability generated by the pure notch \( \Delta T \) will shift the budget constraint downward from the dashed line to a bold line, as shown in Panel A of Figure L2. This notch will create a region of strictly dominated incomes, so that no individual would choose to earn between \( K \) and \( z_{\text{notch}} \). The notch will thus lead to further bunching at the threshold \( K \) and generate a hole in a final distribution of incomes, as shown in Panel B with a bold curve. Panels A and B of Figure L2 thus show that the size of the missing mass and the proportion of bunching attributed to the notch will depend on the relative magnitudes of the marginal tax rate change and the discrete jump in tax liability. Because the construction of the counterfactual depends on the accurate identification of the missing mass to the right of the threshold, as a first step one must determine what proportion of bunching is to be
attributed to the notch. To do so recall that the size of the response to either kink or notch is determined by the elasticity of earnings. Using the definition of taxable income elasticity with respect to the net-of-tax-rate
\[ e \equiv \frac{dz/z}{dt/(1-t)}, \] (1.2)
one can approximate the amount of bunching due to the kink as in Saez (2010):
\[ B_{\text{kink}} \approx \Delta z_{\text{kink}} \cdot h(K) = e \cdot \frac{t_2 - t_1}{1-t_1} \cdot K \cdot h(K), \] (1.3)
where \( h(K) \) denotes the counterfactual density at the threshold \( K \). Because the elasticity is determined by marginal changes, in order to relate elasticity of taxable earnings to the notch, one must approximate the discrete change in total tax liability with an equivalent implicit marginal tax rate change as suggested by Kleven and Waseem (2013). From the definition of marginal tax rate it follows that an increase in the tax liability due to the notch of size \( \Delta T \) can be approximated as an increase in marginal tax rate from \( t_1 \) to \( \hat{t}_3 \approx T(K + \Delta z_{\text{notch}}) - T(K) = \frac{\Delta T + t_1 K + t_1 \Delta z_{\text{notch}} - [t_1 K]}{\Delta z_{\text{notch}}} = t_1 + \frac{\Delta T}{\Delta z_{\text{notch}}}. \) (1.4)
Using definition (1.2) and equation (1.4) one can approximate the bunching resulting from a notch \( \Delta T \) as
\[ B_{\text{notch}} \approx \Delta z_{\text{notch}} \cdot h(K), \]
where \( \Delta z_{\text{notch}} \) solves
\[ e = \frac{\Delta z_{\text{notch}}/K}{(\Delta T/\Delta z_{\text{notch}})/(1-t_1)}. \]
Solving for \( \Delta z_{\text{notch}} \) yields
\[ B_{\text{notch}} \approx \Delta z_{\text{notch}} \cdot h(K) = \sqrt{\frac{eK\Delta T}{1-t_1}}. \] (1.5)
Together equations (1.3) and (1.5) relate the amount of total bunching at the threshold \( K, B_{\text{kink}} + B_{\text{notch}}, \) to the elasticity of earnings with respect to net-of-tax-rate. Moreover, they specify the proportion of total bunching attributable to the kink and to the notch respectively. Several observations are worth noting from equations (1.3) and (1.5). First, when \( \Delta T = 0 \) then \( B_{\text{notch}} = 0 \) and therefore the entire bunching is due to the kink. Similarly, when \( t_2 = t_1 \) then \( B_{\text{kink}} = 0 \) and the entire bunching will be due to the notch. However, for any small changes in tax rates some bunching will always be attributed to the kink only. Second, while bunching due to the kink increases proportionally to the elasticity, bunching attributed to the notch increases at a slower rate.\(^{27}\)

\(^{27}\)The intuition behind this result is that while a kink changes marginal incentives for all individuals located to the right of the threshold, the notch only influences individuals closest to the threshold, with strongest incentives for individuals located in the strictly dominated region.
bunching due the notch one must know the underlying elasticity – which is usually unknown and is typically the variable of interest. To solve this, I implement an iterative procedure that starts with an elasticity guess and iterates until a fixed point is found.

Elasticity formulas derived in (1.3) and (1.5) assume that elasticities are constant across individuals. These formulae also apply to cases where elasticities are heterogeneous. If the distribution of elasticities is independent from the distribution of ability, (1.3) and (1.5) estimate average elasticity in the population. If, on the other hand, the distribution is joint, (1.3) and (1.5) estimate average elasticity of individuals at income level $K$.

Elasticity Estimation Procedure

The conceptual framework presented in the previous section allows me to estimate elasticities of taxable income with respect to the net-of-tax rate by estimating the excess mass at the mini-job threshold in Germany. The estimation strategy relies on accurate estimation of the counterfactual density – the density that describes what the earnings distribution would be if all jobs in Germany followed mini-job rules – using observed density of earnings. I begin by grouping individuals into small bins of $\mathbb{E}X$ based on workers’ monthly incomes. Let $C_j$ denote the number of individuals in income bin $j$, for example, bin $C_1$ records the number of individuals earning $(\mathbb{E}0, \mathbb{E}X]$ and so forth.

Combining the approaches of Chetty et al. (2011) and Kleven and Waseem (2013), I proceed as follows. I start with a guess of elasticity, $e_0$, and estimate a corresponding proportion of bunching due to the notch, $\pi_{\text{notch}} \equiv B_{\text{notch}} / (B_{\text{notch}} + B_{\text{kink}})$, using equations (1.3) and (1.5). Next, I identify a counterfactual distribution by estimating the following regression:

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

(1.6)

To see this, suppose ability and elasticities are jointly distributed according to some distribution $\psi(z, e)$. Then $h(K) = \int e \psi(K, e) de$. Define $\bar{e}_K \equiv \int e \psi(K, e) de / h(K)$ to be the average elasticity at earnings level $K$. Then from (1.3) follows that the number of individuals bunching at $K$ due to a kink of size $t_2 - t_1$ is equal to

$$B_{\text{kink}} = \int e K(t_2 - t_1)/(1 - t_1) \psi(K, e) de = \bar{e}_K h(K) K(t_2 - t_1)/(1 - t_1).$$

Note that the independence of ability and elasticity distributions implies

$$\bar{e}_K \equiv \int e \psi(K, e) de / h(K) = \int e \phi(e) de = \bar{e},$$

where $\phi(e) = \psi(z, e) / h(z)$. Similarly, from (1.5) follows that bunching due to a notch $\Delta T$ is equal to

$$B_{\text{notch}} = \int e \sqrt{e K \Delta T} \psi(K, e) de = \sqrt{K \Delta T} \int e \sqrt{e \psi(K, e) de} \leq \sqrt{\bar{e}_K K \Delta T},$$

where the last step follows from Jensen’s inequality. Therefore, if there is heterogeneity in the population, the elasticities estimated will represent the lower bound on the magnitude of true behavioral response.
where \( C_j \) represents the number of individuals in income bin \( j \) described above, \( Z_j \) is the average income level in bin \( j \), \( q \) is the order of polynomial which is fitted to the counts, \( z_l \) and \( z_u \) determine the size of the excluded region around the mini-job threshold, such that \( z_l < K \leq z_u \).\(^{29}\) The counterfactual distribution is defined by the predicted values from (1.6) omitting the dummies: \( \hat{C}_j^0 = \sum_{i=0}^q \beta_i \cdot (Z_j)^i \). Excess mass \( \hat{B}^0 \) and missing mass \( \hat{M}^0 \) are calculated as the difference between observed empirical density counts \( C_j \) and estimated counterfactual counts \( \hat{C}_j^0 \) in the earnings intervals \((z_l, K]\) and \((K, z_u]\) respectively:

\[
\hat{B}^0 = \sum_{j=z_l}^K (C_j - \hat{C}_j^0) = \sum_{j=z_l}^K \hat{\gamma}_j \\
\hat{M}^0 = \sum_{j=K}^{z_u} (\hat{C}_j^0 - C_j) = -\sum_{j=K}^{z_u} \hat{\gamma}_j. 
\]

The lower bound of the excluded region \( z_l \) is estimated visually.\(^{30}\) To estimate \( z_u \), I make use of the fact that the amount of bunching due to the notch should be equal to the missing mass to the right of the threshold. I start by setting \( z_u = K + 1 \) and keep increasing \( z_u \) by one bin until the estimated excess mass due to the notch equals the estimated missing mass, i.e. until \( \pi_{\text{notch}} \cdot \hat{B}^0 = \hat{M}^0 \).

The resulting counterfactual, \( \hat{C}_j^0 \), does not account for the fact that the excess mass due to the kink comes from the individuals moving from points of the distribution to the right of the threshold, and therefore \( \hat{B}^0 \) resulting from (1.6) overestimates the true excess mass. To correct for this I adjust the estimated counterfactual distribution upward until the area under the counterfactual equals the area under the empirical distribution. This iterative procedure is equivalent to estimating the following regression:

\[
C_j \left( 1 + \mathbf{1}[j > z_u] \sum_{i=z_u+1}^\infty \frac{\hat{B}}{C_j} \right) = \sum_{i=0}^q \beta_i \cdot (Z_j)^i + \sum_{i=z_l}^{z_u} \gamma_i \cdot \mathbf{1}[Z_j = i] + \varepsilon_j. \tag{1.7}
\]

The final estimate of bunching for the original guess of elasticity is then calculated as \( \hat{B} = \sum_{j=z_l}^K (C_j - \hat{C}_j) = \sum_{j=z_l}^K \hat{\gamma}_j \) where \( \hat{C}_j = \sum_{i=0}^q \hat{\beta}_i \cdot (Z_j)^i \) are the fitted values from regression (1.7).\(^{31}\) In line with the previous research, see Chetty et al. (2011) and Kleven and Waseem (2013), I define a measure of total excess bunching \( \hat{b} \):

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

\(^{29}\)Here I assume that bunching will fall into the interval \([z_l, K]\) because individuals are unable to precisely locate at the threshold. Because having income just above the threshold would still subject a worker to a lump-sum tax notch, the excess mass will be located strictly to the left of the threshold. The interval \((K, z_u]\) determines the interval of earnings where the observed distribution will lie below the counterfactual distribution.

\(^{30}\)This is a standard approach in bunching methodology. While such selection might sound ambiguous, in practice it is not. Bunching around the threshold is very sharp, and with well-defined bounds.

\(^{31}\)This adjustment effectively corrects for the shift of the counterfactual due to the kink. Such shift generates a discontinuous drop in the observed earnings distribution at the threshold. The upward adjustment corrects for this drop.
The elasticity of earnings with respect to the net-of-tax rate can then be calculated by substituting $\hat{B}_{kink}(K) = \pi_{kink} \cdot \hat{b}$ into equation (1.3), or alternatively, by substituting $\hat{B}_{notch}(K) = \pi_{notch} \cdot \hat{b}$ into equation (1.5).

The described calculations provide an elasticity estimate $\hat{e}$ based on the original guess $e_0$. Provided the estimated elasticity does not match the guess, i.e. $\hat{e} \neq e_0$, I update the guess to $\hat{e}$ and repeat the calculations for the new guess. I proceed with these iterations until a fixed point is achieved, such that $\hat{e} = e_0$.

Standard errors are calculated using a parametric bootstrap procedure where a large number of estimated vector of errors $\epsilon_j$ are drawn from (1.7) with replacement. The new errors are used to generate a large number of earnings distributions and, employing the technique above, corresponding estimates of $\hat{b}$. Standard errors are defined as the standard deviation of the distributions of excess bunching measures $\hat{b}$ and elasticities $\hat{e}$. The bootstrap procedure takes into account both iterative processes: it incorporates both a search for an optimal missing mass, i.e. finding $z_u$, and a search for a fixed point elasticity.

Earnings Data Description: SIAB

The main source of data is the weakly anonymous Sample of Integrated Labor Market Biographies (Years 1975 - 2010). The Sample of Integrated Labor Market Biographies (SIAB) provides information on employment, job search and receipt of unemployment benefits for a 2% sample of the wage-earners in Germany. The SIAB provides labor histories of 1,639,325 individuals from 1975 until 2010. However, the information on mini-job workers who are the main subject of this study is only available starting from 1999. Employment histories consist of employer notifications which are submitted when an employee is hired, is terminated, switches contribution groups, or changes health insurance company, when an employment is interrupted, or when an employer changes payroll system. In addition, all employment relationships that exist as of December 31 generate an end-of-the-year notification. Thus if no changes are made to the employment relationship then only one notification is recorded per year. Otherwise, multiple notifications, that are precise to the day, are recorded. Because the SIAB data includes all notifications submitted by employers on behalf of their employees, some duplicate entries are present. Appendix A.1 carefully describes how duplicate observations are identified and the number of dropped observations. The data provides demographic and establishment variables such as sex, age, citizenship status, education, occupation, economic activity of the establishment, number of employees at the establishment and the median wage. In addition to labor histories, detailed information on the receipt of

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32 Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access.

33 The 2% sample comprises of all individuals who were subject to Social Security or received unemployment benefits according to Social Code books II and III (since 1975), have been marginally employed (since 1999), or registered as a job seeker or participated in a training measure (since 2000). In short, the SIAB dataset presents a 2% sample of the non-self-employed labor force in Germany.
unemployment benefits and job search is available. Marital status and number of children is known only for benefit recipients and those engaged in job search.

To study the effect of payroll and income taxes on labor supply I aggregate wages reported throughout the year to calculate average monthly earnings. For individuals with one full year of uninterrupted employment average monthly income is calculated as the reported daily wage times 365 divided by 12. For individuals with multiple employment periods, earnings from all individual periods are added (calculated as daily wage times the number of days in the period), and either divided by 12 – if the total number of days in all periods is greater or equal to 365 – or divided by the total number of days and multiplied by 30.

The core sample is restricted to individuals in regular and marginal jobs; employments of other types, e.g. trainees, casual workers, etc, are dropped. Unless otherwise noted I further restrict the sample to individuals aged 26 through 59. I do so for two reasons: first, a large number of secondary and postsecondary students receive funding through the Federal Training Assistance Act (BAföG). While the students are allowed to hold part-time jobs, BAföG stipends are withdrawn euro per euro when earnings exceed €400 per month. BAföG stipends can be, in principle, received at any age, therefore some individuals in my sample might be responding to the BaföG incentives rather than the mini-job threshold. The number of such individuals older than 25, however, should be small and is unlikely to have any effect on the estimates. Second, individuals in partial retirement, for which they may qualify starting from age 60, become subject to an earnings test on their retirement benefits if their earnings exceed €400.

**Size of the Kink and Notch**

Earnings elasticity formulas (1.3) and (1.5) relate the amount of bunching at the threshold to the prevailing marginal tax rates \( t_1 \) and \( t_2 \) and the lump-sum tax \( \Delta T \). When calculating earnings elasticities I will follow the standard neoclassical framework and assume that the social security and income taxes are fully passed through to the employee. Further, I focus on changes in marginal tax rates that apply to *gross* earnings – actual wages paid plus the employer portion of social security taxes. I will refer to three tax rates: \( \tau_{\text{Mini}} \) denotes the prevailing mini-job social security rate that employers must pay on mini-job earnings, \( \tau_{\text{Full}} \) determines the full social security tax rate that is split equally between employers and employees, and \( \tau_{\text{Income}} \) refers to the marginal income tax rate at the mini-job threshold \( K \).

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**Footnotes:**

34 Prior to 2005, spells of unemployment benefits and unemployment assistance are recorded, while after 2005 the data includes information on the receipt of unemployment benefits I and II.

35 Thus the marital status and the number of children are only known for years when individuals received unemployment benefits or engaged in job search.

36 For individuals with multiple jobs throughout the year, this measure will give the average income from all jobs combined. For individuals that worked only part of the year, the measure will give average earnings while working, disregarding periods of unemployment.

37 From 2004 through 2013 the total number of BAföG recipients ranged from 532,000 to 620,000, among these less than one third was given to postsecondary students. See the Federal Ministry of Education and Research statistics, [http://www.bmbf.de/pubRD/10_Year_Overview_.pdf](http://www.bmbf.de/pubRD/10_Year_Overview_.pdf)
Note that the threshold $K$ applies to posted earnings – wages paid to the workers by firms before income taxes and the employee portion of social security taxes are withheld.

The budget constraint (1.1) in terms of gross earnings prior to April 1, 2003 can be summarized as

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

(1.9)

where $\bar{K} \equiv (1 + \tau_{\text{Mini}})K$. Equation (1.9) shows that mini-jobs are exempt from income and employee-paid social security taxes, while both types of taxes are due upon crossing the mini-job threshold. I separate the income tax into a lump-sum and marginal tax rate portions because Germany has continuously progressive marginal tax rates. Therefore income tax rate $\tau_{\text{Income}}$ is not fixed. Thus, $\Delta T_{\text{Income}}$ gives the true value of income tax due when posted income equals the mini-job threshold $K$, while $\tau_{\text{Income}}$ approximates the marginal tax rate at the threshold. After the 2003 reform, the tax schedule (1.1) becomes

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

(1.10)

where $\bar{K} \equiv K(1 + \tau_{\text{Mini}})$. Equation (1.10) shows a decrease in the size of the notch at the mini-job threshold because the social security liability has been reduced.

Equations (1.9) and (1.10) specify how marginal and average tax rates change at the mini-job threshold. Tables 1.1 and 1.2 summarize the social security, $\tau_{\text{Mini}}$ and $\tau_{\text{Full}}$, and average income notch $\Delta T_{\text{Income}}$ and marginal tax rate $\tau_{\text{Income}}$ for men and women. Corresponding budget constraints are shown in Figure 1.1

Because Germany allows for joint taxation of married couples, the size of the income tax notch $\Delta T_{\text{Income}}$ and marginal income tax rate $\tau_{\text{Income}}$ depend on individual’s marital status. Since the SIAB data does not contain information on spousal earnings, I estimate the size of the average income tax notch at the mini-job threshold using the German Socio-Economic Panel (SOEP). In other words,

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

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

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\( \Delta T_{\text{income}} \) and \( \tau_{\text{Income}} \) that I use in (1.9) and (1.10) represent the average marginal tax rate and average tax notch experienced by individuals who earn approximately the mini-job threshold amount. When calculating spousal incomes I take three types of earnings into account: labor earnings (regular and self-employed), social security pensions (old-age, disability, and widowhood) and private retirement pensions (supplementary civil servant pension income, company pensions, private pensions and pension income from “other” sources as reported in the SOEP).

Figure 1.1 shows that the social security notch was almost fully erased in 2003, when the social security liability was smoothed at the mini-job threshold. Table 1.2 shows that women experience the largest income tax notch at the threshold, ranging between €80 to €99 depending on the year. Men experience smaller income notch at the threshold, ranging from €28 to €34. Tax notches also vary greatly by age. The largest notch is experienced by middle-aged women and smallest by young individuals under age 25.

**Labor Responses to Mini-Job Threshold**

**Graphical Evidence**

Figures 1.3 and 1.4 show the distribution of monthly posted wage earnings of women and men by calendar year. Each point shows the number of individuals in a €25 bin, scaled to represent the German population in that year from a 2% SIAB representative sample. The vertical red lines identify mini-job thresholds: €325 prior to 2003 and €400 thereafter. Several observations are striking. First, both men and women show strong responses to tax incentives in the form of sharp bunching at the threshold. Second, bunching is concentrated just below the threshold with little excess mass above the threshold consistent with the existence of a notch. Since the tax liability is incurred immediately upon crossing the mini-job threshold, individuals optimize by earning at or below the mini-job threshold. Third, bunching is substantially larger for women than for men. Typically, there are about 4 times more women working in at-the-threshold mini-jobs than men, which is consistent with women having higher labor supply elasticities than men. Fifth, when the threshold increases from €325 to €400 on April 1, 2003, bunching follows rapidly. In the year of the change, in 2003, there is substantial bunching at the new threshold. Already by the end of 2004 roughly two thirds of the excess mass is shifted to the new threshold. Such rapid shift in the the hours worked suggests that both individuals and firms are able to adjust labor hours quickly. Finally, in addition to bunching at the mini-job threshold there is some bunching at €165.

\[40\text{For details of the calculations see Appendix A.2.}\]

\[41\text{Prior to 2005 statutory pensions were tax-exempt. Starting from 2005, 50\% of pension earnings are subject to income tax, and the percentage has been increasing by 2 percentage points each year. Taxation of private pensions vary, but for simplicity I assume that the entire amount of pension is subject to income tax. In the Appendix A.2 I consider alternative income specifications and show that calculations are again not sensitive to the specification.}\]
and €100 due to incentives generated by the unemployment benefits.42

Figures 1.3 and 1.4 show earnings distributions by year for men and women aged 26 through 59. In Figure 1.5 and 1.6, on the other hand, I plot earnings distributions for men and women by 5 age groups: under 25, 25-25, 35-45, 45-55 and 55-65 year olds. For comparison I show respective earnings distributions in 1999-2002 and in 2003-2010. Bunching patterns in Figures 1.5 and 1.6 show substantial heterogeneity between men and women of different age groups. For women, bunching shows inverse U-shaped relationship with age, with most bunching observed for 35-45 year old women. This observation is consistent with tax incentives experienced by women: as spousal income increases with age, the incentive to bunch increases, while child-rearing responsibilities further reduce incentives to work long hours. For men, bunching shows U-shaped relationship, with most bunching observed for young men (likely corresponding to students receiving BAföG stipends) and older men in early retirement. This relationship is again consistent with work needs throughout men’s lives: younger and older men prefer part-time employment, while middle-age men seek out full-time jobs. Figures 1.5 and 1.6 also show considerable heterogeneity in the speed of adjustment to the new threshold. Younger individuals adjust the fastest, as can be seen by relatively small excess bunching at the €325 threshold in 2003-2010. Older individuals adjust slower with oldest men adjusting the slowest: large number of males aged 55-65 continued to bunch at the old threshold in 2003-2010.

**Elasticity Estimation Assumptions**

As discussed in Section 1.3, the bunching approach relies on one crucial assumption: in absence of the mini-job notch and kink, under a flat tax schedule, the distribution of earnings would have been continuous. The empirical approach outlined in Section 1.3 then recovers average elasticity in the population if the distributions of ability and elasticities are independent and an average elasticity of individuals at the mini-job level of income if ability and elasticities are distributed jointly.

I make two more simplifying assumptions. First, I assume that individuals perceive social security contributions as a tax and do not value social security benefits gained from regular employment. Social security contributions provide individuals with three main benefits: unemployment insurance, health insurance and pension insurance. For married women with working spouses, health insurance can be obtained through the spouse, however, unemployment and pension insurance are based on individual contribution record. This assumption is weakly consistent with evidence that people do not assign high value to pension benefits,

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42Individuals receiving unemployment insurance – both UI and unemployment assistance prior to 2005 and unemployment benefits type I from 2005 on – can earn part-time income as long as they work less than 15 hours per week and earn less than €165 or 20% of previous earnings, whichever is smaller. If earnings exceed the €165 limit, unemployment benefits are reduced at a 100% withdrawal rate. It is thus not surprising to see stronger bunching for men than women, since men are more likely to claim unemployment benefits. The €100 threshold was introduced in 2005 and affects individuals receiving unemployment benefit type II. If their earnings exceed €100, benefits are withdrawn at a rate of 80% up to €800 and 90% for higher incomes.
see Fitzpatrick (2014) and Tazhiltinova (2015b), and means that the estimated elasticities represent a lower bound on the true magnitude of behavioral response.

Second, I explicitly assume that only tax liabilities of individuals change at the threshold. This assumption thus further disregards the possibility that mini-jobs and regular jobs differ in fringe benefits they provide or job security and likelihood of promotion. If regular jobs offer better job security or increase the probability of being promoted, the elasticity estimates described in this section represent a lower bound on the true elasticities of earnings with respect to net-of-tax rate. The assumption further disregards the possibility that gross wages of mini-job and regular workers of identical abilities differ, in which case gross earnings do not accurately reflect the working hours of individuals. I study the wage differential between mini-jobs and regular jobs in Section 1.5 and find that mini-job gross wages are approximately 6% higher than gross wages of regular employees, reflecting lower fringe benefits paid to mini-job workers. I discuss how these differences in gross wages and fringe benefits affect elasticity estimates in Section 1.5. Because most fringe benefits paid to regular workers carry substantial monetary values, they are likely to be valued at actuarially fair rates. Under this assumption, elasticities shown in Figure 1.7 are estimated correctly.

**Elasticity Estimates**

I follow the estimation procedure outlined in Section 1.3 and tax rate changes described in Section 1.3 to calculate the earnings elasticities with respect to net-of-tax rate. Figure 1.7 summarizes elasticity estimates and corresponding excess mass (recall definition (1.8)) by year for men and women. To calculate elasticities, I fit a 5th degree polynomial to the empirical distribution of gross earnings: it is important to use the distribution of gross earnings because the posted earnings (shown in Figures 1.3–1.6) already account for differences in employer-paid social security taxes below and above the threshold, making the comparison inappropriate.

The lower bound of the exclusion region \( z_l \) is determined visually and ranges from 3 bins (not including the threshold bin) 1999-2002 to 6 bins in 2006. The estimation procedure starts with an initial guess of \( e_0 = 0.05 \) and iterates until a fixed point is reached. Bootstrap standard errors are based on 1000 iterations. The estimated elasticities

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43 Results in Section 1.5 suggest that mini-job workers receive smaller bonuses and fewer paid vacation days. Bachmann et al. (2012) and Wippermann (2012) find that in addition to aforementioned benefits, mini-job workers also do not receive such benefits as statutory holiday pay, sick day pay, maternity leave pay, and company training. Since these benefits carry clear monetary value, they are likely to be valued by individuals in actuarially fair way.

44 Assuming wages reflect all labor costs, an individual earning €400 in a mini-job in 2010 would have to work more hours than a person earning €400 in a regular job, because the employer-paid social security tax rate for mini-jobs was approximately 10% higher than for regular jobs.

45 The empirical distributions are generated by multiplying reported posted earnings of mini-job workers by \( 1 + \tau_{Mini} \) and earnings of regular employees by \( 1 + 0.5\tau_{Full} \). Because \( \tau_{Mini} > \tau_{Full} \) there is a small number of regular employees whose gross earnings fall in the interval \((K(1+0.5\tau_{Full}), K(1+\tau_{Mini})]\). These individuals are dropped, so that all observations below the gross mini-job threshold \( K(1+\tau_{Mini}) \) correspond to observations below the official posted mini-job threshold \( K \).
CHAPTER 1. FIRM INCENTIVES AND LABOR RESPONSES TO TAXES

are not very sensitive to the specification. In Appendix A.2 I describe the estimation process and consider smaller income bins (€12.5) and different degree of polynomial \((d = 4, 5, 6)\).

The results in Figure 1.7 show that yearly elasticity point estimates range from 0.20 to 0.37 for women and 0.09 to 0.25 for men. Excess bunching, on the other hand, shows smaller variation, ranging from 7.16 to 10.79 for women and from 3.05 to 5.59 for men. Results show a decrease in elasticities in 2003-2005 for women and in 2001-2002 for men, followed by a steady increase from 2005 on. The standard errors are relatively small for women, and show a clear increase in elasticities from 2004 on. The results for men are much noisier, but the difference between elasticities in earlier years (1999–2002) and later years (2006-2010) is statistically significant.

Calculated elasticities are substantially larger than has been previously estimated using the bunching method and it is unlikely that the institutional and demographic differences alone can explain the magnitude. For comparison, Saez (2010) finds elasticities of 0.003–0.025 (statistically insignificant) for wage earners around the EITC limits in the USA; Chetty et al. (2011) estimate elasticities of approximately 0.01 for all wage earners, 0.02 for women, and 0.06 for married women professionals in Denmark; and Bastani and Selin (2014) find statistically significant elasticity of 0.001 for wage earners in Sweden. The elasticities estimated in this paper are of comparable magnitude to elasticities estimated using non-bunching methods. For example, point estimates of the elasticity of working hours with respect to net-of-tax wage estimated by MaCurdy (1981), Eissa and Hoynes (2006), Blundell et al. (1998) and Ziliak and Kniesner (1999) range between 0.09 to 0.44.

There are two institutional reasons why elasticities derived from the responses to the mini-job threshold may be larger than previous estimates. First, this study focuses on part-time workers who are likely to have greater ability to adjust working hours and locate at the mini-job threshold. Second, the magnitude of the notch and kink at the mini-job threshold is particularly large, providing stronger incentives to optimize. In the rest of this section I argue that while these explanations are likely to account for part of the magnitude, they do not present a sufficient explanation.

Saez (2010) finds little response among the part-time workers to the first kink of the EITC (which has been set at approximately $8,500), lending little support to the notion that part-time workers must show stronger responses. In a related setting, Tazhitdinova (2015b) studies labor supply responses to the kink generated by the payroll tax exemption threshold in the UK. In the UK, earnings below the primary/secondary payroll threshold are exempt from employee/employer portions of the National Insurance Contributions (NIC). For several years, from 2001 to 2007, this payroll threshold coincided with the income tax exemption threshold and ranged in value from £4,525 to £5,200. Crossing the threshold implied an increase in combined payroll-income tax from 0% to 30%. While the kink also affects part-time workers, Tazhitdinova (2015b) finds small bunching at the threshold and estimates elasticities of around 0.04-0.08.

\[^{46}\text{Calculated as the sum of employee (11\%) and employer (12.8\%) payroll taxes, and 10\% income tax divided by one plus employer payroll tax of 12.8\%}.\]
The combined kink and notch at the mini-job threshold is indeed the largest among previous studies. The comparison, however, is inappropriate because previous studies focused on the income tax changes alone and disregarded payroll taxes, while in this study, payroll tax rates are incorporated into the calculation of the magnitude of the kink and notch. For example, Bastani and Selin (2014) study responses to a kink which increases the income tax from 36.4% to 59.7%. When one does not account for payroll taxes, the simple percent change in taxes is \( \frac{t_2 - t_1}{t_1} = 36.6\% \), however, if one incorporates flat payroll tax of 20%, the tax change increases to 53.4%.\(^{47}\) In short, if previous studies would have incorporated the underlying payroll taxes, as this study does, the elasticity estimates would have been even smaller.

As suggested by Chetty et al. (2011), sharper tax changes generate strongest incentives for individuals to optimize and thus could lead to stronger observed responses when workers incur large job search costs. Chetty (2012) estimates that if one accounts for frictions, previous studies suggest an average Hicksian labor supply elasticity of 0.3, which is in line with many estimates from Figure 1.7. Such comparison, however, implies that individuals experience zero adjustment costs in Germany, which is a strong assumption and is unsupported by the presence of individuals immediately to the right of the threshold in 1999-2002 when the threshold presented a notch for all individuals. The counterfactual fits show that nearly 35% to 55% of individuals are unresponsive to tax incentives and experience sufficiently high adjustment costs that prevent them from moving away from the strictly dominated region. Kleven and Waseem (2013) use the share of unresponsive workers to scale elasticities to account for the percent of individuals affected by the frictions costs in Pakistan and calculate an upper bound on the taxable income elasticity of less than 0.094 for wage earners. Applying this approach to this paper would make elasticities 1.5-2 times larger.

Finally, it is worth noting that the earnings distributions are completely smooth with the exception of bunching at the mini-job threshold and at the unemployment insurance threshold. From 2004 until 2008 the first bracket of income tax started at €7,664 (corresponding to a monthly wage of €639) and introduced a 15% kink in the tax schedule of individuals. If individuals have an average elasticity of 0.3, following (1.3) this kink would lead to an excess mass of \( b = 0.3 \cdot 0.15 \cdot 7,664/12/25 \approx 1.14 \). However, there is no apparent bunching in the vicinity of €639 in Figures 1.3 and 1.4 in 2004-2008. A possible explanation is that bunching is diffused because of the joint taxation in Germany. However, distributions of men and women under age 25, who are likely to be single, in Figures 1.5 and 1.6 are also smooth. There is also no bunching around the first kink of the income tax schedule in a subsample of single individuals. Unfortunately, a similar exercise cannot be applied to other tax brackets because the income tax schedule in Germany consists of continuously increasing marginal tax rates. As an additional robustness check, I estimate elasticity of taxable income around the first kink of the income tax schedule in 1998 and 2001 using Wage and Income Tax public-use datasets.\(^{48}\) I find small taxable income elasticities,

\(^{47}\)Calculated as \( \frac{0.597 - 0.364}{0.364} = 53.4\% \).

\(^{48}\)See Lohn- und Einkommensteuerstatistik datasets at
ranging from 0.04 to 0.09, see Figure 1.8. These elasticities are several times smaller than the elasticities estimated in this study, despite reflecting both real responses – reductions in hours worked – and potential avoidance responses – through income deductions. In a recent study Doerrenberg et al. (2015) estimate that the elasticity of taxable income in Germany is likely to be 2-3 times larger than the elasticity of earnings exclusive of deductions. Another observation from Figures 1.3 and 1.4 is that individuals also do not respond to a concave kink point at €800. Recall that starting from 2003, the social security taxes paid by individuals are gradually phased out in the monthly earnings interval of \([€400, €800]\). For monthly income \(X \in [€400, €800]\), the total amount of social security tax due is equal to \(400 \cdot \frac{\tau_{\text{Mini}}}{\tau_{\text{Full}}} + (2 - \frac{\tau_{\text{Mini}}}{\tau_{\text{Full}}})(X - 400) \cdot \tau_{\text{Full}}\), and therefore the combined marginal tax rate changes from \(\frac{2\tau_{\text{Full}} - \tau_{\text{Mini}} + 1}{1 + 0.5\tau_{\text{Full}}}\) to \(\frac{\tau_{\text{Full}} + 1}{1 + 0.5\tau_{\text{Full}}}\) at €800. Assuming \(\tau_{\text{Income}} = 0.24\) (average MTR of women from Tables 1.1-1.2), the joint marginal tax rate decreased from approximately 68.5% to 54.5% in 2003–2006 and from 60.25% to 52.7% in 2006–2010. Despite an approximately 10% tax change, there is no missing mass in the distribution of earnings around €800 in Figures 1.3 and 1.4. These findings suggest that strong real responses along the intensive margin at the mini-job threshold are unlikely to be attributed to low friction costs of workers in Germany.

Heterogeneity of Labor Responses and “Firm Bunching”

The results in the previous section suggest that earnings responses to the mini-job threshold are large. If the magnitude of observed response is driven by individuals’ preferences, we should observe substantially smaller bunching for individuals who experience smaller tax changes at the mini-job threshold. On the other hand, if the large bunching is due to firms readily offering mini-job positions, at-the-threshold jobs will be “diffused” across population groups and we will see substantial bunching regardless of individuals’ status. In this section I investigate how the magnitude of response changes with individual incentives. To do so, I divide population into several groups: single individuals, individuals with multiple jobs, women and men of different ages, and individuals working in different industries. The results in this section imply that at-the-threshold jobs are readily available in the labor market and are often taken up by individuals who have small incentives to bunch (e.g. singles) or none at all (individuals with multiple jobs before 2003). I also find substantial heterogeneity in the relative magnitude of bunching across age groups and industries.

Figure 1.9 focuses on individuals with multiple jobs. Prior to 2003, the mini-job threshold applied to the cumulative earnings, therefore, individuals who had a regular job had no incentive to bunch at the mini-job threshold, since doing so would not reduce their tax bill. Nevertheless, Figure 1.9 shows substantial bunching at the mini-job threshold among individuals who hold another job with monthly earnings of at least €325 in 1999–2002. Of

\[^{49}\text{http://www.forschungsdatenzentrum.de/bestand/lest}\]
particular interest is that in addition to bunching at the mini-job threshold, the distribution shows a permanent drop at the threshold. Figure 1.9 implies that for the vast majority of individuals who hold multiple jobs, the second job is effectively a mini-job. This bunching has been termed “firm bunching” by Chetty et al. (2011) and is a direct evidence of firm responses to the mini-job threshold. Firms make at-the-threshold jobs available either because this helps them to fill positions or because they find mini-jobs attractive for some other reasons. Starting from 2003, individuals with a regular job are allowed to hold one mini-job tax-free. This reform lead to an increase in take up of secondary jobs, with a large number of these jobs being at-the-threshold jobs.

Table 1.3 shows how labor supply responses vary by gender, age, marital status and industry. Women display stronger behavioral responses as they become older, while men’s responses are U-shaped, with larger elasticities for males under age 25 and over 60. Table 1.3 also shows elasticities for a sample of single individuals. Recall that mini-jobs provide two types of tax breaks: first, they exempt workers from employee-paid social security taxes, and second, they exempt workers from income taxes. The income tax exemption is irrelevant to single individuals, because their total earnings remain too low to qualify for income taxes. Therefore, bunching at the mini-job threshold identifies responses to changes in social security liability. The SIAB earnings data does not provide information on individual’s marital status, however, this information is available when individuals apply for unemployment insurance (UI) benefits or register with an employment agency. In my sample of “single” individuals I include workers who report the same marital status at least twice during 1999–2010 with at least a 3 year gap between UI and/or job search applications. I then assume that these individuals had the same marital status in between these reports. The obtained subsample, of course, is not a representative sample of single individuals, since individuals are selected based on their unemployment experience. To partially mitigate this concern, I require that these individuals have at least a 3 year gap between UI applications. The results show reasonable estimate of elasticity in 1999–2002 when single individuals experienced a large social security notch. However, when the notch was substantially reduced in 2003–2010, the elasticity estimate doubles, reflecting similarly large number of individuals in at-the-threshold jobs despite a decrease in tax incentives to bunch.

Finally, Table 1.3 shows how elasticities vary with the industry of employment. I focus on women because of the larger sample sizes. The results show large variation across industries. Largest responses are observed in construction, motor vehicles (sales and repair), food manufacturing, wholesale, finance and insurance. Labor supply responses in these industries are two to three times larger than in education, organizations, professional services. Some of this variation is quite surprising and suggests that in industries that typically hire few part-time workers, many part-time jobs are offered in the form of mini-jobs. Further research is required to better understand what determines the popularity of mini-jobs in a indeed subject to social security taxes. Figure 1.9 thus presents the lower bound on the total amount of bunching in secondary jobs, because individuals who work at 3 or more establishments during the year are not included.
Robustness Checks

Extensive margin

There are two types of extensive margin responses that can affect the estimation process. First, some individuals may choose not to work because of the notch itself. Such responses would make the observed distribution to the right of the threshold lower than it would be otherwise, and leave the distribution to the left unchanged. Therefore, when fitting the counterfactual, we might slightly overestimate the amount of bunching. The amount of overestimation is likely to be very small for two reasons. First, because bunching at the notch remains within individuals’ budget set, only those individuals whose outside option is strictly greater than the utility derived by working at the threshold could be affected. Intuitively, only workers who have barely satisfied the participation constraint absent the notch may choose to exit the labor force. Second, what matters is not the total number of individuals who exit the labor force, but the percent of these individuals in each bin, which is likely to be very small.

The second type of extensive margin response possible is the overall effect of the outside option on the distribution as a whole, disregarding the presence of the notch/kink. Changes to the outside option effectively shift the entire distribution of earnings up when the outside option decreases and down when the outside option increases. Such shifts should not bias the estimate because the entire distribution is affected. Therefore, not just the counterfactual will shift up or down, but also the amount of bunching will increase or decrease accordingly.

As an attempt to understand this variation I studied how elasticities vary with such industry indicators as presence of bargaining agreements, industry growth in dollars, volume or total hours employed. With the exception of growth measured in total hours employed, no indicators appear to be good predictors of high elasticities. However, I find a robust inverse relationship between changes in total hours employed and the elasticity of earnings in a given industry.

50 As an attempt to understand this variation I studied how elasticities vary with such industry indicators as presence of bargaining agreements, industry growth in dollars, volume or total hours employed. With the exception of growth measured in total hours employed, no indicators appear to be good predictors of high elasticities. However, I find a robust inverse relationship between changes in total hours employed and the elasticity of earnings in a given industry.

51 Suppose the total amount of mass at the threshold is \( B \) and the true counterfactual value is \( c \). Then ideally, we would like to estimate the excess bunching as \( (B - c)/c \). Let \( p \) identify the percent of individuals who choose to exit the labor force, then we will underestimate the counterfactual by approximately \( p \cdot c \) and therefore the estimated excess bunching will be \( \frac{B - c}{c(1 - p)} \). The absolute value of bias is \( \frac{pB}{c(1 - p)} \), or as proportion of excess mass, \( \frac{pB}{B - c} \cdot \frac{p}{(1 - p)} \). Since the \( c \ll B \) in case of mini-job, the size of the bias will be driven by the magnitude of the extensive margin response \( \frac{p}{(1 - p)} \). The bias effectively overestimates intensive margin elasticity by incorporating extensive margin responses. This type of bias applies to the bunching approach around kinks also, though the bias is likely to be stronger for notches. The reform in 2003 reduced the size of the notch and therefore should have “returned” some workers back to the labor force and potentially “lifted” up the distribution to the right of the threshold. When one overlaps 2002 and 2003 distributions for women, it is possible to see a small increase in the number of people immediately to the right of the threshold, and no differences further away from the threshold, consistent with intensive margin responses rather than extensive margin responses. For individuals just to the right of the threshold, by the revealed preference argument, bunching at the threshold should be preferable to exiting the labor force, since the change in utility is the smallest. At the same time, 2003 and 2004 distributions overlap perfectly to the right of the threshold.
Evasion

It is possible that some of the bunching observed at the mini-job threshold is due to evasion. Evasion, however, would require collusion between employers and employees since mini-job earnings are third-party reported. Such collusion is likely to be profitable only to firms that experience losses that cannot be carried over to other periods, since by reducing individuals’ pay, these employers simultaneously reduce the amount of labor costs they can deduct against profits. Alternatively, collusion can also be profitable to firms if the savings obtained by employees are passed through to the employers. Both scenarios, however, imply that the optimal strategy is not to reduce employees’ pay to the mini-job threshold, but to as close to zero as possible, since by doing so firms would also save on their share of social security taxes.

As a robustness check I study how the amount of bunching and estimated elasticities change with firm size, since collusive behavior is unlikely to be prevalent among larger firms. I find that bunching is indeed larger for smaller firms but the difference is not substantial (not shown here). Beyond evasion, mini-jobs can be attractive to smaller firms because of lower administrative costs.

1.4 Theoretical Framework

The results in the previous section show that in contrast to previous studies that find weak bunching at kinks and notches of tax schedules, workers in Germany are able to find at-the-threshold mini-jobs with ease. To explain the magnitude of response, I consider firm incentives and study how these incentives affect workers’ ability to respond to taxes. In this section I extend the framework of Chetty et al. (2011) and develop a partial equilibrium tax incidence model with job search costs and endogenous hour constraints. I start with the baseline scenario of zero search costs and show that the strength of labor supply responses depends on the magnitude of tax change and on the elasticity of substitution between the individuals working under different tax regimes. Next, I extend the model to a case where individuals have positive search costs and show that the magnitude of labor supply responses to taxes further depends on the statutory incidence of taxes and on the incidence of job search burden. The model predicts that labor supply responses are strongest when the statutory incidence of taxes falls on the firms.

Social security reporting and remittance is very complicated for regular workers, since different types of social security contributions must be remitted to different offices. Mini-job social security taxes, on the other hand, are simpler to administer because all taxes are paid to the Minijob Zentrale. These results are also consistent with findings of Spaeth and coauthors, Spaeth (2013a), Spaeth (2013b) and Koch et al. (2013), who show that marginal employment and other flexible contracts are particularly popular with young firms, which are likely to be small.
Baseline Model with Zero Search Costs

In this model firms offer two types of employment: mini-jobs which are subject to employee-paid tax \( t_1 \) and employer-paid tax \( \phi_1 \) and regular jobs which are subject to employee-paid tax \( t_2 \) and employer-paid tax \( \phi_2 \). Tax rates \( t_1, t_2, \phi_1 \) and \( \phi_2 \) should be interpreted as a sum of all taxes – social security and income – as well as other auxiliary costs such as fringe benefit payments that are required by law and which statutory incidence falls on employees or employers respectively. In the model, regular jobs are fully unrestricted and allow workers to earn any amount, while mini-job earnings are limited by a fixed threshold \( K \), uniform to all workers. For simplicity of presentation, I will identify mini-jobs with subscript 1 and regular jobs with subscript 2. In this baseline model I assume that individuals and firms experience zero search costs.

**Labor Supply.** Individual \( k \) chooses a job from the aggregate distribution of hours offered with corresponding wages \((w_1, w_2)\) that maximizes his utility

\[
\max_{c,l} u(c, l) = c - \alpha_k^{-1/\varepsilon} \frac{l^{1+1/\varepsilon}}{1 + 1/\varepsilon},
\]

given his individual ability parameter \( \alpha_k \) and subject to one of the two constraints:

\[
c = (1 - t_1)w_1 l = \hat{w}_1 l \quad \text{and} \quad w_1 l \leq K
\]

or

\[
c = (1 - t)w_2 l = \hat{w}_2 l,
\]

where \( w_1 \) is the wage offered in type 1 jobs and \( w_2 \) is the wage offered in type 2 jobs. For simplicity, I assume that all individuals have the same elasticity of labor supply \( \varepsilon \).

If equilibrium wages are such that \( \hat{w}_2 > \hat{w}_1 \), individuals will always prefer job of type 2 and work \( l_k = \alpha_k \hat{w}_2 \), since earnings in type 2 jobs are unrestricted. Therefore an interesting case arises when after-tax wages \( \hat{w}_1 \) exceed after-tax wages \( \hat{w}_2 \), since jobs of type 1 are constrained by the earnings threshold \( \hat{K} \). Define \( \alpha_k^* \equiv \hat{K}/\hat{w}_1^{\varepsilon+1} \), where \( \hat{K} = (1 - t_1)K \), then all individuals with \( \alpha_k \leq \alpha_1^* \) will choose jobs of type 1. Next, let \( \alpha_k^* \) solve \( u(\hat{K}, \hat{K}/\hat{w}_1) = u(\alpha_1^* \hat{w}_2^{\varepsilon+1}, \alpha_1^* \hat{w}_2^{\varepsilon}) \).

Individuals with \( \alpha_k \in (\alpha_1^*, \alpha_2^*) \) would like to work more hours under wage \( \hat{w}_1 \) but are unable to do so due to the threshold \( \hat{K} \). Because they find it suboptimal to work \( l_k = \alpha_1^* \hat{w}_2^{\varepsilon} \) under lower wage \( \hat{w}_2 \), they will bunch at the threshold \( \hat{K} \) and work \( l_k = \hat{K}/\hat{w}_1 \) in jobs of type 1. Finally, individuals with \( \alpha_k > \alpha_2^* \) will work \( l_k = \alpha_2^* \hat{w}_2^{\varepsilon} \) in jobs of type 2. In summary, individuals with ability \( \alpha_k \) will work \( l_k^* \) hours, where

\[
l_k^* = \begin{cases} 
\alpha_k \hat{w}_1^{\varepsilon} & \text{if} \quad \alpha_k < \alpha_1^* \\
\hat{K}/\hat{w}_1 & \text{if} \quad \alpha_1^* \leq \alpha_k \leq \alpha_2^* \\
\alpha_k \hat{w}_2^{\varepsilon} & \text{if} \quad \alpha_k > \alpha_2^*.
\end{cases}
\]

---

53 Individuals with ability \( \alpha_2^* \) are indifferent between earning \( K \) in job type 1 and working \( l = \alpha_2^* \hat{w}_2^{\varepsilon} \) hours in job of type 2.
Thus for a skill distribution \( \alpha \) with a cdf \( F_\alpha(\cdot) \) and a density \( f_\alpha(\cdot) \), the total labor supply of jobs type 1 and 2 will be given by

\[
L_1^S = \int_{-\infty}^{\alpha_1^*} \alpha \hat{w}_1 f(\alpha) d\alpha + \int_{\alpha_1^*}^{\alpha_2^*} \hat{K}/\hat{w}_1 f(\alpha) d\alpha \quad \text{and} \quad L_2^S = \int_{\alpha_2^*}^{\infty} \alpha \hat{w}_2 f(\alpha) d\alpha.
\]

(1.15)

**Labor Demand.** A continuum of identical firms offers two types of employment: mini-jobs that incur employer-paid taxes \( \phi_1 \) and regular jobs which impose employer-paid tax \( \phi_2 \). In line with [Chetty et al., 2011], I assume that firms cannot change hours worked after the firm has been matched with a worker. Each firm posts job offers for each type of employment; combined these postings generate an aggregated distribution of hours offered \( G(l) \).

Both types of labor are employed in a one-factor production technology that produces goods sold at a fixed price. Here I explicitly assume that type 1 and type 2 workers are perfectly substitutable. This assumption relies on the intuition that because the threshold \( K \) is set exogenously and is driven by government policy needs, there is no reason to believe that workers just below and just above the threshold are inherently different. Each firm \( i \) determines optimal quantities of total labor hours in each type of jobs, \( L_{1i} \) and \( L_{2i} \), by minimizing costs subject to a quantity constraint:

\[
\min_{L_{1i}, L_{2i}} C_i = (w_1 L_{1i} + w_2 L_{2i}) + (w_1 \phi_1 L_{1i} + w_2 \phi_2 L_{2i}) \quad \text{s.t.} \quad Q(L_{1i} + L_{2i}) = \bar{Q},
\]

(1.16)

where \( Q(\cdot) \) is the production function, and \( w_1 \) and \( w_2 \) denote wages. For each firm \( i \), let \( Q'_i \) denote the marginal product of labor for firm \( i \), then aggregating the first order conditions across a spectrum of firms yields a system of labor demand equations

\[
\begin{align*}
L_{1i} & : \quad w_1 + \phi_1 w_1 - \lambda Q' = 0 \quad \text{(1.17)} \\
L_{2i} & : \quad w_1 + \phi_1 w_1 - \lambda Q' = 0 \quad \text{(1.18)}
\end{align*}
\]

It follows from (1.17)–(1.18) that when \( L_{1i} \) and \( L_{2i} \) are perfectly substitutable, the wage differential \( w_1/w_2 \) will only depend on employer-paid taxes \( \phi_1 \) and \( \phi_2 \):

\[
\begin{align*}
w_1 &= \frac{\lambda Q'}{1 + \phi_1} \quad \text{and} \quad w_2 = \frac{\lambda Q'}{1 + \phi_2}.
\end{align*}
\]

(1.19)

Therefore any tax differences which statutory incidence falls on the workers will not affect the wage differential between the jobs of type 1 and type 2. The equilibrium wages and quantities of labor, however, will depend on all taxes. Equilibrium wages \( w_1^* \) and \( w_2^* \) will solve

\[
\begin{align*}
w_1 &= \frac{\lambda Q'(L_1^S(w_1, w_2) + L_2^S(w_1, w_2))}{1 + \phi_1} \quad \text{and} \quad w_2 = \frac{\lambda Q'(L_1^S(w_1, w_2) + L_2^S(w_1, w_2))}{1 + \phi_2},
\end{align*}
\]

(1.20)
where $L_1^S$ and $L_2^S$ are functions of wages given by (1.15). The intuition for this result is simple: when inputs are perfectly substitutable, employers will always hire the cheapest form of labor, thus in equilibrium employer costs of different types of labor must align in order for employers to be indifferent. Since the subsidies given to the employees do not directly affect firms’ labor costs, they will not affect the relative prices of two labor inputs. However, the equilibrium levels of wages will depend on elasticities of labor supply and demand.

Applying this insight to the case of mini-jobs in Germany implies that if mini-job workers and regular workers are perfect substitutes, the subsidies given to the workers (e.g. exemption from income taxes and social security payments) can affect the overall levels of wages of all workers, but not the wages of one group in particular. In practice, there is no intrinsic reason for mini-job workers to be more or less productive than regular workers. However, “productivity differences” can arise due to the earnings threshold that implicitly limits the number of hours a mini-job worker can supply, and therefore the total number of employees required. If handling more employees increases costs non-linearly (e.g. due to complexities of supervision or training needs), workers will not be perfectly substitutable.

**Labor Supply Responses in Presence of Frictions**

In this section I use the results derived in the previous section to show that when individuals experience adjustment and search costs, the amount of bunching at a kink or a notch will depend on two factors: first, the statutory incidence of taxes, and second, the incidence of burden of search. In the following section, I will further extend the model to consider frictions experienced by firms.

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

What do I mean by the burden of search? We can think of the labor market clearing process in two ways. Under the first approach, firms post jobs and individuals choose jobs among the available postings. This search process is usually modeled with the individuals drawing a job from the distribution of all postings (or its subset) at random, with the ability to re-draw a job by paying some cost $C$. In this framework the burden of search is fully borne by the workers: individuals have to “pay” for the quality of the job match, while firms are not penalized for the duration of the search process or the costs it imposes on the workers. Under the second approach, individuals advertise desired working hours, and firms search for workers. In this framework the burden of search is fully borne by the firms. The
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second framework is likely to apply in markets for rare talent, where firms are willing to spend resources to seek out the best of the best. In the majority of labor markets, however, firms can have access to numerous qualified applicants by simply posting a job opening.

Let \( f(l; w) \) and \( F(l; w) \) represent the probability density function and the cumulative distribution function of the distribution of “ideal” hours \( l^* \) given by (1.14) for a vector of before-tax wage levels \( w = (w_1, w_2) \). In other words, \( F \) represents the desired distribution of hours given some after-tax wages \( \hat{w}_1 \) and \( \hat{w}_2 \) if individuals had zero search costs. Note that because \( \hat{w}_1 > \hat{w}_2 \), all jobs with hours \( l \leq K/w_1 \) will be of type 1, and all jobs with hours \( l > K/w_1 \) will be of type 2. When the burden of search falls on the workers, the search process proceeds as follows. Individuals observe the offered distribution of hours \( G(l; w) \) and corresponding wages \( w = (w_1, w_2) \) and draw a job at random. At this point workers must decide whether to accept the offer or search for an alternative. If a worker with ideal hours \( l^* \) declines the offer, he will draw a new offer from a distribution \( \hat{G}_{l^*}(l; G, C, w) \) that depends on his ideal hours \( l^* \), the distribution of offered hours \( G \) and search costs \( C \). I assume that \( \hat{G}_{l^*} = G \) whenever search costs are infinite and \( \hat{G}_{l^*} = 1_{\{l = l^*\}} \) whenever search costs are zero.

Thus \( \hat{G}_{l^*} \) determines the distribution of alternative offers that individual has access to given his individual preferences and search cost function \( C \). Aggregating across workers, we find the distribution of accepted offers

\[
G_{\text{accepted}}(l; w) = P(l; G, w | F(l; w)) \cdot G(l; w) + (1 - P(l; G, w | F(l; w))) \cdot \hat{G}(l; G, F, C, w), \quad (1.21)
\]

where \( P(G | F) \) represents the probability that a job is accepted given the distribution of ideal hours \( F \) and offered hours \( G \), and \( \hat{G}(G, F, C) \) represents the aggregated distribution of accepted offers when individuals engage in job search.

Now suppose the burden of search falls on firms. From the cost-minimization problem of firms (1.16) follows that firms will accept any distribution of hours offered by individuals, as long as the cumulative hours offered equal the cumulative hours demanded. Because firms’ labor costs and output depend on the total hours employed, rather than the distribution of hours, firms only optimize with respect to the quantity of hours hired, rather than the distribution of hours.\(^{54}\)

Suppose we start with an equilibrium where employees and employers pay identical taxes on both types of labor, so that \( 1 - t_1 = \frac{1}{1 + \phi_1} = 1 - t_2 = \frac{1}{1 + \phi_2} \). The government decides to reduce the tax rate on type 1 workers by setting either \( t_1 = 0 \) or \( \phi_1 = 0 \). Does the choice of statutory tax break affect the magnitude of equilibrium labor response? If neither firms nor individuals experience search costs, the equilibrium wages \( w_1^* \) and \( w_2^* \) are equal to tax-adjusted marginal products of labor given by (1.20) and the equilibrium quantities of labor supplied can be found by substituting \( w_1^* \) and \( w_2^* \) into (1.15). Regardless of whether the government exempts firms from tax \( \phi_1 \) or individuals from tax \( t_1 \), the after-tax wage \( \hat{w}_1^* \)

\(^{54}\)At the end of this subsection I discuss firm incentives when wages cannot adjust to incorporate all differences across worker types.
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will be the same since \( \frac{\lambda}{1 + \phi_1} = \lambda(1 - t_1) \), hence, equilibrium quantities of labor supply will also be equal \(^{55}\)

Now let us consider what happens when either individuals or firms experience search costs. To answer this question I consider 4 cases. In the first two cases I assume the burden of search falls on the firms, and in the last two cases, the burden of search will fall on workers. I will show that labor supply responses will be weakest when the burden of search and the statutory incidence of taxes falls on the workers. In this model I assume that wages cannot adjust instantaneously and for wages to reach equilibrium, the quantity of labor supplied must equal the quantity of labor demanded.

Case 1. Government sets \( t_1 = 0 \) and the burden of search falls on firms.
Because wages for all workers are the same, firms are indifferent between hiring type 1 and type 2 workers and therefore will accept any distribution of hours offered by the individuals, as long as the cumulative hours offered equal the cumulative hours demanded. Note that the ideal distribution of hours \( F \) satisfies this condition at equilibrium wage. Therefore, to maximize their utility, individuals will offer the distribution of ideal hours \( F(l; w^*) \) at equilibrium wages \( w^* \) given by (1.20) and firms will accept.

Case 2. Government sets \( \phi_1 = 0 \) and the burden of search falls on firms.
Because \( \phi_1 < \phi_2 \) and wages do not adjust immediately, type 1 workers incur lower labor costs for firms than type 2 workers and therefore all firms will want to hire type 1 workers. Due to high demand the equilibrium wages of type 1 workers will increase until the total labor costs have equalized and \( \frac{w_1^*}{w_2^*} = 1 + \phi_2 \). The offer distribution \( G \) that firms will be willing to accept must reflect the largest number of type 1 jobs individuals would be willing to accept at equilibrium wages. Because firm preferences align perfectly with individuals’ preferences at equilibrium wages, individuals will offer the distribution of ideal hours \( F(l; w^*) \) at equilibrium wages \( w^* \) given by (1.20) and firms will accept \(^{56}\).

Case 3. Government sets \( t_1 = 0 \) and the burden of search falls on workers.
Because \( \phi_1 = \phi_2 \), equilibrium wages are equal and firms are indifferent between hiring type 1 and type 2 workers. In equilibrium, the distribution of hours offered by firms, \( G(l; w) \), should equal the distribution of accepted hours, given by (1.21). Therefore, a distribution of hours \( G(l) \) is an equilibrium if it satisfies the following two conditions:

\[
\begin{align*}
    w^* &= (w, w) \quad \text{with} \quad w = \frac{\lambda Q' \int_0^\infty l \, dG}{1 + \phi_1} \quad (1.22) \\
    G(l) &= P(l; G, w^*|F(l; w^*)) \cdot G(l) + (1 - P(l; G, w^*|F(l; w^*))) \cdot \hat{G}(l; G, F, C, w^*). \quad (1.23)
\end{align*}
\]

\(^{55}\)This result relies on one additional assumption: that the threshold remains the same in gross value. In present notation, setting \( t_1 = 0 \) below a threshold \( K \) is equivalent to setting \( \phi_1 = 0 \) below threshold \( K \cdot (1 + \phi_1) \).

\(^{56}\)In this case the assumption that wages cannot adjust instantaneously is not important and the same equilibrium would be achieved even if wages can adjust immediately because the distribution of ideal hours \( F(l; w^*) \) is the ideal outcome for workers and firms alike.
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Condition (1.22) determines equilibrium wages $w^*$ given the total amount of labor hours $L_1 + L_2 = \int_0^\infty l \, dG$ implied by the distribution $G$ and follows from (1.19). Condition (1.23) ensures that the distribution of offered hours equals the distribution of accepted hours at the equilibrium wage level $w^*$. From (1.23) follows that when search costs are zero, $\dot{G} = F$ and the only equilibrium solution is $G = F$, since it is the only fixed point of equation (1.23). On the other hand, when search costs are infinite, $\dot{G} = G$ and any distribution of hours offered will be accepted. Note that while $G = F$ always satisfies equilibrium condition (1.23), it need not be the only solution. As search costs increase, the set of possible equilibria increases and the equilibrium distribution of hours need not represent $F$ closely. The reason why multiple equilibrium distributions of hours are possible is because individuals find job search costly, and therefore would be willing to accept offers that do not satisfy optimality condition (1.14) precisely.

**Case 4. Government sets $\phi_1 = 0$ and the burden of search falls on workers.**

Because $\phi_1 < \phi_2$ and wages do not adjust immediately, type 1 workers incur lower labor costs for firms than type 2 workers and therefore all firms will want to hire type 1 workers. Due to high demand the equilibrium wages of type 1 workers will increase until the total labor costs have equalized and $w^*_1 = \frac{w^*}{1 + \phi_2}$. The offer distribution $G$ therefore will reflect the largest number of type 1 jobs the individuals would be willing to accept at equilibrium wages. Define $\Omega_G$ to be the set of all distributions $G$ that satisfy

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

$$(1.24)$$

$$G(l) = P(l; G, w^*|F(l; w^*)) \cdot G(l) + (1 - P(l; G, w^*|F(l; w^*))) \cdot \dot{G}(l; G, F, C, w^*).$$

Then the set of equilibria is the set of all $G \in \Omega_G$ that in addition to (1.24) and (1.25) satisfy

$$\int_0^{K/w} l \, dG = \max_{G \in \Omega_G} \left\{ \int_0^{K/w} l \, dG \right\}.$$  

(1.26)

Conditions (1.24) and (1.25) are similar to conditions (1.22) and (1.23) and ensure that at equilibrium prices, the distribution of hours offered equals the distribution of hours accepted. The intuition behind (1.26) is the following: firms will not be willing to pay higher wages to type 1 workers, unless they are exhausting the supply of workers willing to take type 1 jobs. Therefore, for wages of type 1 to adjust upward, employers must hire the maximum number of people willing to take type 1 offers. Condition (1.26) ensures that the wage equilibrium is achieved, and the quantity of type 1 labor demanded equals the quantity of type 1 labor supplied. Since $F \in \Omega_G$, condition (1.26) implies that there will be as many type 1 hours

$^57$Condition (1.26) thus stems from the assumption that wages cannot adjust instantaneously. If wages could adjust immediately, firms would not find type 1 workers attractive, and would have no incentive to increase demand for type 1 workers. However, this would mean that wages can adjust upward without a corresponding increase in labor demand, which is implausible.
offered in equilibrium as people ideally would like, or maybe more. Note that while incentives to hire more type 1 workers exist in the short run only, the long run equilibrium must still satisfy condition (1.26). If the condition is not satisfied, labor supply of type 1 workers will exceed labor demand and wages will decrease, again generating incentives to hire more type 1 workers.

These 4 cases demonstrate that in presence of search costs, the equilibrium distribution of hours depends both on the statutory incidence of taxes and on the incidence of search costs. If individuals are able to advertise their desired hours, then an optimal distribution of hours \( F \) is an equilibrium regardless of the statutory incidence of taxes. In cases 1 and 2 firms accept \( F \) because firms optimize with respect to the total hours hired and have no preferences regarding the breakdown of hours across workers. If firms had own preferences on the structure of hours and experienced low search costs, the equilibrium distribution of hours would be different. Cases 3 and 4 demonstrate that the statutory incidence of taxes becomes important when the burden of search falls on the workers. If the statutory incidence of taxes falls on individuals, the magnitude of response will depend on the ability of individuals to seek out, negotiate or otherwise convince employers to provide at-the-threshold jobs. If search costs are prohibitively high, individuals would be willing to accept whatever distribution of hours that is offered by employers. On the other hand, if the statutory incidence of taxes falls on the firms, firms have an incentive to hire a large number of mini-job workers in the short run. Because mini-jobs are readily offered by firms, individuals need not engage in costly search process and therefore equilibrium labor supply response will be strong. Note that the model does not predict what portion of type 1 hours will be offered in the form of the at-the-threshold jobs, merely that the total number of hours in type 1 jobs will satisfy the labor supply preferences. It is imaginable that firms would find it easiest to satisfy their strong (short run) preferences for type 1 workers by offering numerous at-the-threshold jobs.

These results can be extended to markets where type 1 and type 2 workers are not perfectly substitutable. Lack of perfect substitution between workers means that even when the statutory incidence falls on the workers, equilibrium wages will be different. For such equilibrium to be reached, conditions (1.24)–(1.26) must be satisfied. Therefore, the statutory incidence is not important when type 1 and type 2 workers are not perfect substitutes. However, in case of most taxes and labor rules, workers are likely to be perfectly substitutable.

It is difficult to characterize the set of equilibria defined by equations (1.23), (1.25) without making strong assumptions on the functional form and distribution of individual preferences. To illustrate the intuition behind the possibility of multiple equilibria, consider the following example. For simplicity, suppose firms are perfectly competitive, workers are perfectly substitutable and production function exhibits constant returns to scale. Then wages \( \hat{w}_1^* \) and \( \hat{w}_2^* \) are fixed and equal to the marginal product of labor. Suppose all individuals in the economy would like to work \( h^* \) hours per week and have utility function given by (1.11) with \( \alpha_k = h^*/\hat{w}_2^* \). The density of the ideal distribution of hours \( F \) therefore satisfies:

\[
f(h^*) = 1 \text{ and } f(h) = 0 \text{ whenever } h \neq h^*.
\]

58Without loss of generality, I assume that all individuals would like to hold type 2 job.
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Suppose that by exerting some effort $\sigma C(1/\bar{l})$, with $C' > 0$ and $\sigma > 0$, individuals can narrow their search interval to $[l^* - \bar{l}, l^* + \bar{l}]$ from which they will draw a job at random from the distribution of hours offered $G$. Following our notation,

$$\hat{G} = \frac{G \cdot 1_{l \in (l^* - \bar{l}, l^* + \bar{l})}}{G(l^* + \bar{l}) - G(l^* - \bar{l})}. $$

Because effort $\sigma C(\cdot)$ is decreasing in $\bar{l}$, individual will choose $\bar{l}$ that maximizes his expected utility from job search process:

$$\bar{l}^* = \arg \max_{\bar{l}} \mathbb{E}_G \left[ u(l) \middle| l \in (l^* - \bar{l}, l^* + \bar{l}) \right] - \sigma C(1/\bar{l}), \quad (1.27)$$

where $u(l) = u(w(l), l)$ given by (1.11) and $w(l) = \hat{w}_1^* \text{ if } l \leq K/w_1 \text{ and } w(l) = \hat{w}_2^* \text{ otherwise}$. It follows that optimal $\bar{l}$ depends on the distribution of offered jobs $G(l)$ and individual’s ideal job $l^*$, i.e. $\bar{l} = \bar{l}(l^*, G)$. Moreover, $d\bar{l}/d\sigma > 0$, so that if $\sigma = 0$ and individual experiences zero search costs, the optimal interval will be reduced to a single optimal point – the ideal hours $l^*$.

Now consider a probability density function $g$ that satisfies:

$$g(h^* - \hat{h}) = q_1, g(h^*) = q_2, g(h^* + \hat{h}) = q_3, \text{ and } g(h) = 0 \text{ otherwise}$$

for some values $\hat{h}$. Then any combination of $(\hat{h}; q_1, q_2, q_3)$ that satisfies the following two conditions at equilibrium prices $\hat{w}_1^*, \hat{w}_2^*$ is an equilibrium:

$$q_1 u(h^* - \hat{h}) + q_2 u(h^*) + q_3 u(h^* + \hat{h}) > u(h^*) - \sigma C(\hat{h}) \quad (1.28)$$

$$q_1 + q_2 + q_3 = 1, \quad (1.29)$$

where $u(l) = u(w(l), l)$ given by (1.11). Condition (1.28) is derived from (1.27) and ensures that all individuals prefer to not pay the search cost and draw a job from the entire distribution at random rather than pay the smallest necessary search cost $- \sigma C(\hat{h})$ to make the interval small enough, so that only $h = h^*$ could be drawn. Condition (1.28) effectively implies that $\hat{G} = G$ and therefore $G$ is by default a solution to condition (1.23) or (1.24). Finally, condition (1.29) ensures that the triple $(q_1, q_2, q_3)$ represents a probability density function. It is easy to see that there are numerous combinations of $(\hat{h}; q_1, q_2, q_3)$ that would satisfy conditions (1.28) and (1.29) for most cost function $\sigma C(\cdot)$. Further, higher values of cost shifter $\sigma$ would lead to a larger set of $(\hat{h}; q_1, q_2, q_3)$ that satisfy these conditions. Intuitively, as the cost of searching for a job increases, more individuals would be willing to draw a job at random rather than engage in costly search process. This example can be easily generalized to a case where individuals restrict their search to an asymmetric interval around $h^*$, where firms offer more than two choices of “non-ideal” hours, where these additional hours are asymmetric around the ideal hours $h^*$, and even to continuous distributions around $h^*$ hours.

The example can further be generalized to discrete or continuous distributions of ideal hours $F$.

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59 Under asymmetric distribution, offered hours would include $h^* - \hat{h}_1, h^*$, and $h^* + \hat{h}_2$, with $\hat{h}_1 \neq \hat{h}_2$. 
If multiple equilibria are possible, which equilibrium will be observed in the market? Because firms offer the hour distributions and individuals search among posted jobs, firms can incorporate the choice of the offered hour distribution into the profit-maximizing function. In other words, in addition to choosing the total optimal hours of work $L_{1i}$ and $L_{2i}$, each firm chooses the distribution of hours it offers, $G_i$. Because individuals experience positive search costs, the hours supplied will no longer be given by (1.15), instead labor supply will be determined by individuals’ ideal hours (1.14) transformed by the offered distribution of aggregated hours $G$ as in (1.23). There are many reasons why firms might prefer one distribution of hours over the other. If firms experience fixed production costs per employee, then the optimal hour distribution would include as few workers as possible. For example, employee training requires the same amount of expenditures regardless of how many hours an employee is going to work in the future. In case of mini-jobs in Germany, the existence of such fixed costs would lead to a double peaked distribution: with a large number of individuals working at the mini-job threshold and a large number of individuals working the maximum number of hours allowed. The amount of bunching at the threshold therefore will be exaggerated, because there will be too few workers with low number of hours. Effectively, there will be some additional bunching due to firms’ fixed costs, that is coming from the left. It is important to note that this larger bunching should exist regardless of whether wages are able to adjust to reflect difference in labor costs. If wages cannot adjust, for example because firms are worried that workers will find it unfair to be paid different wages for the same type of work, then firms will have a direct incentive to hire workers at the maximum allowed hours. If, on the other hand, wages can adjust, equilibrium conditions (1.24)–(1.26) will apply and workers would be willing to take more at-the-threshold jobs because they offer higher wages.

Labor regulations can also influence firms’ preferred hour distributions. For example, recently introduced Affordable Care Act requires large firms to pay for full-time workers’ health insurance coverage, but not for part-time workers’ coverage. Employees are considered to be full-time if their weekly hours exceed 30 hours. The law thus incentivizes firms to offer more 29-hours-or-less jobs than 30-hours-or-more jobs. The equilibrium outcome in this case would depend on whether wages can adjust to reflect differential costs of part-time and full-time workers, and whether individuals value provided health insurance. If wages of full-time workers can adjust downward and individuals value the health insurance provided, then no bunching will be present because individuals will be willing to accept lower wages in exchange for health insurance. However, if wages cannot adjust firm and workers incentives diverge. Firms will have an incentive to hire more 29-hour workers. At the same time, workers, because they value health insurance, will prefer to work 30 hours or more since they can gain additional benefits while receiving the same wages. Hence, workers’ preferences and firms’ preferences conflict. The equilibrium outcome will depend on the magnitude of search costs experienced by workers. If the search costs is high, firms will “win” and more 29-hour jobs will be offered. If, on the other hand, search costs are low and firms find it hard to fill 29-hour positions, bunching will be small.
Incorporating Firm Frictions

In the previous section we considered a framework where firms experience zero frictions and are able to offer any hour contracts. In reality firms are likely to experience three types of frictions. First, some hour contracts can be simply illegal (e.g. workers cannot exceed 40 hours per week without incurring overtime surcharges) or be prohibitively expensive (e.g. training and supervision costs likely to exceed any potential savings from employing 1-hour-per-week employees). Such restrictions can be easily incorporated into the model in the previous section by assuming that the distribution of hour offers $G$ must belong to some set of feasible offers $\Gamma$. This would imply that regardless of individual preferences and frictions, firms will never offer distributions outside of the set $\Gamma$. It is straightforward to see that for most tax schedules this restriction will not change the predictions of Section 1.4.

Second, in practice workers are not perfectly substitutable and therefore finding the right match is costly both for individuals and firms alike. In this paper, I focus on hour constraints and disregard differences in ability. For this reason, I ignore productivity-matching frictions and defer to future work. Third, in many cases firms are not able to change working hours of employees immediately, for example because of contractual obligations. In this section I focus on this type of frictions experienced by firms and show that the conclusions of the previous section remain valid, but the adjustment process is slower.

Consider the following three-period model. In the first period the government sets flat tax rates, so that $1 - t_1 = \frac{1}{1 + \phi_1} = 1 - t_2 = \frac{1}{1 + \phi_2}$. Firms and workers are matched as described in the previous section, resulting in an equilibrium distribution of hours $G^1$ with a corresponding equilibrium wages $(w^1_1, w^1_2)$. Further, assume that with some probability $\theta$ contracts expire in the beginning of the second period and with probability $1 - \theta$ contracts expire in the beginning of the third period. If the contract expires in the beginning of the third period, then neither firms nor workers can change working hours during the second period. In the beginning of the second period the government announces a reform that reduces the tax on type 1 workers by either setting $t_1 = 0$ or by setting $\phi_1 = 0$. Workers and firms renegotiate contracts and pay applicable penalties. In the third period all contracts expire, workers and firms freely renegotiate contracts.

Suppose the tax break is given to individuals, i.e. $t_1 = 0$. Because firm costs have not changed, firms will not be interested in changing working hours in the second period even for workers whose contracts have expired. On the hand, individuals with ability $\alpha_k < \alpha^*_2$ (recall equation (1.14)) will want to change working hours. Since some of these workers are locked in until period three, the adjustment to final equilibrium will be slow: only $\theta$ fraction of workers will be able to change working hours in the second period. The transitory distribution of hours in the second period will be a sum of distributions $G^2_{\theta}$, which satisfies equivalents of (1.22)-(1.23) and represents new hours of workers whose contracts expire in the beginning of the second period, and distribution $G^2_{1-\theta}$, which represents the distribution of locked-in jobs.

An exception to this rule would be reforms that reduce taxes due on “infeasible” workers. In which case, the equilibrium outcomes will be identical, regardless of whether the tax break is given to individuals or firms, since firms will ignore such incentives.
and therefore is a subset of the first period distribution $G^1$. The final equilibrium distribution in the third period $G^3$ will satisfy conditions (1.22)-(1.23), and therefore will be identical to that of a one-period model described in the previous section. Note that lower tax rate $t_1$ will lead to an increase in labor supply which may lead to a lower equilibrium wages in period three. Adjustment to this new level of wages will be gradual, since only a fraction of workers will be able to increase working hours in period two. Hence, the wages will satisfy $w_1^j \geq w_2^j \geq w_3^j$ for each type of worker $j = 1, 2$ and $w_t^1 = w_t^2$ for each period $t = 1, 2, 3$.

Now suppose the tax break is given to the firms, i.e. $\phi_1 = 0$. Because tax breaks make type 1 workers cheaper, all firms would want to hire as many type 1 workers as they can. Since only fraction $\theta$ of workers is available in period 2 the adjustment will be gradual. Once again, the transitory distribution of hours in period 2 will be a sum of distributions $G_\theta^2$, which now satisfies equivalents of (1.24)-(1.26) and represents new hours of workers whose contracts expire in period 2, and distribution $G_{1-\theta}^2$, which represents the distribution of locked in jobs and therefore is a subset of period 1 distribution $G^1$. The wage level adjustment will be gradual with period 2 wage level of type 2 workers potentially lower than in period 1. However, type 1 workers who sign new contracts in period 2 will immediately enjoy higher wages, since firms will be willing to pay higher wages to enjoy lower taxes. The final equilibrium distribution of hours in period 3 will satisfy conditions (1.24)-(1.26), and therefore will be identical to that of a one-period model described in the previous section. The wages will satisfy $w_1^1 = w_2^1$, $w_1^j \geq w_3^j$ for each type of worker $j = 1, 2$ and $w_t^1 / w_t^2 = 1 + \phi_2$ for each period $t = 2, 3$.

Intuitively, contractual obligations do not erase asymmetry of search and adjustment frictions experienced by firms, merely slow down the adjustment process to the new equilibrium. The model can be further extended to frameworks where firms can change hours of work at any period by paying some penalty $\pi$ distributed according to some cumulative distribution $F_\pi$ with mean $\bar{\pi}$. In this case there exists some critical value of penalty $\pi^*$, so that all contracts with penalties $\pi \leq \pi^*$ are cancelled in the beginning of period 2. The speed of adjustment then depends on how costly the penalties are: the lower the average penalty $\bar{\pi}$, the faster is the adjustment process.

Note that in both frameworks — with locked-in contracts or cancellation penalties — the speed of adjustment will depend not only on the strength of frictions, i.e. respective magnitudes of $\theta$ and $\bar{\pi}$, but also on their distribution across contracts (assuming these are not randomly assigned). Since the reform mostly affects individuals in type 1 contracts, what matters is how many of type 1 workers end up locked-in in their contracts. If most type 1 workers are associated with contracts with low levels of $\pi$ or high value of $\theta$, the adjustment will be faster than if the lower levels of $\pi$ or high levels of $\theta$ are associated with type 2 workers.

61 Whether wages decrease or remain the same will depend on the production function $Q$ and the implied elasticity of labor demand.
Discussion

The results in the baseline model show that the wages of job types 1 and 2 workers will not be equal if at least one of the two conditions is satisfied: employer-paid auxiliary costs are not equal, i.e. $\phi_1 \neq \phi_2$, or labor inputs of type 1 and 2 are not perfectly substitutable and employee-paid taxes change at the threshold, i.e. $t_1 \neq t_2$. The presence of heterogeneous labor costs (either due to employer-paid $\phi_i$ or due to employee-paid $t_i$) will incentivize employers to hire the cheapest form of labor, until an equilibrium is achieved and wages have adjusted appropriately. In other words, even if individuals have large search costs, employers will have an incentive to hire workers of type 1 – assuming type 1 jobs incur lower labor costs – until effective labor costs are equalized. Since the demand for such jobs will be highest around the threshold, “threshold jobs” will be offered and hence bunching at the threshold will be large.

The majority of empirical studies that estimate responses to taxes focus on kinks and notches in the income tax schedules of individuals. From the point of view of firms, workers who earn just below or above the threshold are perfectly substitutable, therefore, income tax differences cannot be passed through to the employer. Since employer-paid taxes do not change at the threshold, neither of the two conditions is satisfied and firms have no incentives to hire more workers just below the kink/notch. Since firms are indifferent, the magnitude of the observed bunching will depend on the strength of employee responses only. Hence, no bunching will be observed if workers experience high search costs and do not seek out “threshold” jobs.

Only a few studies consider settings where employer-paid costs change at the threshold. In many countries, including Germany, social security taxes need not be paid above a predetermined income cap. Hence, employer-paid auxiliary cost of labor decreases above such income cutoff and therefore firms have an incentive to hire more workers “away” from the threshold, thus generating a gap around the income cap.\footnote{Note that in some countries, e.g. UK, employer-paid social security taxes are due on the entire earnings, even though employee-paid contributions stop or become reduced at higher levels of income. The above scenario, therefore, only applies to settings where both employees and employers become exempt from social security taxes.} Liebman and Saez (2006) study earnings responses around the Social Security Wage Base threshold and find no missing mass at the threshold. There are two potential explanations for the lack of response. First, such income threshold represents a kink, rather than a notch. Hiring an employee whose earnings exceed the threshold does not exempt employer from the entire social security contributions, merely a portion of earnings above the cutoff. Therefore, potential savings are small. Second, social security income cutoffs are typically set at large income levels, where the majority of employees work full time. The differences in incomes, therefore, often represent the type of work performed rather than the number of hours worked. Firms thus might be limited in their ability to adjust working hours of employees. Tazhitdinova (2015) studies labor supply responses to a kink generated by the payroll tax exemption threshold in the UK. Because earnings below the primary/secondary payroll threshold are exempt from employer
portions of the National Insurance Contributions (NIC), employers have an incentive to hire more workers below the threshold. While Tazhitdinova (2015b) finds stronger responses to this threshold than do the studies that look at income tax thresholds, bunching is still small. Since the threshold represents a kink, the incentives faced by employers are small as in Liebman and Saez (2006).

1.5 Source of Employer Incentives

The theoretical model in the previous section shows that if firms experience lower labor costs for mini-job workers as compared to regular workers, the equilibrium distribution of earnings will exhibit a large number of mini-jobs. In the short run, until wages adjust to reflect labor cost differences, firms will want to hire more mini-job workers because they incur lower total costs. In the long run, the equilibrium distribution of hours must still reflect a large number of mini-job workers to ensure the wages remain in equilibrium. In this section I provide empirical evidence that the fringe benefits paid to mini-job workers are lower than those paid to regular employees, but the gross wages of mini-job workers are higher, suggesting that the differences in auxiliary costs are passed through to the workers in the form of higher wages, as would be expected in the long run equilibrium. The results of this section thus show that the conditions of case 4 discussed in Section 1.4 are satisfied, and the large magnitude of bunching at the mini-job threshold can be explained by firms’ incentives to make mini-jobs available.

Empirical Approach

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

$$\log(w_{if}) = \alpha_0 + \beta_0 \cdot \text{Mini}_{if} + \alpha_1 \cdot D_{if} + \mathbf{X}_i' \cdot \gamma + \mathbf{F}_f' \cdot \theta + u_i, \quad (1.30)$$

where $w_{if}$ represent hourly gross or net wage of individual $i$ working at establishment $f$, Mini$_{if}$ indicates whether the job individual holds is a mini-job, $\mathbf{X}$ is a vector of individual controls, and $\mathbf{F}$ is a vector of firm controls. The coefficient $\beta_0$ identifies the wage differential $\log(w_1/w_2)$.

In practice, observed individual controls $\mathbf{X}$ omit such important wage determinations as ability, work ethics, etc. Failure to control for omitted variables will lead to a bias in the estimate of $\beta_0$. The problem can be ameliorated using two approaches. The first approach restricts the sample to individuals with plausibly similar skills. A reasonable proxy for skills
is income itself: individuals earning similar incomes are likely to have similar abilities. The second approach uses income directly as a proxy for skills by including a polynomial of income in specification (1.30). As a final specification, I estimate the following econometric model:

$$\log(w_{if}) = \alpha_0 + \beta_0 \cdot \text{Mini}_{if} + \alpha_1 \cdot D_{if} + \alpha_2 \cdot D_{if}^2 + \beta_1 \cdot D_{if} \cdot \text{Mini}_{if} + \beta_2 \cdot D_{if}^2 \cdot \text{Mini}_{if} + X_i' \cdot \gamma + F_f' \cdot \theta + u_i,$$

(1.31)

where $D_{if} \equiv (Y_{if} - K)/K$ is the percent difference between individual’s income $Y_{if}$ and the mini-job threshold $K$. The coefficient of interest, $\beta_0$, captures the discontinuity of wages at the mini-job threshold, when mini-job tax exemptions are removed. I use two approaches to control for the relationship between one’s income and one’s wage. Under the first approach, I control for wage trends by including $D_{if}$, which measure the percent distance between monthly income and the mini-job threshold. Because I restrict the sample to employments with monthly earnings under €1,500 per month, only polynomials of second degree are included. Under the second approach, I restrict the sample to a narrower window around the mini-job threshold, specifically, $[K-€50, K+€100]$. Note that a slightly larger window is used to the right of the threshold because the number of observations is smaller. The second approach thus relies on the assumption that within a small window of monthly earnings, wage trends are absent.

A natural concern of specification (1.31) is that individuals might select into mini-jobs based on unobserved preferences or abilities. Alternatively, only certain types of jobs, which qualities are not observed to the researcher, might be allowed under the mini-job status. As the results will show, mini-jobs typically offer worse working conditions than regular part-time jobs, therefore selection into mini-jobs should primarily depend on one’s savings due to the mini-job tax exemptions rather than anything else. To control for this type of selection, I include, whenever available, a measure of tax savings a mini-job offers to each individual, which depends on individual’s marital status and spousal earnings. The results show that mini-job workers are paid slightly higher wages but lower fringe benefits, suggesting that these differences cannot be attributed to selection among workers: if workers are negatively (positively) selected into the mini-job status, they should receive both lower (higher) wages and lower (higher) fringe benefits. Selection concerns are further mitigated by the fact that the study focuses on part-time workers with low incomes. The majority of workers are employed in low-skilled occupations, naturally limiting the variation in skills or qualities that may lead to differential wages.

The datasets used to estimate equation (1.31) provide information on earnings and working hours, but do not have information on wages. Therefore, two types of measurement error are possible under specification (1.31). First, working hours might be reported with noise. Since 2003, working hours only affect the value of wages and do not determine one’s job status (mini-job vs. regular job), as a result the estimate of the effect of mini-job status on wages $\beta_0$ will remain unbiased and consistent, so long as the measurement error in hours is not correlated with the independent variables. Prior to 2003, mini-jobs were restricted by the amount of monthly earnings and weekly hours. Therefore, when mini-job identifiers are
not available, measurement error in hours would lead to a positive bias in the estimate of $\beta_0$, since overstated hours would understate wages and increase the likelihood of assigning that individual to a regular job status, while at the same time, understated hours would both overstate wages and decrease the likelihood of assigning an individual to a mini-job status. Unfortunately, none of the datasets provide mini-job identifiers prior to 2003. For this reason I focus on observations from 2003 on. Of larger concern is when income is reported with error. Intuitively, an overstated income would overstate both wages and increase the likelihood of assigning that individual to a regular job status. At the same time, understated income would both understate wages and increase the likelihood of assigning an individual to a mini-job status. Therefore, measurement error in income leads to a negative bias in the estimate of $\beta_0$. Fortunately, this type of error is easily alleviated as long as we can correctly assign individuals to the mini-job status. Among the two datasets I use to study estimate (1.31), one dataset (a firm survey) provides mini-job identifiers and therefore eliminates the possibility of a negative bias.

Data Description

I estimate specification (1.31) using two distinct datasets: a survey of businesses and a survey of households. The survey of businesses is a large dataset that provides reliable information on working hours, however, the dataset is not representative of the German population since only firms with 10 or more employees are surveyed. Moreover, the data does not include information of family structure and therefore individuals’ incentives to hold mini-jobs. The household survey, on the other hand, is representative of the population and includes detailed family structure, however, this survey more likely to suffer from measurement error due to the self-reported nature of hours. In this section I describe each dataset and provide summary statistics.

Firm survey – VSE

The first dataset consists of 2006 and 2010 waves of the Structure of Earnings Survey (VSE).\(^{63}\) To create the VSE the German Federal Statistical Offices survey a large sample of firms with ten employees or more in selected industries. The inclusion of industries has changed over time: VSE 2006 did not include businesses operating in agriculture and fishing, public administration and defense.\(^{64}\) VSE 2010 added employees working in public administration, defense and social security, as well as. The main advantage of the VSE is that it provides working hour information that was reported by the firms and therefore is likely to be more

\(^{63}\)In German: Verdienststrukturerhebung, VSE.

\(^{64}\)In other words, VSE 2006 included businesses operating in mining and quarrying; manufacturing; energy and water supply; construction; trade; maintenance and repair of motor vehicles and personal and household goods; hotels and restaurants; transport, storage and communications; financial intermediation; real estate, renting and business activities; education, health and social work, other public and personal services sectors.
accurate than from household surveys such as the SOEP, where the hour data is reported by individuals and therefore is more likely to suffer from measurement error. In addition to working hours, the VSE contains information about the employees themselves (age, sex, experience, training), their jobs (working hours, overtime hours, regular pay and bonuses, number of vacation days), and firms’ characteristics (number of employees, industry, applicable bargaining agreements, geographical location). I restrict the core sample to individuals working in regular jobs and mini-jobs earning from €50 to €1500 per month in 2006/2010. The core sample is restricted to individuals between the ages of 16 to 80 who work more than 1 hour but not more than 45 hours per week. Finally, I drop individuals with gross hourly wage of less or equal to the 1st percentile and greater or equal to the 99th percentile. Appendix Table A.5 provides summary statistics separately for five income groups: with posted earnings of [€50, €375], [€375, €400], [€400, €500], [€500, €1000], [€1000, €1500] per month.

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

**Household Survey – SOEP**

The second dataset I use to estimate equation (1.31) is the German Socio-Economic Panel (SOEP) introduced in Section 1.3. While the SOEP data is more likely to suffer from measurement errors, it provides two advantages. First, the SOEP is representative of the entire German population and therefore includes employees working in all industries and at the establishments of all sizes. Second, the SOEP provides detailed information on family struc-

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65Prior to 2010, short-term marginal employees might be included in the sample and are likely to be assigned the status of “mini-job” whenever earnings do not exceed the mini-job threshold, these employments, however, are not included in 2010. There are two types of mini-jobs in Germany: employments with earnings below the mini-job threshold (which are the focus of this paper) and short-term marginal employments, in German *kurzfristige Beschäftigung*, which are not subject to an earnings limit but are limited in duration to 50 working days or two months per year. This second type of employment is significantly less popular than classical mini-jobs.

66Due to the statistical confidentiality rules the 1st and 99th percentiles cannot be disclosed. However, Panel B of Figure 1.10 suggest that $p_{1} \in (€3, €5)$ and $p_{99} > €21$.

67October 2006 and 2010 respectively.

68There are 0 missing hour observations in 2010 and a total of 69,661 missing hour observations in 2006, of these 60,198 are reported by establishments working in education and 66,049 have reported incomes of less than €375 per month. Because missing hours are concentrated within one industry and within one income group, they are unlikely to bias the results.
ture and therefore allows me to control for selection into mini-jobs based on individual tax incentives. Finally, the SOEP supplies more detailed information of worker’s characteristics, such as education, total working experience, citizenship status. The SOEP includes a self-reported marginal employment status identifier but the quality of this variable is very poor: many of the individuals who self-report as marginal workers earn substantially more than the mini-job threshold. For these reasons, I identify mini-job workers based on the self-reported income only. To reduce the impact of measurement error I restrict my sample to 2004-2011, when the threshold has been set at €400 and hour requirements have been abolished. Since prior to 2003 mini-jobs were restricted to employments under 15 hours per week, including earlier years would likely bias the results substantially due to large measurement errors in hours. The core sample is selected similarly to the VSE sample: individuals between the ages of 16 to 80 with earnings between €50 to €1500 per month, working more than 1 hour per week but less than 45 hours per week. Observations with gross hourly wages at or below the 1st and at or above the 99th percentiles are dropped. Because a few yearly bonus observations show very high values, all yearly bonuses above the 99th percentile were set equal to the 99th percentile. A few individuals reported net wages that exceed posted wages. For these individuals net wage was set equal to the posted wage. Summary statistics from the SOEP are available in the Appendix Table A.6.

Results

Graphical Evidence

Before estimating (1.31) I examine how reported hours, wages and fringe benefits change with workers’ earnings visually in Figures 1.10 and 1.11. Figure 1.10 uses firm survey data. Panel A shows how average hours, as well as 25th and 75th percentiles of hours, change as income rises. There is a clear increasing trend with no apparent discontinuity at the mini-job threshold. Panel B shows that gross hours increase dramatically as income increases. Interestingly, the trend is much stronger for low-income jobs (under the mini-job threshold) than for regular jobs above the threshold. Again, there is no clear discontinuity at the threshold. The majority of these individuals report working less than 20 hours per week earning less than €13 per hour. Nearly 20 percent of individuals report earning very lower wages – under €7 per hour. Panels C and D show the evolution of posted and net wages over the income distribution. Posted wages show no apparent discontinuity, while net wages, as expected, show strong discontinuity at the threshold, since all individuals become liable for social security taxes and some for income taxes. Finally, Panels E and F show how yearly bonuses and the number of vacation days change with income. Very few people in mini-jobs receive yearly bonuses (which include holiday, Christmas and performance bonuses, severance

Moreover, the difference between gross and net wages for these individuals is large which is contradictory to mini-jobs being exempt from social security and income taxes. In contrast, for the majority of mini-job workers in the VSE 2006/2010 social security and income taxes are reported to be zero, consistent with mini-job rules.
payments, profit sharing, bonuses for improvement suggestions, allowances for inventions, and the taxable value of stock options), and there is a clear discontinuity at the threshold. The number of vacation days for which a person is eligible also increases dramatically with income, and again there is a clear discontinuity at the threshold. Surprisingly, at least 25% of workers are reported to qualify for zero vacation days despite vacation allowances being a legal requirement in Germany. This evidence is consistent with survey evidence of [Bachmann et al. (2012)] and [Wippermann (2012)], who find that many individuals are unaware of their rights and do not receive required by law holiday pay.

Figure 1.11 shows graphical evidence similar to Figure 1.10 but based on household survey data. Panel A again shows that weekly working hours increase rapidly with income and that there is a clear discontinuity at the mini-job threshold. Gross wages reported in Panel B are substantially lower than reported in the VSE, corresponding to higher working hours in Panel A. Panel B also shows a discontinuity in gross wages at the mini-job threshold. Panels C and D show the evolution of posted and net wages across income bins. Posted wages show no clear discontinuity at the threshold, but net wages are higher for mini-job workers around the threshold. Finally, Panel E shows the size of the yearly bonus (which includes 13th and 14th month pay, christmas and holiday bonus, and profit sharing payments). The the vast majority – more than 75% – earning less than €400 per month report receiving zero bonuses. The magnitude increases slightly for higher incomes but remains small when compared to Figure 1.10. Unfortunately, no information on the number of vacation days is available in the SOEP.

Higher reported hours in the SOEP could either be due to measurement errors, due to sample selection, or due to reporting rules. It is possible that individuals working in smaller firms – with 10 employees or less – earn lower hourly wage. Since VSE only surveys firms with 10 employees or more this would lead to a negative bias in hours reported in the VSE. On the other hand, survey respondents in the SOEP might include all hours worked, regardless of whether they were paid for these additional hours or not. Further, the SOEP hour variable includes overtime hours, while in the VSE overtime hours are reported separately. The number of overtime hours reported in the VSE is very small since most of the individuals are part-time workers and thus it is unlikely to explain the difference.

The preliminary evidence from Figures 1.10 and 1.11 indicates that mini-jobs are attractive to firms because they incur lower fringe benefits as compared to regular jobs. The graphical evidence, however, does not account for the fact that some individuals with incomes below the mini-job threshold are regular employees, while some individuals with incomes above the threshold are mini-job workers. If one restricts the sample to individuals whose incomes and mini-job status correspond precisely, the discontinuity in gross wages

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70 Employers were asked to provide the number of full-time equivalent vacation days a worker is entitled to during the survey year.

71 Because the mini-job threshold applies to combined earnings, individuals with several low-paying jobs might be subject to regular taxation. Alternatively, workers who usually receive higher incomes, might temporarily experience low hours and hence report earnings below the mini-job threshold. Finally, mini-job workers are allowed to exceed the threshold several times per year.
CHAPTER 1. FIRM INCENTIVES AND LABOR RESPONSES TO TAXES

at the mini-job threshold becomes apparent in the VSE data. See Figure 1.12. In addition, the results in Figures 1.10 and 1.11 do not control for observable characteristics such as occupation, industry, or geographical location. For this reason, I turn to regression evidence.

Gross Wage Differential and Fringe Benefits

Results from the VSE (firm survey) are presented in Table 1.4. Columns (1) through (5) estimate specification (1.31) within a narrow window of earnings around the mini-job threshold: only individuals earning between €375 to €500 are included. Columns (6) through (9) extend the window to the core sample – individuals earning between €50 and €1500 per month. Table 1.4 provides results for several dependent variables: logarithm of hourly gross, posted and net wages, yearly bonus (in euros), the number of vacation days, and the logarithm of total gross wage calculated as the sum of all yearly payments divided by total yearly hours. Firm fixed effects are included in columns (2), (3), (4), (7) and (9). Table 1.4 shows that gross wages are 6-9% higher for mini-job workers than regular employees, the results are robust across all 9 specifications. Including firm fixed effects increases the wage differential, a likely explanation is that firms that hire mini-job workers are more “frugal” and pay lower wages. Such firm selection is then implicitly absorbed in the mini-job coefficient $\beta_0$ when firm fixed effects are not included. Since wages show increasing trends both below and above the mini-job threshold, including linear and quadratic trends also increases the wage differential between the gross wages paid to mini-job and to regular workers. Note that in contrast to Panel C of Figure 1.10, which shows gross wage just below the threshold approximately equal to gross wage just above, specification (1) implies that mini-job wages are approximately 6% higher. This discrepancy is due to the fact that not all workers below the threshold are mini-job workers, and vice versa. When one restricts the sample to individuals whose incomes and mini-job status correspond precisely, the discontinuity at the mini-job threshold becomes apparent. See Figure 1.12 in the Appendix.

In contrast to gross wages, hourly posted wages are extremely similar, with a statistically significant difference of plus/minus 2% depending on the specification. In other words, in the market, mini-job workers and regular workers are paid similar posted wages, but employers are liable for larger social security taxes on mini-jobs, which generates a higher gross wage for those employees. Net wages are approximately 15 to 23% larger for mini-job workers than regular employees, which roughly corresponds to the difference expected from Tables 1.1-1.2.

Consistent with graphical evidence from Figures 1.10, regression evidence shows that fringe benefits are smaller for mini-job workers than regular employees. Table 1.4 shows that...

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Recall that women must pay an average of €90 in income taxes, while men an average of €30. Together with €40 euros of social security contributions due, this implies a combined notch of €70 to €130, which corresponds to a drop of 17.5 to 32.5% in net wages at the mini-job threshold. The total amount of social security contributions changes smoothly at the mini-job threshold, but the relative shares change discontinuously: employers switch from paying 30% contributions in mini-jobs to roughly 20% in regular jobs. The differential is picked up by the workers, hence, crossing the threshold implies paying a minimum of €40 in social security taxes.
mini-job workers receive smaller yearly bonuses — €60-100 less — and fewer vacation days — 2-3 days less — than regular employees. Including firm fixed effects reduces the difference, again consistent with the notion that firms that hire the mini-job workers offer worse wages and benefits in general. Finally, the last dependent variable incorporates fringe benefits (bonuses and vacation day pay) into a measure of total gross wage and shows that accounting for bonus and vacation pay does not equate the wages of mini-job workers and regular employees, but it reduces the difference substantially.\footnote{The dependent variable is calculated as the sum of all yearly gross wages plus yearly bonuses plus the number of vacation days times 7.5 hours times the gross wage divided by the yearly equivalent of hours worked.} Unfortunately, the yearly bonuses and vacation days do not cover all fringe benefits received by the employees. For example, sick day pay, statutory holiday pay, and maternity leave payments are not included. The fact that mini-job workers are paid slightly higher wages but lower fringe benefits suggests that these differences cannot be attributed to selection among workers: if workers are negatively selected into the mini-job status, they should receive both lower wages and lower fringe benefits. Similarly, if workers are positively selected into the mini-job status, they should receive both higher wages and higher fringe benefits. The results in Table 1.4 therefore suggest that employers are willing to pay mini-job workers higher gross wages because they incur lower fringe benefit costs. This finding leads support to the theoretical model in Section 1.4: workers in Germany are able to bunch at the mini-job threshold because the labor cost structure differs for mini-job and regular workers.

The regression results from the SOEP (household survey) are available in Table 1.5 and reinforce the finding that mini-job wages are higher at the threshold than regular wages. Columns (1) and (6) can be directly compared to columns (1) and (6) of Table 1.4, while columns (3) and (8) provide the closest comparison to columns (4) and (8) of Table 1.4 respectively. The gross wage differential varies between 6.5% to 13.7%, and thus is quite a bit larger in the SOEP than in the VSE. In columns (2), (4), (5), (7) and (9), I control for incentives to bunch at the threshold by including the variable \textit{individual notch} which measures the size of the tax notch experienced by a worker at the mini-job threshold and is based on spousal earnings. Results in columns (2), (4), (5), (7) and (9) suggest that controlling for marital status and tax incentives does not have a large effect on the wage differential. This finding is reassuring in light of my inability to control for family characteristics in the firm survey results, and again supports the idea that selection is unlikely to explain the differences in wages and fringe benefits.

Posted wages are slightly larger for mini-job than regular workers, but the difference is not statistically significant. Net wages are reported to be 15.5-19% larger for mini-job workers than regular employees. In the household survey data, yearly bonus appears to be smaller for mini-job workers, but not all coefficients are statistically significant, as can be seen in Table 1.5. Not surprisingly, including bonus in gross wage calculation does not decrease the wage differential between mini-job workers and regular employees substantially: the magnitude of reported bonuses is smaller in the SOEP as compared to the VSE. This difference could
either be due to measurement error – individuals forget to report received bonuses – or due to firm selection – firms with 10 employees or more might give larger bonuses than smaller firms.

Together the results in Tables 1.4 and 1.5 provide strong evidence that the wage differential between mini-job and regular workers is positive and it reflects the differences in fringe benefits between the two types of jobs. Because I do not have data on all fringe benefits paid, I am not able to show that the total labor costs – inclusive of wages, taxes and benefits paid – are equal for mini-job and regular workers, but the estimates in the last row of Table 1.4 suggests that this is likely to be the case. Following the prediction in Section 1.4, the large amount of bunching at the mini-job threshold can then be explained by the differences in labor costs between mini-job and regular part-time workers. Originally, lower fringe benefits made mini-jobs attractive to firms because mini-job workers incurred lower costs. In the long run – when mini-jobs wages have adjusted upward – the number of mini-jobs remains to be high to ensure wage equilibrium.74

Tables 1.6 repeats specifications (4) and (9) from Table 1.4 but interacts the mini-job indicator with gender and age indicators, and indicators of collective agreements. Columns (1) and (4) show that the wage gap is slightly bigger for males, but the difference is extremely small. Most interaction terms with age variables are not statistically significant in columns (2) and (3). Finally, columns (3) and (6) study the effect of collective agreements. For each firm up to three types of collective agreements are reported, these include industry-level collective agreements which only cover workers from specific industry, firm collective agreements that cover workers of the firm, and enterprise level collective agreement which cover workers at the enterprise level. None of these agreements typically apply to mini-job workers. Moreover, not all agreements affect wages, some agreements only regulate working hours, overtime, vacancy postings, etc. Industry agreements are most common, however, these need not apply to all workers at the firm, merely to the workers who are part of the respective union. Results in column (3) suggest that only the presence of an enterprise-level agreement affects the wage differential between mini-job workers and regular employees, completely eliminating the difference. The magnitude of this effect is smaller in column (6). The presence of an industry agreement, on the other hand, increases the wage differential in specification (6).

Appendix Tables A.7 and A.8 show that estimates are robust to sample selection and hour definition.

### Employment Duration

It is possible that mini-jobs are attractive to firms because of potentially lower dismissal costs. In this section I argue that such incentive is unlikely to be the driving mechanism behind the popularity of mini-jobs. In Germany labor protections do not apply during the

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74If the number of mini-jobs were to decrease, the labor supply of mini-jobs would exceed labor demand, and wages would decrease, again generating incentives for firms to hire mini-job workers.
first 6 months of employment. Therefore, if temporary help is needed firms can hire regular part-time workers without worrying about future termination costs. Figure 1.13 provides further evidence that at-the-threshold mini-job employments are more stable than those of similar part-time workers. Figure 1.13 shows the cumulative distribution of employment durations with a given enterprise based on the SIAB data. I consider employment spell terminated if individual quits labor force, switches to a different establishment, or employment is interrupted for more than 30 days. The results show that more than 50% of non-threshold mini-job workers, i.e. individuals earning less than mini-job threshold minus €25 per month, and regular part-time workers, i.e. individuals earning between mini-job threshold and €400 per month, are employed for 6 months or less at any given establishment. In contrast, less than 35% of individuals in at-the-threshold jobs are terminated within 6 months. In general, at-the-threshold mini-jobs offer longer employment spells compared to other part-time jobs.

Most mini-job workers are also not flexible along the intensive margin. As can be seen in Figures 1.3 and 1.4, the vast majority of mini-job workers are employed in at-the-threshold jobs. Since these individuals already work the maximum number of allowed hours, their hours cannot be extended as necessary. Hence, mini-jobs should not be attractive to firms that are looking for flexibility in the number of hours worked.

Re-evaluating Elasticity Estimates

When estimating earnings elasticities in Section 1.3, I assume that only tax liabilities change at the threshold. The results in this section provide clear evidence that this is not the case: in addition to tax liabilities, gross wages and fringe benefits, e.g. vacation pay and yearly bonuses, also change at the threshold. How does this finding affect the estimates of elasticities in Section 1.3? The answer to this question depends on what we believe about individuals’ valuation of fringe benefits. If individuals value fringe benefits in full and wages adjust appropriately to reflect differences in employer labor costs, then elasticity estimates are correct as long as we estimate them using the distributions of total pay, i.e. earnings inclusive of all benefits. On the other hand, if fringe benefits are not valued by workers, and mini-job wages are higher than wages in regular jobs, then in addition to tax-induced notch and kink, individuals experience an additional kink at the mini-job threshold due to the difference in wages.

Vacation pay and bonus payments are monetary benefits that are likely to be valued by individuals at their face value. Bachmann et al. (2012) and Wippermann (2012) find that mini-job workers are also less likely to receive sick day pay, statutory holiday pay, maternity pay and company training. All these benefits, with the exception of company training are monetary payments received in the near future and therefore there is no reason to believe individuals would not value them. The distribution of earnings used to estimate elasticities in Section 1.3 is inclusive of bonus payments, as well as vacation, sick day and statutory pay. Therefore elasticities estimated in Section 1.3 should provide accurate estimates of the true elasticity of earnings with respect to the net-of-tax rate if gross wages reached an equilibrium and reflect differences in employer costs. Results of Table 1.4 suggest this is likely to be the
case. If the wages of mini-job workers are too low, the size of the notch is actually smaller, and elasticities are slightly underestimated.

1.6 Conclusion

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

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

The findings of the paper stress the importance of firms in the equilibrium outcomes of labor markets in general. While individuals are likely to suffer from adjustment costs, information frictions and behavioral biases, and therefore are constrained in their ability to respond to tax changes and labor regulations, firms are likely to be more responsive to incentives generated by tax systems and labor rules. To devise effective labor rules, policymakers should not only take into account how policies may influence workers’ decisions, but also consider firms’ incentives.
# Table 1.1: Mini-Job Rules and Social Security Tax Rates

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<thead>
<tr>
<th>Mini-Job Threshold</th>
<th>Social Security</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mini rate</td>
<td>Phase-out rate</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>$\tau_{\text{Mini}}$</td>
</tr>
<tr>
<td>by year:</td>
<td>1999</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>2001</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>2002</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>2004</td>
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</tr>
<tr>
<td></td>
<td>2006</td>
<td>400</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>2010</td>
<td>400</td>
</tr>
<tr>
<td>1998-2002:</td>
<td>under 25</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>25–40 years old</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>40–60 years old</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>over 60</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>25–40 years old</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>40–60 years old</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>over 60</td>
<td>400</td>
</tr>
</tbody>
</table>

*Notes:* This table shows the size of the mini-job threshold (in posted earnings); mini-job, the phase out and full social security tax rates. Mini-job social security (SS) rate is charged on incomes below or at the mini-job threshold. The phase out SS rate is charged on earnings between €400 and €800 from 2003 on. Regular SS rate is charged on incomes above €400. For further details see Section 1.3 and Appendix A.2. *Source:* Author’s calculations using Socio-Economic Panel (SOEP), version 30.
### Table 1.2: Income Tax Notches and Marginal Tax Rates

<table>
<thead>
<tr>
<th>Year</th>
<th>Income Tax Women</th>
<th>Income Tax Men</th>
<th>Notes</th>
</tr>
</thead>
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<tr>
<td></td>
<td>Notch $\Delta T_{Income}$</td>
<td>MTR $\tau_{Income}$</td>
<td>Notch $\Delta T_{Income}$</td>
</tr>
<tr>
<td>by year:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>86</td>
<td>27</td>
<td>31</td>
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<tr>
<td>2000</td>
<td>85</td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td>2001</td>
<td>80</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>2002</td>
<td>80</td>
<td>25</td>
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<td>2003</td>
<td>99</td>
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<td>34</td>
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<tr>
<td>2004</td>
<td>94</td>
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<td>31</td>
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<tr>
<td>2005</td>
<td>92</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
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<td>92</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>2007</td>
<td>92</td>
<td>24</td>
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<td>2008</td>
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<td>24</td>
<td>30</td>
</tr>
<tr>
<td>2009</td>
<td>91</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td>2010</td>
<td>90</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td>1998-2002:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>under 25</td>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>25–40 years old</td>
<td>84</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>40–60 years old</td>
<td>80</td>
<td>25</td>
<td>41</td>
</tr>
<tr>
<td>over 60</td>
<td>20</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>2003-2011:</td>
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<td></td>
</tr>
<tr>
<td>under 25</td>
<td>8</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>25–40 years old</td>
<td>92</td>
<td>24</td>
<td>19</td>
</tr>
<tr>
<td>40–60 years old</td>
<td>92</td>
<td>24</td>
<td>49</td>
</tr>
<tr>
<td>over 60</td>
<td>24</td>
<td>7</td>
<td>10</td>
</tr>
</tbody>
</table>

**Notes:** This table shows the average income tax notch and income tax marginal tax rate experienced by individuals at the mini-job threshold. *Notch* is the average lump-sum payment of income tax an individual must make upon exceeding the mini-job threshold. *MTR* is the average marginal tax rate at the mini-job threshold. For single individuals, spousal income is set to zero. Spousal income includes labor earnings, as well as social security and private pensions. For further details see Section 1.3 and Appendix A.2. *Source:* Author’s calculations using Socio-Economic Panel (SOEP), version 30.
Table 1.3: Heterogeneity of Elasticities by Gender, Age, Marital Status and Industry

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>e</td>
<td>s.e.(e)</td>
<td>e</td>
</tr>
<tr>
<td><strong>Women:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>under 25</td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
</tr>
<tr>
<td>25-40 years old</td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
</tr>
<tr>
<td>40-60 years old</td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
</tr>
<tr>
<td>over 60</td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
</tr>
<tr>
<td><strong>Men:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>under 25</td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
</tr>
<tr>
<td>25-40 years old</td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
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<tr>
<td>40-60 years old</td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
</tr>
<tr>
<td>over 60</td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
</tr>
<tr>
<td><strong>Singles:</strong></td>
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<tr>
<td>2003-2005</td>
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<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
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<tr>
<td>2006-2010</td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
<td><img src="image" alt="Cell" /></td>
</tr>
</tbody>
</table>

Notes: This table shows elasticities of earnings with respect to net-of-tax rate by gender, age group, marital status and industry. These elasticities are estimated using an approach presented in Section 1.3. Source: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.
Table 1.4: The Effect of Mini-Job Status on Wages, Bonuses and Vacation Days (Firm Survey VSE)

<table>
<thead>
<tr>
<th>Dependent Variable: Log(Hourly Gross Wage)</th>
<th>Monthly Income €375–€500</th>
<th>Monthly Income €50–€1500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Monthly Income €375–€500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini-Job</td>
<td>0.060***</td>
<td>0.091***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Monthly Income €50–€1500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini-Job</td>
<td>-0.017***</td>
<td>0.014***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Dependent Variable: Log(Hourly Net Wage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini-Job</td>
<td>0.173***</td>
<td>0.191***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Dependent Variable: Yearly Bonus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini-Job</td>
<td>-141.561***</td>
<td>-80.246***</td>
</tr>
<tr>
<td>Dependent Variable: Vacation Days</td>
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<td></td>
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<tr>
<td></td>
<td>(0.320)</td>
<td>(0.171)</td>
</tr>
<tr>
<td>Dependent Variable: Log(Hourly Gross Wage incl. Bonus and Vacation Pay)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini-Job</td>
<td>-0.017**</td>
<td>0.053***</td>
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<tr>
<td></td>
<td>(0.009)</td>
<td>(0.006)</td>
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<tr>
<td>Firm FE</td>
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<tr>
<td>Individual Controls</td>
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<td>No</td>
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<tr>
<td>Firm Controls</td>
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<tr>
<td>Linear Wage Trend</td>
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<td>No</td>
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<tr>
<td>Quadratic Wage Trend</td>
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<td>No</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>107,239</td>
<td>107,239</td>
</tr>
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</table>

Notes: This table shows the coefficients from regressing the listed dependent variables on a mini-job indicator variable. Standard errors are clustered by firm. Source: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author’s calculations.
### Table 1.5: The Effect of Mini-Job Status on Wages and Bonuses (Household Survey SOEP)

<table>
<thead>
<tr>
<th>Dependent Variable: Log(Hourly Gross Wage)</th>
<th>Monthly Income €375–€500</th>
<th>Monthly Income €50–€1500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Mini-Job</td>
<td>0.086**</td>
<td>0.065*</td>
</tr>
<tr>
<td></td>
<td>(0.038)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>Indiv. Notch</td>
<td>0.003***</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Dependent Variable: Log(Hourly Posted Wage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini-Job</td>
<td>0.017</td>
<td>-0.004</td>
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<tr>
<td></td>
<td>(0.038)</td>
<td>(0.038)</td>
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<tr>
<td>Indiv. Notch</td>
<td>0.003***</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
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<tr>
<td>Dependent Variable: Log(Hourly Net Wage)</td>
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<tr>
<td>Mini-Job</td>
<td>0.196***</td>
<td>0.158***</td>
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<td>Dependent Variable: Yearly Bonus</td>
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<td>Indiv. Notch</td>
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<td>Dependent Variable: Log(Gross Wage incl. Bonus)</td>
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<td>(0.038)</td>
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<tr>
<td>Indiv. Notch</td>
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<td>-0.001</td>
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<td></td>
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<td>(0.001)</td>
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<td>Year Effects</td>
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<td>Indiv. Controls (full)</td>
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<tr>
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<td>Number of Observations</td>
<td>3,373</td>
<td>3,238</td>
</tr>
</tbody>
</table>

Notes: This table shows the coefficients from regressing the listed dependent variables on a mini-job indicator variable. Standard errors are clustered by individual. Source: Socio-Economic Panel (SOEP), version 30.
### Table 1.6: The Effect of Mini-Job Status on Gross Wage (Firm Survey VSE)

<table>
<thead>
<tr>
<th></th>
<th>Monthly Income €375–€500</th>
<th>Monthly Income €50–€1500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Dependent Variable: Log(Hourly Gross Wage)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini-Job</td>
<td>0.087***</td>
<td>0.089***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Mini-Job x Male</td>
<td>0.001***</td>
<td>0.016***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Mini-Job x Age&lt;25</td>
<td></td>
<td>-0.011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.009)</td>
</tr>
<tr>
<td>Mini-Job x Age 40-60</td>
<td>0.007</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td></td>
</tr>
<tr>
<td>Mini-Job x Age 60-65</td>
<td>-0.011</td>
<td>0.011***</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Mini-Job x Age &gt;65</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td></td>
</tr>
<tr>
<td>Mini-Job x Industry Coll. Agr.</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td></td>
</tr>
<tr>
<td>Mini-Job x Firm Coll. Agr.</td>
<td>-0.023</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td></td>
</tr>
<tr>
<td>Mini-Job x Enterprise Coll. Agr.</td>
<td>-0.101***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td></td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Occupation Controls</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Linear Wage Trend</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Quadratic Wage Trend</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>107,239</td>
<td>107,239</td>
</tr>
</tbody>
</table>

**Notes:** This table shows the coefficients from regressing the logarithm of gross wage on a mini-job indicator interacted with gender (columns 1 and 4), age (columns 2 and 5), collective agreements (columns 3 and 6). Standard errors are clustered by firm. *Source:* FDZ der Statistischen Ämter des Bundes und der Länder, Verdienstrukturhebung, 2006 and 2010, author’s calculations.
Figure 1.1: Budget Constraints Around the Mini-Job Threshold (in Gross Wages)

**Panel A: 1999-2002**

**Panel B: 2003-2005**

**Panel C: 2006-2010**

Notes: This figure shows budget constraints experiences by individuals in 1999-2002, 2003-2005 and 2006-2010 in terms of gross earnings. Gross earnings are defined as wages paid inclusive of all income and employee-paid social security taxes plus social security taxes paid by the employer. The budget constraints show the magnitude of the social security notch and the magnitude of change in social security tax rate (absolute difference). In addition to higher social security taxes, individuals must pay income taxes. The magnitude of income tax due, $\hat{\tau}_{\text{income}}$ and $\Delta \hat{\tau}_{\text{income}}$, depends on individual’s marital status and spousal earnings. For single individuals, $\hat{\tau}_{\text{income}} = 0$ and $\Delta \hat{\tau}_{\text{income}} = 0$. For married individuals, $\hat{\tau}_{\text{income}} = \frac{\tau_{\text{income}}}{1 + 0.5\tau_{\text{Full}}}$ and $\Delta \hat{\tau}_{\text{income}} = \Delta T + \tau_{\text{income}} K \left( \frac{1}{1 + 0.5\tau_{\text{Full}}} - \frac{1}{1 + \tau_{\text{Mini}}} \right)$, where $\tau_{\text{Mini}}, \tau_{\text{Full}},$ and average $\tau_{\text{income}}$ and $\Delta T_{\text{income}}$ are available in Table 1.1 and 1.2. For further details see Section 1.3.
Figure 1.2: Budget Constraint in Presence of Kink and a Notch

Notes: Panel A shows the budget constraint of an individual whose marginal tax rate increases from $t_1$ to $t_2$ and who must pay a lump-sum tax $\Delta T$ at the threshold $K$. Panel B shows the corresponding distribution of earnings in the presence of such tax schedule.
Figure 1.3: Earnings in 1999–2010: Women

Notes: This figure shows the distribution of monthly wage earnings (posted) of women by calendar year. Each point shows the number of individuals in a €25 bin, scaled to represent the German population in that year from a 2% random sample. The vertical red lines identify the mini-job thresholds: €325 prior to 2003 and €400 thereafter. Source: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.
Figure 1.4: Earnings in 1999-2010: Men

Notes: This figure shows the distribution of monthly wage earnings (posted) of men by calendar year. Each point shows the number of individuals in a €25 bin, scaled to represent the German population in that year from a 2% random sample. The vertical red lines identify the mini-job thresholds: €325 prior to 2003 and €400 thereafter. Source: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.
Figure 1.5: Earnings in 1999-2002 and 2003-2010: Women by Age Group

Notes: This figure shows the distribution of monthly wage earnings (posted) of women by age group in 1999-2002 and 2003-2010. Each point shows the number of individuals in a €25 bin divided by the total number of females in that year group. The vertical red lines identify the mini-job thresholds: €325 prior to 2003 and €400 thereafter. Source: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.
Figure 1.6: Earnings in 1999-2002 and 2003-2010: Men by Age Group

Notes: This figure shows the distribution of monthly wage earnings (posted) of men by age group in 1999-2002 and 2003-2010. Each point shows the number of individuals in a €25 bin divided by the total number of males in that year group. The vertical red lines identify the mini-job thresholds: €325 prior to 2003 and €400 thereafter. Source: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.
Figure 1.7: Excess Mass and Elasticity Estimates

Figure 1.8: Behavioral Responses to the First Income Tax Kink in 1998 and 2001

Notes: These figures show the distribution of posted earnings in 1998 and 2001 for single and married individuals around the start of first income tax bracket. In 1998, the marginal income tax rate increased from zero to 25.9% at €6,322 for single and at €12,644 for married individuals. In 2001, the marginal income tax rate increased from zero to 19.9% at €7,206 for single and at €14,412 for married individuals. Source: FDZ der Statistischen Ämter des Bundes und der Länder, Lohn- und Einkommensteuerstatistik Public-Use-Files, 1998 and 2001, author’s calculations.
Figure 1.9: “Firm Bunching” – Individuals with Multiple Jobs

Notes: This figure shows the distribution of posted earnings in a secondary job for individuals who concurrently hold a second job in addition to “regular” job, defined as a job that pays more than €325 in 1999-2002 or more than €400 in 2004-2010. The distributions shown present averages across respective years. Only individuals who are reported to work at two enterprises per year are included. Source: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.
Figure 1.10: Earnings Distributions, Weekly Hours and Wages by Income (Firm Survey VSE)

Panel A: Weekly Hours

Panel B: Gross Wages

Panel C: Posted Wages

Panel D: Net Wages

Panel E: Yearly Bonus

Panel F: Vacation Days

Source: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienstrukturbericht, 2006 and 2010, author’s calculations.
Figure 1.11: Earnings Distributions, Weekly Hours and Wages by Income (Household Survey SOEP)

Panel A: Weekly Hours

Panel B: Gross Wages

Panel C: Posted Wages

Panel D: Net Wages

Panel E: Yearly Bonus

Source: Socio-Economic Panel (SOEP), version 30, author’s calculations.
Figure 1.12: Hourly Gross Wage by Income: Subsample (Firm Survey VSE)

Notes: This figure shows the mean, as well as the 25th and 75th percentiles of hourly gross wage by €25 bins of monthly pay in 2006 and 2010. The sample is restricted to mini-job workers with monthly posted earnings below the mini-job threshold and regular workers with monthly posted earnings above the mini-job threshold. Source: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author’s calculations.
Figure 1.13: Job Duration by Type of Employment

Notes: This figure shows the cumulative distribution function of job durations (within the same establishment) based on the SIAB 1999-2010 data. Job duration is calculated as the time spent at any given establishment with employment breaks of less than 30 days. Cumulative distributions are based on monthly earnings in the first year of employment. Mini-jobs are defined as employments with monthly earnings of less than €300 before 2003 and less than €375 from 2003 on. At-the-threshold mini-jobs are defined as employments with monthly earnings of [€300,€325] or [€375,€400] respectively. Midi-jobs are defined as employments with monthly earnings of (€325, €800] or (€400,€800] respectively. Finally, regular jobs are defined as employments with monthly earnings of more than €800. Source: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.
Chapter 2

Labor Supply Responses to Payroll Taxes in the UK

2.1 Introduction

Recent empirical literature on taxation and labor supply has found small behavioral responses to kinks and notches in income tax rates among the wage earners. However, much less is known about the ability of individuals to optimize with respect to payroll taxes. In this paper I consider the unique setup of payroll taxation in the U.K. to study and compare behavioral responses to payroll and income taxes.

In contrast to the majority of Organization for Economic Co-operation and Development (OECD) countries where payroll taxes are charged on any amount of earnings, in the UK earnings below a certain threshold are exempt from both employee and employer payroll taxes. Similarly, self-employed individuals do not pay payroll taxes below a pre-determined yearly threshold. An additional feature of the tax system makes behavioral responses to this kink attractive. Individuals (both wage earners and self-employed) are able to earn social security credits even when their earnings do not exceed the contribution limit. In case of wage earners, social security credits are earned when earnings exceed a different threshold that is set below the contribution threshold. In case of the self-employed, social security credits are based on a flat weekly contribution that is paid separately from proportional payroll tax. Therefore limiting one’s earnings to the contribution threshold does not prevent one from qualifying for retirement benefits or unemployment insurance. The UK setting therefore allows to study responses to payroll taxes in addition to income taxes and also understand whether individuals find social security benefits valuable.

1For a recent literature review see Saez et al. (2012a).
2Payroll taxes in the UK — called National Insurance Contributions — qualify individuals for retirement pension benefits, unemployment insurance, maternity allowance and bereavement benefits. In order to qualify for the benefits workers need to accumulate a number of credits which can by obtained by earning a certain minimum each year or by making voluntary contributions.
I find that responses depend on individual’s employment status: whether a worker is a wage earner, self-employed, or a proprietor. In line with the existing literature I document weak (but statistically significant) bunching at the first combined kink point of the income plus payroll tax schedule among the wage earners in 2003–2007. When the income tax exemption threshold increases in 2009–2010, bunching remains at the payroll threshold, suggesting that individuals are aware of the payroll tax rules and respond accordingly. Estimated elasticities are small and do not exceed 0.09. I also find heterogeneous responses across age groups and industries, but less variation by region. Despite some small bunching at the payroll/income tax threshold, I find no bunching to the right of the threshold that determines whether an individual earns social security credit in that year. This finding suggests that either individuals do not assign a high value to pension benefits, or unaware of how social security credits are accumulated. Lack of bunching is persistent across age groups and unlikely to be explained by friction costs as individuals are able to bunch at other kink points.

Next, I find strong responses to tax incentives among the self-employed. I estimate an elasticity of taxable earnings of approximately 0.3. The magnitude of response, however, differs substantially by the kink type. The strongest response is observed around the first kink of income or social security tax schedules and smaller bunching at higher kinks. I use a tax reform to investigate whether self-employed individuals simply ignore nonsalient kinks or instead aggressively reduce earnings to bunch at the lower, more salient kink point. I estimate that bunching at the first kink does not change despite changes in tax rates, suggesting that in presence of multiple kinks individuals are likely to reduce earnings so that to bunch at the lower kink point.

Finally, I document very strong behavioral responses by the proprietors. I find that roughly 20% of firm owners minimize payroll tax liability by paying a salary equal to the payroll threshold and the rest in the form of dividends. Nevertheless a large number of firm owners fail to optimize, thus incurring a unnecessarily large payroll tax liability. This finding shows that many individuals – including those self-employed – fail to use simple and legal tax avoidance mechanisms. I also show that another 8% of directors follow rules of thumb and pay salaries in the multiples of £5,000 and £6,000.

The paper contributes to several literatures. First it shows that wage earnings responses to social security taxes in general are weak and similar in magnitude to responses to income taxes (Saez (2010), Chetty et al. (2011), Bastani and Selin (2014), Kleven and Waseem (2013)). Previous literature (Kramarz and Philippon (2001), Liebman and Saez (2006), Saez et al. (2012b), Lehmann et al. (2013)), struggled to estimate responses to payroll taxes because most payroll schedules are flat and rarely experience large changes. The institutional setting in the UK thus allows to separately observe responses to income and social security taxes.

Second, the paper provides evidence that wage earners in the UK either do not assign high value to pension benefits, consistent with some evidence from other countries and settings (Gruber (1997) and Fitzpatrick (2014)) or unaware of how social security contributions work, consistent with the literature that documents the importance of information frictions in tax
systems (Chetty et al. (2013), Chetty and Saez (2013), HMRC (2007)). The results provide support to small literature that argues about the erosion of the contributory principle in the UK (Johnson and Stears (1996), Clasen (2001) and Hills (2003)).

Third the results provide evidence of large behavioral responses, in the form of avoidance and evasion, by the self-employed and proprietors. The paper contributes to the literature by showing that on the one hand self-employed individuals are successful at reducing tax liabilities by decreasing reported earnings, as has been found in other countries (Saez (2010), Chetty et al. (2011), le Maire and Schjerning (2013)), and through income shifting (Romanov (2006), Sivadasan and Slemrod (2008), Pirttil and Selin (2011)). On the other hand, many individuals fail to take advantage of simple and legal tax avoidance schemes. This finding suggests that individuals are likely to suffer from information frictions or other behavioral biases. Further, this paper provides a potential explanation for the lack of bunching at smaller kinks in the tax schedule by the self-employed, observed in many studies (e.g. Saez (2010) and Chetty et al. (2011)). I find that lack of bunching at nonsalient kinks is compensated by larger bunching at the lower, salient kinks, thus showing that the self-employed do not ignore changes in the tax rates, but aggressively reduce reported income to bunch at lower, more salient thresholds.

The rest of the paper is organized as follows. Section 2 explains institutional framework and describes the data, while Section 3 explains the estimation approach. Sections 4, 5 and 6 describe behavioral responses of the wage earners, self-employed and proprietors. Section 7 concludes.

2.2 Institutional Setting and Data Description

Payroll Taxation in the UK

In the United Kingdom National Insurance system provides individuals with pension and unemployment benefits. The contribution rate depends on individuals’ status. For wage earners – including company directors – pension and unemployment insurance credits are earned when one’s wage earnings exceed the Lower Earnings Limit (LEL). Employees are liable to pay their portion of the National Insurance Contributions (NIC) on weekly earnings above the primary (i.e. employee) threshold. Employers are liable for their portion of NIC on worker’s weekly earnings above the secondary (i.e. employer) threshold. Both primary and secondary thresholds are set above the LEL. NIC are only charged on the portion of earnings exceeding the primary and secondary thresholds, rather than on the entire earnings as was the rule before 1999.

Tables 2.1 and 2.2 summarizes these thresholds (in yearly equivalents) since 2000. While Table 2.1 shows yearly equivalents of thresholds, NIC thresholds typically apply on a weekly basis. Thus for individuals with variable income it is possible to pay NIC contributions in some weeks and none in other weeks. Note that for the majority of years the primary and secondary thresholds are identical. Since 2000, in the three years when the two thresholds
differ, the primary threshold exceeded the secondary by at most £3 per week or £156 per year. To simplify discussion, I will refer to primary and secondary thresholds as the payroll threshold. From 2000 until 2008 the primary and secondary thresholds nearly coincided with personal allowance which determines one’s liability for personal income tax, also shown in Table 2.2. Since income taxation in the UK is individual, the correspondence between payroll and income tax thresholds likely made this threshold particularly salient. In addition, in 2007/2008 the payroll threshold also corresponded to Working Tax Credits (WTC) income threshold, which has been set at £5,060-£5,220 in 2003-2007 and at £6,420 in 2008-2010. This concurrence likely affected few individuals because WTC income threshold applies to joint incomes of families.

While the LEL and the payroll threshold are rather small, they are not trivial. The payroll threshold is roughly equivalent to a 20-hour part time job at the minimum wage. Therefore while it is not possible for a full-time worker with one job to remain below the payroll threshold, part-time workers could easily avoid paying payroll taxes yet earn NI credits and possibly qualify for WTC at the same time. An important feature of the UK payroll system is that it applies per job. Earnings from each job are subject to the thresholds separately and pension credits are earned as long as at least one of the jobs exceeds the LEL. Full-time employees, therefore, are also able to avoid payroll taxes by holding two jobs with different employers instead of one. This is, however, not the case with the income tax personal allowance which applies to the sum of all earnings.

The NIC contributions qualify individuals for a number of benefits, including retirement pensions, unemployment benefits, maternity allowance and bereavement payments. The pension benefits consist of two parts: a Basic Pension, which is a flat amount per year equivalent to the LEL, and an Additional Pension which depends on the amount of average earnings over one’s lifetime above the LEL.

Self-employed individuals are subject to the same income tax schedule as the wage earners, but have to pay different NIC: a flat weekly tax that ranged between £2 and £2.65 and a proportional tax of 7-9% on profits. The flat tax determines one’s pension credits, while the proportional NIC do not provide any further benefits.

3In 2014-2015 the thresholds will again coincide at £7,956.
4WTC is a program similar in spirit to the Earned Income Tax Credit (EITC) program in the USA that provides in-work incentives to single parents and couples. The unique feature of WTC is that it requires individuals to work a specific number of hours to qualify for the benefits. For example, single and childless adults are required to work 30 hours a week, while single parents need to work at least 16 hours a week to qualify.
5The existing system is changing for individuals reaching State Pension Age on or after April 6, 2016. The Basic and Additional Pension are being substituted with a flat rate New State Pension.
CHAPTER 2. LABOR SUPPLY RESPONSES TO PAYROLL TAXES IN THE UK

Data

In this paper I use annual income data from the Survey of Personal Incomes Public Use Tapes which are based on administrative data collected by the HMRC. The data is created by combining samples from the National Insurance and PAYE Service database, The Computerized Environment for Self Assessment (CESA) and Claims system. The first database contains details of individuals’ employment income, the second database provides details of self-employed, rental, and untaxed investment income and the third database contains information about the people who have claimed a repayment of tax deducted. Summary statistics are available in Table 2.3. Since 2001, the SPI provides a large number of observations, with a total of 400,000-600,000 observations per year, and 45,000-110,000 observations of individuals with positive employment incomes of less than £10,000. For individuals with incomes above the personal allowance threshold, “the SPI provides the most comprehensive and accurate official source of data on personal incomes.” However, for incomes below this threshold the coverage is not complete: information on earnings not subject to PAYE reporting is unavailable. For the purposes of this paper this does not generate significant concerns because we are mainly interested in earnings around the primary/secondary thresholds which are set above the LEL. Firms must report earnings of individuals who earn more than the LEL threshold since otherwise the worker will not earn pension credits. Therefore, while the SPI data might underestimate the overall earnings of individuals, it should provide sufficiently accurate information to estimate the behavioral response to the payroll thresholds.

2.3 Empirical Approach

To calculate earnings and taxable income elasticities with respect to net-of-tax rates I follow the approach outlined in Saez (2010) and Chetty et al. (2011). I assume individuals maximize utility functions \( u(c, z) \) that are increasing in consumption \( c \) and decreasing in before-tax income \( z \) subject to a budget constraint \( c = z - T(z) \). The crucial assumption of the framework is that under a flat tax \( t \), individuals’ density of incomes \( h(z) \) is smooth and continuous. For simplicity of exposition, I assume that the heterogeneity in incomes \( z \) stems only from the heterogeneity in abilities imbedded in utility functions \( u(c, z) \). I will return to the more generous case, where individuals’ labor supply elasticities vary with ability, at the end of the section.

Consider an individual with ability \( \alpha \), where \( \alpha \) is distributed according to some distribution \( F \), who maximizes a quasi-linear and isoelastic utility function

\[
u(c, z) = c - \alpha^{-1/\varepsilon} \frac{z^{1+1/\varepsilon}}{1 + 1/\varepsilon}
\]


\(^7\)See page 3 of the SPI Public Use Tape 2010-2011 user guide.

\(^8\)For a detailed review of the bunching approach and applications, see Kleven (2016).
subject to a budget constraint
\[ c = (1 - \tau)z. \]

First order conditions imply
\[ z = (1 - \tau)^{\alpha}. \]  (2.1)

Now suppose instead of a flat tax schedule, the tax rate increases from \( \tau_1 \) to \( \tau_2 \) at some threshold \( z^* \). Then from (2.1) follows that the optimal earnings \( z \) will be defined by
\[
z = \begin{cases} 
(1 - \tau_1)^{\alpha} & \text{if } (1 - \tau_1)^{\alpha} < z^* \\
z^* & \text{if } (1 - \tau_1)^{\alpha} \geq z^* \geq (1 - \tau_2)^{\alpha} \\
(1 - \tau_2)^{\alpha} & \text{if } (1 - \tau_2)^{\alpha} > z^*. 
\end{cases} \]  (2.2)

Equation (2.2) shows that a mass of workers will choose to reduce labor supply and locate at the kink. Note that the utility of the individual with highest \( \alpha_M \) who bunches at the kink must satisfy
\[ u((1 - \tau_1)z^*, z^*) = u((1 - \tau_2)^{\alpha+1} \alpha_M, (1 - \tau_2)^{\alpha} \alpha_M). \]

Therefore his ability \( \alpha_M = \frac{z^*}{(1 - t_1)^{\alpha}} \) and from (2.1) follows that under a flat tax \( t_1 \) his earnings would be equal to \( z^M = \frac{z^* (1 - t_1)^{\alpha}}{1 - t_2} \). Hence, all individuals who would prefer to earn between \( z^* \) and \( z^M \) under a flat tax \( \tau_1 \) would choose to bunch at the kink and earn income \( z^* \). It then follows that the elasticity of earnings \( \varepsilon \) can be estimated as
\[ \varepsilon \approx \frac{B}{h(z^*)} = \frac{b}{z^* \ln \left( \frac{1 - \tau_1}{1 - \tau_2} \right)}, \]  (2.3)

where \( B \) measures the excess mass of workers at the kink and \( b \equiv B/h(z^*) \) measures the fraction of workers who bunch at the kink \( z^* \) normalized by the density of earnings at the kink, \( h(z^*) \).

Elasticity formula derived in (2.3) assumes that elasticities are constant across individuals. This formula also applies to cases where elasticities are heterogeneous. If the distribution of elasticities is independent from the distribution of ability, (2.3) estimates the average elasticity in the population. If, on the other hand, the distribution is joint, (2.3) estimates average elasticity of individuals at income level \( z^* \). To see this, suppose ability and elasticities are jointly distributed according to some distribution \( \psi(z, e) \). Then \( h(z^*) = \int e \psi(z^*, e) de \). Define \( \bar{\varepsilon}_z^* \equiv \int e \psi(z^*, e) de/h(z^*) \) to be the average elasticity at earnings level \( z^* \). Then from (2.3) follows that the number of individuals bunching at \( z^* \) due to a kink of size \( t_2 - t_1 \) is equal to
\[ B = \int e z^* \ln \left( \frac{1 - \tau_1}{1 - \tau_2} \right) \psi(z^*, e) de = \bar{\varepsilon}_z^* h(z^*) z^* \ln \left( \frac{1 - \tau_1}{1 - \tau_2} \right). \]

Note that the independence of ability and elasticity distributions implies
\[ \bar{\varepsilon}_z^* \equiv \int e \psi(z^*, e) de/h(z^*) = \int e \phi(e) de = \bar{e}, \]
where $\phi(e) = \psi(z,e)/h(z)$.

Earnings elasticity formula (2.3) relate the amount of bunching at the kink points to the prevailing marginal tax rates. In this paper I study responses to payroll and income taxes and therefore will estimate elasticities of gross wages, defined as wages inclusive of all social security (employee- and employer-paid) and income taxes. When calculating earnings elasticities I will follow the standard neoclassical framework and assume that the social security and income taxes are fully passed through to the employee. In presence of employer-paid taxes, I calculate marginal tax rate at income level $z$ as

$$t = \frac{\tau_I + \tau_R + \tau_E}{1 + \tau_R}, \quad (2.4)$$

where $\tau_I$ is the income tax marginal tax rate at income $z$, and $\tau_R$ and $\tau_E$ are employer and employee NIC. Respective tax rates $\tau_I$, $\tau_R$ and $\tau_E$ are shown in Tables 2.1 and 2.2. For self-employed individuals, the NIC rate $\tau_{SE}$ and income tax rate $\tau_I$ are simply added up.

### 2.4 Behavioral Responses of Wage Earners

Figure 2.1 shows the budget constraint of a wage-earner in 2000-2013. Starting from tax year 2000/2001, individuals were not required to pay NIC as long as their earnings did not exceed the Primary/Secondary threshold set above the LEL. Earnings above the PT/ST were subject to NIC only on the portion of earnings exceeding the PT/ST. Pension benefits, however, are accrued for earnings at or above the LEL. The budget constraint thus shows a notch at the LEL (assuming individuals value pension credits) and a kink at the PT/ST. If individuals value social security benefits, they should bunch at the LEL from the left and regardless of their valuation of benefits they should bunch at the PT/ST from the right.

Figure 2.2 shows the distribution of pound differences between the employment pay and the secondary payroll threshold in 2003–2007 and 2009–2010 by £100 bins using the SPI data.\(^9\) Recall that prior to 2008/2009 the primary/secondary thresholds nearly coincided with the personal allowance, differing by less than £13 each year. As a result the combined kink at the payroll threshold in 2003-2007 was equal to 30%: 11% employee NIC contributions, 12.8% employer NIC contributions and 10% income tax.\(^10\) Personal allowance was abruptly increased in 2008 and was exceeding the payroll threshold by £755 in 2009-2010, thus decreasing the size of the kink at the payroll threshold to 21%, the sum of employee and employer NIC contributions only. The income tax started at 20% above the higher personal allowance. In Figure 2.2 I focus on wage earnings and therefore restrict the sample to employed individuals who do not hold directorship positions but who may or may not be self-employed in addition to holding a wage employment.

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9Personal income tax year runs from April 6 of a given year until April 5 of the following year. Throughout the paper I will refer to years by the first year, in other words, 2009/2010 would be referred to as “2009”. Accordingly, 2003-2007 refers to years from 2003/2004 up to an including 2007/2008.

10Calculated using (2.4): $$(0.1+0.11+0.128)/(1+0.128)$$. 
Several observations are notable in Figure 2.2. First, there is a well-defined spike at zero. Second, the spike is rather concentrated at the threshold, especially in 2009-2010. Third, bunching stays at the payroll threshold in 2009-2010 instead of moving with the personal allowance 7 bins to the right. Fourth, the excess bunching occurs both below the limit and just above it, consistent with diffused responses typically observed around the kinks. Fifth, bunching is larger in 2009-2010, even though the combined tax rate has decreased from a total of 33.8% to 23.8%. These observations remain unchanged when one breaks down taxpayers by gender.

Figure 2.2 also shows the results of the elasticity estimates following the empirical approach described in Section 2.3. Here I calculate the elasticity of earnings, rather than taxable income, with respect to the combined payroll and income tax rate of 30% in 2003-2007 and with respect to the combined payroll rate of 21% in 2009-2010. To calculate these elasticities I fit a polynomial of degree seven through a distribution of earnings in the interval of $[-\text{£}4000, \text{£}8000]$ excluding a tight bunching region around zero marked with dashed red lines. Due to the proximity of other thresholds, namely the LEL and personal allowance, I choose a small bunching window of $[-\text{£}300, \text{£}300]$. Results are not sensitive to the choice of the fitting intervals and bunching windows. The estimated counterfactual distribution is shown as a dashed green curve, while the bunching window is identified with dashed red lines. In 2003-2007 the elasticity of earnings is estimated as 0.05, while estimates of 2009-2010 elasticities are larger and range between 0.06-0.09. All elasticities are statistically significant at 1%. While the difference between 2003-2007 and 2009-2010 estimates is not statistically significant for women and the overall population, it is statistically significant at 5% for men. Note that 2009-2010 estimates are significantly noisier due to the smaller sample sizes. Unfortunately it is not possible to compare obtained earnings elasticity to taxable income elasticity due to data limitations. Individuals subject to basic tax rates do not have to submit a tax return. The SPI dataset provides estimated values of other sources of income and deductions based on information obtained from banks and surveys. However, because these are estimated values, bunching will be underestimated and elasticity estimates will be inaccurate.

The results in Figure 2.2 show marginally stronger responses to payroll taxes and income taxes in the UK as compared to other studies using the bunching method. For example, Chetty et al. (2011) estimate taxable income elasticities of under 0.02 for regular wage earners in Denmark, while Bastani and Selin (2014) estimate a statistically significant 0.001 using tax data from Sweden. Both studies rely on large kinks in the income tax schedule that are of similar magnitude, but focus on taxable income, rather than earnings. The differences in elasticities is likely to be explained by the part-time status of wage earners in the UK. With the exception of Saez (2010), most studies focus on higher-income individuals who are plausibly less flexible at adjusting hours worked and therefore wage earnings.

Figure 2.3 looks at the responses to the Upper Earnings Limit (UEL) – a threshold above which employee NIC are reduced to 1%. The UEL ranged between £26,000-£43,888 in 1999-2010 and generated a small ≈ 10% concave kink point. Consistent with Liebman and Saez (2006) and Tazhitdinova (2015a), there is no evidence of a missing mass.
CHAPTER 2. LABOR SUPPLY RESPONSES TO PAYROLL TAXES IN THE UK

Heterogeneity of Responses

Next I study how the magnitude of behavioral responses varies by age, region, and industry. Table 2.4 summarizes elasticities of employment earnings with respect to one minus the tax rate by age, industry and region among the wage earners. Because the magnitude of the kink size changed in 2008, elasticities are calculated separately for 2003-2007 and 2009-2010. As before, the results are obtained with a fitting interval of $[-£4000, £8000]$ and bunching window of $[-£300, £300]$. The corresponding graphical evidence is available in Figures 2.4–2.6. The results in Table 2.4 show large variations by age and industry but smaller variation by region.

The SPI data does not provide the precise age of individuals, however, information on the age bracket is available. Figure 2.4 shows the difference between employment income and the secondary threshold by age group in 2003-2007 and 2009-2010. Panel (a) focuses on young workers, under age 25. These individuals show very small elasticities, that are not statistically significant in 2009-2010. Lack of bunching for younger individuals is rather surprising because many of these workers are students who are likely to work in small part-time jobs that offer flexible hours of work. In addition, benefits provided by the NI contributions are less relevant for these workers because they are a long way away from reaching retirement age. On the other hand, younger individuals might be less knowledgeable about the tax system because they have had less exposure to it and therefore might not be aware of tax incentives. Alternatively, younger workers might avoid payroll and income taxes through other mechanisms, for example, by relying on cash earnings. Panel (b)-(e) show larger elasticities of earnings for individuals of working age, ranging between 0.03–0.07 in 2003-2007 and 0.06-0.13 in 2009-2010. For all age groups, bunching is stronger in 2009-2010 and more sharply concentrated at the payroll threshold. In 2009-2010 the behavioral response is also increasing with age, until workers reach 65. Panel (f) shows little bunching among the workers older than 65. In the UK workers older than the State Pension Age (SPA) do not pay their portion of NI contributions. The employer, however, is still required to contribute the usual 12.8%, regardless of worker’s age. In the period covered by this study the SPA was set at 60 for women and 65 for men. Lack of bunching for individuals above the SPA suggest that the observed behavioral response comes from workers’ efforts of finding “at-the-threshold” jobs, rather than firms standardizing their job offers.

Table 2.4 shows elasticities by industry and region in 2003-2007 and 2009-2010 and suggests that the order of responses by industry and region are consistent across years but elasticities are slightly larger in 2009-2010. Figure 2.5 and 2.6 show the distributions for 2003-2010 combined. Figure 2.5 shows large differences in response by industry. The strongest response is observed in construction with an excess mass of 2.45. Large responses are also observed for individuals working in transport, storage and communications, agriculture, and manufacturing with excess mass ranging between 1.26 in manufacturing to 1.8 in agriculture.

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11 NI contributions start when workers reach age 16.
12 In contrast to the USA, where payments after the Normal Retirement Age increase one’s Social Security benefits upon retirement, such system is not available in the UK.
Real estate, arts, entertainment, wholesale and retail trade, and hotels and restaurants show smaller excess mass, between 0.51–1.05. Finally, very little or no bunching is observed for individuals employed in financial intermediation, public administration, defense, and education. Results in Figure 2.5 suggest that adjustment frictions play a large role in the ability of individuals to bunch at the thresholds. Industries that are more likely to employ full-time workers such as education, public administration and defense show small behavioral responses. Industries that typically allow for more flexible working arrangements, such as construction or agriculture show larger responses. At the same time, size of response in some industries is rather surprising, for example, modest elasticities in wholesale and retail trade, or hotels and restaurants are unexpected. Retail trade is known for hiring numerous part-time workers instead of full-time employees. A possible explanation is that individuals employed in retail are able to find multiple jobs more easily than workers in other industries, resulting in small bunching at the threshold when one studies yearly earnings. Since the payroll threshold applies per job, these individuals might be able to avoid NI taxes without explicitly bunching at the payroll threshold. Individuals employed in food industry, on the other hand, might be able to evade payroll and personal tax through tips or other “under-the-table” payments, again with no need to bunch at the threshold.

Figure 2.6 shows that there is some variation by region, but it is not large. The largest excess mass is observed in East of England, South East and South West and London, ranging from 1.1 to 1.23. The lowest amount of bunching is observed in Scotland, Wales, Northern Ireland and North East with excess mass ranging from 0.62 to 0.17.

Pension Benefits Valuation

While NIC are due only when individuals’ earnings exceed the primary/secondary threshold in a given pay period, pension credits are accumulated when yearly earnings exceed the LEL. Pension credits qualify individuals for the statutory pension benefits, which consist of two parts: the Basic Pension and the State Second Pension. To qualify for full Basic Pension, workers have to obtain 30 years of credits if they are born after April 5, 1945 (men) or 1950 (women). For those born before these dates, men had to obtain 44 years of credits while women – 39 years. The yearly Basic Pension is set equal to the LEL. Prior to 2002, the Additional Pension was calculated as 20% times the average earnings in excess of the LEL and up to the Upper Earnings Limit (UEL). Starting from 2002, the accrual rate was increased to 40% for earnings between the LEL and the Low Earnings Threshold (LET), at

\[ \text{LET} = \text{UEL} \times 0.4 \]

Therefore the amount of contributions due is determined by the magnitude of pay in that pay period only and depends on the frequency of pay. Proportional thresholds apply to weekly, bi-weekly, monthly and yearly pay periods.

See [http://www.rights4seniors.net/content/qualifying-years](http://www.rights4seniors.net/content/qualifying-years).

The existing system is changing for individuals reaching State Pension Age on or after April 6, 2016. The Basic and Additional Pension are being substituted with a flat rate New State Pension.

NIC are reduced to 1-2% above the UEL, which ranged between £26,000-£43,888 in 1999-2010. Recall Figure 2.3.
which point it decreased to 10%.\textsuperscript{17} The LET is set roughly £10,000 above the LEL. In other words, earning the LEL precisely provides one with a pension equal to 100% of his prior earnings, while earnings above the LEL earned a 20% marginal replacement rate. Therefore, if individuals value pension benefits, we should observe bunching to the right of the LEL, signifying that individuals are willing to increase labor supply to qualify for pension benefits in the future.

Figure 2.7 shows the distribution of pound differences between the employment pay and the lower earnings limit (LEL) in 2003–2007 and 2009–2010 by £100 bins using the SPI data. Figure 2.7 shows no bunching to the right of the LEL, suggesting that individuals either do not value social security benefits, or are unable to manipulate hours worked to earn above the LEL. Figure 2.8 suggests that the absence of bunching is persistent and does not depend on worker’s age. Instead, Figure 2.8 suggests there is a small increase in earnings that starts strictly below the LEL. This is likely to be explained by the nature of data: earnings must be reported if they are equal or exceed the LEL. If the earnings in a given period are below the LEL, they must be reported only if the firm provides payroll information for other employees whose earnings exceed the LEL. Given that pension benefits are accrued only if the LEL is exceeded, the results in Figures 2.7 and 2.8 provide strong evidence that there is no response to incentives generated by the LEL.

It is unlikely that individuals would like to respond but are unable to do so because of friction costs, since some bunching (though small) is present at the primary/secondary threshold. It is also unlikely that absence of bunching is due to the quality of data also, because earnings at or above the LEL are third-party reported. Finally, it is also unlikely that individuals constrain their labor supply because of other incentives: the LEL is substantially higher than the Income Support or Job Seeker’s Allowance threshold\textsuperscript{18} and the LEL is below the Working Tax Credit phase-out threshold.

Lack of bunching thus suggests that individuals are either unaware of pension rules and the importance of the LEL, or believe they can qualify for pension benefits in other ways. \textsuperscript{17}Chetty et al (2013) and Chetty and Saez (2013) provide evidence that many individuals are not familiar with the rules of the EITC program in the USA. Similarly, HMRC (2007) show that many workers in the UK are unfamiliar with the Working Tax Credit (WTC) rules. It is conceivable that workers in the UK are also not aware of how pension credits are accumulated and therefore do not respond to incentives. On the other hand, Johnson and Stears (1996), Clasen (2001) and Hills (2003) argue that the contributory principle has been largely eroded in the recent years. Under the current system individuals earn pension credits when they are unemployed, disabled, sick, on maternity leave, or caring for a sick person, thus increasing the likelihood of receiving the full pension upon retirement regardless of labor force participation.

\textsuperscript{17}Accrual rate increased to 20% once earnings exceed 3·LET-2·LEL.

\textsuperscript{18}Income Support benefits are given to needy people and are phased out when earnings exceed £20 per week. Similar rules apply to contributory and non-contributory Job Seeker’s Allowance benefits.
2.5 Behavioral Responses of Self-Employed

Next I study how self-employed individuals respond to NIC and income taxes. Self-employed individuals are subject to the same income tax schedule as the wage earners. However, the payroll tax schedule is different. Self-employed individuals are liable for two types of social security contributions. Pension credits are assigned based on Class 2 NI contributions, a fixed amount per week that ranged between £2-2.65 since 2003. Individuals who earn less than the small earnings exception, an amount roughly equal to the LEL, can request to be exempt from Class 2 contributions by submitting form CF10. Most self-employed individuals, however, choose to pay Class 2 taxes, even when they could apply for exemption, to ensure continuous credit history. In addition, self-employed individuals must pay Class 4 NIC on earnings above the Lower Profit Limit (LPL). Before 2003, Class 4 contributions were capped by the Upper Profit Limit (UPL) – set around £30,000 – but starting from 2003, a 1% tax is due on earnings above the UPL. LPL has coincided with the personal allowance from 2000 until 2007, when the personal allowance was increased. Therefore, in 2003-2007 the self-employed experienced a combined 18% kink at this threshold, a sum of 8% NIC and 10% income tax, while in 2009-2010 the kink at the LPL decreased to 8% and the kink at the personal allowance increased to 20%. Because self-employed individuals have better control over their labor supply and have wider opportunities for evasion, larger elasticities of earnings and taxable income are expected. Figures 2.9–2.15 confirm that self-employed individuals show larger behavioral elasticities, but the magnitude of response is inconsistent with a uniform average elasticity across population.

Figure 2.9 and 2.11 graph the difference between the self-employment earnings and the LPL, threshold from which self-employed individuals are liable to pay Class 4 NI taxes. Figures 2.10 and 2.12 show the distribution of taxable income minus the personal allowance in 2003-2007 and 2009-2010. Because all self-employed individuals must submit a tax return, accurate information of taxable income is available. I restrict the sample to self-employed individuals who are not directors but who may or may not have additional pay income from regular employment.

In Figures 2.9 and 2.10 self-employed individuals show strong bunching at both the payroll and income tax thresholds (where the MTR increased from 0 to 18%) with an estimated elasticity of self-employment earnings of 0.3. Taxable income elasticities in Figure 2.10 are slightly larger – 0.32 – but the difference is not statistically significant. Overall, the amount of bunching is very similar for both measures of incomes, consistent with the idea that low-income individuals have fewer deductions and therefore likely to have similar earnings and taxable income. Males show larger responses than females do, with an elasticity of 0.34 against 0.22 for females, a statistically significant difference at 1%. However, this difference might be attributed to the relative noisiness of the earnings distribution of women.

The behavior of the self-employed in 2009-2010, shown in Figures 2.11 and 2.12 is more complicated. The self-employed show strong response both to the payroll threshold (where the MTR increases from 0 to 8%) and to the income tax threshold (where the MTR increases from 8% to 28%), bunching at both thresholds, with clear excess mass at each threshold
regardless of whether earnings or taxable income is plotted. Overall, we see that bunching is larger at the taxable income threshold consistent with it providing stronger incentives to respond (a 20% kink instead of 8%) but the magnitude is less than twice as strong. Elasticity estimates are 0.23 and 0.12 respectively.

Figures 2.13 and 2.14 estimate responses to two other kinks in the income tax schedule. From 2003 until 2008 income tax schedule featured three marginal tax rates: an introductory rate of 10%, a basic tax rate of 22% and a higher rate of 40%. Despite substantial bunching at the first kink (when the MTR increases from zero to 18%) shown in Figure 2.10, there is very little response to the second kink point, as can be seen in Figure 2.13. While the tax change is not substantial – the MTR increases from 18% to 30% (including NIC) – it is larger than the change at the LPL in 2009-2010. Corresponding elasticity estimates are very small and under 0.06. This small response is rather surprising since individuals show substantial bunching at the LPL in 2009-2010 as can be seen in Panel A and B of Figure 2.11, where the MTR increased from 0 to 8%. Further, Figure 2.14 shows weak responses to the top kink of the taxable schedule, where the MTR increased from 30% to 40% in 2003-2007 and from 28% to 40% in 2009-2010. While the amount of bunching is roughly similar to that observed at the first kink, the estimated elasticities of about 0.03 are much smaller due to the stronger tax incentives and the higher income level of the self-employed.

Finally Figure 2.15 shows no behavioral responses to the concave kink point around the Upper Profit Limit (UPL). NIC are reduced from 8% to 1% above the UPL thus generating a small concave kink point in the tax schedule of the self-employed. Figure 2.15 shows that there is no visually visible nor statistically significant missing mass around the UPL.

Earnings elasticities obtained for the self-employed generally correspond to the estimates of other studies. Chetty et al. (2011) calculate an elasticity of 0.24 around a top kink in Denmark and a smaller elasticity of 0.1 at the middle kink. le Maire and Schjerning (2013) estimate an elasticity of 0.43-0.53 in Denmark when not accounting for intertemporal shifting and an elasticity of 0.014-0.2 once accounted for intertemporal shifting. In the UK, self-employed profits are taxed each year, providing for little opportunities to shift income across years. On the other hand, Bastani and Selin (2014) find much smaller elasticities around the first tax kink, ranging from 0.019 to 0.027, for self-employed in Sweden. Largest elasticities are obtained by Saez (2010), who estimate an elasticity of 0.75-1.1 around the first kink of the EITC in the USA.

Behavioral Responses in Presence of Multiple Kinks

The results in the previous section show that despite having large opportunities to avoid taxes, self-employed individuals show weak responses to some kinks in the income tax schedule. Similar behavior has been observed in other settings. For example, Chetty et al. (2011) calculate an elasticity of 0.24 around the top kink in Denmark but a smaller elasticity of 0.1 at the middle kink. Saez (2010) also finds no evidence of bunching at higher kink points of the income tax schedule in the USA but finds substantial bunching at the first kink by the self-employed U.S. taxpayers.
Several explanations are possible. First, the ability to change one’s hours worked might depend on individual’s income, with richer individuals being less able to control their hours of work. Alternatively, high income individuals might have lower opportunities to avoid or evade taxes. This explanation, while possible, is unlikely to provide a satisfying answer. The response to the 2nd kink in Figure 2.13 is substantially weaker than responses to the 1st kink in Figure 2.10 despite being only £2,000 apart.

Second explanation is that some kinks might be more salient than others. For example, the first kink and the last kink might be more salient than the middle kinks. The first kink might be most salient because the tax liability starts from this threshold. The last kink similarly signifies switching into a top tax rate category which again likely to be of importance to some taxpayers. An interesting question arises that if the difference in salience explains the magnitude of response, what is the underlying reporting behavior? On the one hand, individuals might be aggressively reducing income (through avoidance or evasion) to bunch at the most salient thresholds. In other words, having multiple kinks does not eliminate response, merely shifts it to the most salient threshold. On the other hand, individuals might simply disregard nonsalient thresholds and not respond to these.

Understanding the underlying nature of behavior is important as it can help determine the optimal tax bracket structure since similarly progressive tax schedules can be obtained with few (as in the UK) or many (as in the USA) tax rates. Alternatively, the tax schedule can feature continuously increasing marginal tax rates, as is done in Germany, where the tax schedule has no kinks with the exception of one kink at the personal allowance threshold. Increasing the number of tax brackets, however, makes the tax system more complex and less transparent. If individuals are inattentive to small kinks, optimal strategy is to increase the number of thresholds, thus reducing the distortions. On the other hand, if individuals are attentive, a simpler tax schedule may be preferred.

The setting in the UK provides an opportunity to better understand the underlying behavior by comparing the magnitude of responses in 2003-2007 to those in 2009-2010. For this analysis, I compare bunching at the 18% kink in 2003-2007 to the combined bunching at the 8% and 20% kink in 2009-2010. I do so because the LPL and personal allowance threshold are very similar in 2009-2010 (only £760 apart) and are likely to be equally salient to taxpayers because some type of tax liability starts from these thresholds. Figure 2.16 shows that the total amount of bunching is very similar in 2003-2007 and in 2009-2010, despite a 10% difference in the magnitude of the kinks. The excess mass is roughly 3.8 in 2003-2007 and 3.73 in 2009-2010. The total amount of bunching is slightly smaller if one focuses on self-employment earnings only. Together with Figure 2.13 – that shows that there was some additional small bunching at the 12% kink in 2003-2007 – the results suggest that individuals aggressively reduce income – through evasion or avoidance – to bunch at the most salient kinks. Therefore the absence of bunching at the middle kinks at the tax schedule should not be taken is direct evidence of individuals’ inattention and lack of optimizing behavior. Increasing the number of tax brackets is unlikely to reduce the amount of evasion or avoidance among the self-employed.
2.6 Behavioral Responses of Proprietors

Company directors in the UK can pay themselves in the form of salary, dividends, pension contributions or a combination of the above. Salary distributions are subject to the usual NI taxes and personal income tax while dividends are subject to corporate tax rate and the dividend tax rate minus a notional credit of 10%. Since 2000 the effective corporate tax rate – a combination of corporate tax rate, dividend rate and notional credit rate – has been approximately equal the income tax rate. However, because wages also incur NI contributions, while dividends do not, the most optimal strategy to withdraw money from a company (apart from pension contributions) is to pay oneself a salary equal to the payroll threshold and the rest in the form of dividends.\(^{19}\) Paying oneself a salary equal to the payroll threshold earns the proprietor pension credits, reduces corporate tax base and does not incur payroll or income taxes.

Figure 2.17 shows the distribution of wage payments of company directors. As seen in Figure 2.17 many directors follow the optimal strategy precisely. I estimate the elasticity of earnings to be 0.98 for all directors, 1.03 for male directors and 0.86 for female directors, but the difference for men and women is not statistically significant. The elasticities calculated using 2009-2010 distributions are of similar magnitude despite the fact that some directors chose to bunch at the personal allowance. Because the combined NI tax – 23.8% – is slightly higher than the effective corporate tax rate – 21% – paying oneself a salary equal to the personal allowance is a suboptimal strategy, though savings are minimal. The large bunching is consistent with findings of Devereux et al. (2014) who use FAME database and find that many firm owners – but not all – pay themselves salaries equal to the the payroll threshold.

Failure to Optimize

Figure 2.17 shows that many directors do not follow the dominant strategy of paying themselves a salary equal to the secondary payroll threshold. There are two reasons why directors may do so. First, directors might not know or understand the existing tax incentives and simply follow some ad-hoc rules when choosing the amount of salary paid. Second, directors who have multiple shareholders might be restricted in the amount of dividends they can take out. Under the standard rules, a firm with multiple shareholders should pay dividends in proportion to shareholder’s participation. Following the dominant strategy of paying a salary equal to the secondary threshold is not problematic if shares and directorships are assigned accordingly. However, if the proportions do not align, optimal strategy becomes harder to implement. Unfortunately the SPI does not provide the information on the number of directors or composition of shareholders, making it impossible to verify the validity of the second explanation.

Figures 2.18 explores the types of salaries non-optimizing directors pay. For simplicity I focus on a narrow window of wages: between £5,900 and £37,000. Figure 2.18 shows that

\(^{19}\)The downside of withdrawing money in the form of pension contributions is that these funds are locked in until age 55 and earlier withdrawal is subject to substantial penalties.
many directors choose to pay themselves salaries in the multiples of £6,000 and multiples of £5,000 – marked with dashed red and solid blue lines respectively. Table 2.5 shows the break-down of wage payments by type. The first column shows that among directors who report wages of less than £100,000, approximately 19% pay within £200 of the secondary payroll threshold and about 11% less than the secondary threshold. In addition, 4% and 8% respectively pay themselves a multiple of £5,000 and of £6,000 respectively. The second column reports the average ratio of wages paid to the total amount of profits paid, i.e. dividends plus wages paid. Among the individuals who report wages of less than the threshold, wages represent an average of 57% of total pay taken from the company. Since these individuals pay non-zero dividends, this finding suggests that many individuals fail to optimize by taking out too little in the form of wages. Because wage earnings are deductible from corporate profits, paying higher wages reduces corporate tax base and therefore decreases corporate tax due. Therefore, the optimal strategy is to pay wages equal to the payroll threshold precisely, thus avoiding NIC yet reducing the corporate tax base as much as possible. Column 2 shows of Table 2.5 shows that the lowest ratio of wages to total profits taken is smallest for individuals who pay precisely the threshold amount. The larger is the percentage of profits taken as wages the more NIC the proprietors must pay. Therefore Column 2 shows that individuals who pay multiples of £6,000 are better at minimizing their tax liability than proprietors who pay multiples of £5,000. Individuals who pay other amount of wages optimize the least. Columns 3 and 4 show how the type of wages paid varies with the amount of dividends paid. Among proprietors who pay themselves less than £500 in dividends, nearly 67% pay wages above the payroll threshold which are not multiples of £5,000 or £6,000.

Because the majority of companies are owner managed (Devereux and Liu (2014)), it is unlikely that a large number of directors are unable to follow the optimal withdrawal strategy because of dividend limitations. It is also unlikely that directors fail to optimize because they believe that by paying higher salaries they can obtain NI credits, since paying a salary equal to the payroll threshold provides those benefits automatically. The most likely explanation is that directors are unaware of the optimal tax approach or are unwilling to follow it for some personal considerations.

2.7 Conclusion

In this paper I use the unique institutional setting of payroll taxes in the UK to study behavioral responses to payroll and income taxes. I focus on three groups of taxpayers: the wage earners, the self-employed and the proprietors. In line with research on taxable income elasticities, I find weak responses to payroll and income taxes among the wage earners. I also find that wage earners do not bunch at the threshold that allows them to earn pension credits without making contributions. This finding suggests that policymakers should improve understanding of the social security system by emphasizing the link between paid contributions and future pension entitlements.

The paper shows that the self-employed individuals show strong responses to tax incen-
tives in the form of sharp bunching at the kinks in the income tax schedule. The magnitude of response, however, varies across kinks and likely depends on the salience of tax changes. I find largest bunching at the first and last kinks, with little excess mass at the middle kink. The size of bunching, however, suggests that individuals do not ignore nonsalient kinks, but instead aggressively reduce tax liabilities to bunch at the lower, salient kink.

Finally, the paper documents tax optimizing behavior among the proprietors. I find that roughly 20% of proprietors pay a salary equal to the primary/secondary payroll threshold thus minimizing tax liability. However, the vast majority of proprietors fail to optimize and instead pay large payroll taxes. This finding shows that many individuals fail to use simple and legal tax avoidance mechanisms. Further research is needed to better understand why these individuals fail to optimize.
## Table 2.1: Thresholds and Tax Rates

<table>
<thead>
<tr>
<th>Year</th>
<th>LEL Employee/</th>
<th>LPL Employee</th>
<th>τ_E</th>
<th>τ_R</th>
<th>τ_SE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Threshold</td>
<td>Threshold</td>
<td>Contributions</td>
<td>Contributions</td>
<td>Contributions</td>
</tr>
<tr>
<td>2000 – 2001</td>
<td>3,484</td>
<td>3,952/4,368</td>
<td>4,385</td>
<td>10%</td>
<td>12.2%</td>
</tr>
<tr>
<td>2001 – 2002</td>
<td>3,744</td>
<td>4,524</td>
<td>4,535</td>
<td>10%</td>
<td>11.9%</td>
</tr>
<tr>
<td>2002 – 2003</td>
<td>3,900</td>
<td>4,628</td>
<td>4,615</td>
<td>10%</td>
<td>11.8%</td>
</tr>
<tr>
<td>2003 – 2004</td>
<td>4,004</td>
<td>4,628</td>
<td>4,615</td>
<td>11%</td>
<td>12.8%</td>
</tr>
<tr>
<td>2004 – 2005</td>
<td>4,108</td>
<td>4,732</td>
<td>4,745</td>
<td>11%</td>
<td>12.8%</td>
</tr>
<tr>
<td>2005 – 2006</td>
<td>4,264</td>
<td>4,888</td>
<td>4,895</td>
<td>11%</td>
<td>12.8%</td>
</tr>
<tr>
<td>2006 – 2007</td>
<td>4,368</td>
<td>5,044</td>
<td>5,035</td>
<td>11%</td>
<td>12.8%</td>
</tr>
<tr>
<td>2007 – 2009</td>
<td>4,524</td>
<td>5,200</td>
<td>5,225</td>
<td>11%</td>
<td>12.8%</td>
</tr>
<tr>
<td>2008 – 2009</td>
<td>4,680</td>
<td>5,460</td>
<td>5,435</td>
<td>11%</td>
<td>12.8%</td>
</tr>
<tr>
<td>2009 – 2010</td>
<td>4,940</td>
<td>5,720</td>
<td>5,715</td>
<td>11%</td>
<td>12.8%</td>
</tr>
<tr>
<td>2010 – 2011</td>
<td>5,044</td>
<td>5,720</td>
<td>5,715</td>
<td>11%</td>
<td>12.8%</td>
</tr>
<tr>
<td>2011 – 2012</td>
<td>5,304</td>
<td>7,228/7,072</td>
<td>7,225</td>
<td>12%</td>
<td>13.8%</td>
</tr>
<tr>
<td>2012 – 2013</td>
<td>5,564</td>
<td>7,592/7,488</td>
<td>7,605</td>
<td>12%</td>
<td>13.8%</td>
</tr>
</tbody>
</table>

**Notes:** Lower Earnings Limit (LEL): wage earners earn credits for NI starting from this limit. Employee/Employer Threshold: employee and employer NI contributions start from this limit, respectively. Self-employed limit: self-employed contributions start from this limit. Personal Allowance: income taxes are due above this income level. 1st Income Tax Rate: marginal tax rate in the first income tax bracket.
### Table 2.2: Thresholds and Tax Rates

<table>
<thead>
<tr>
<th>Year</th>
<th>Income Tax</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Personal</td>
<td>1st Income</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allowance</td>
<td>Tax Rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(in £)</td>
<td>$\tau_I$</td>
<td></td>
</tr>
<tr>
<td>2000 – 2001</td>
<td>4,385</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2001 – 2002</td>
<td>4,535</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2002 – 2003</td>
<td>4,615</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2003 – 2004</td>
<td>4,615</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2004 – 2005</td>
<td>4,745</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2005 – 2006</td>
<td>4,895</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2006 – 2007</td>
<td>5,035</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2007 – 2009</td>
<td>5,225</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2008 – 2009</td>
<td>6,035</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>2009 – 2010</td>
<td>6,475</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>2010 – 2011</td>
<td>6,475</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>2011 – 2012</td>
<td>7,475</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>2012 – 2013</td>
<td>8,105</td>
<td>20%</td>
<td></td>
</tr>
</tbody>
</table>

*Notes:* Lower Earnings Limit (LEL): wage earners earn credits for NI starting from this limit. Employee/Employer Threshold: employee and employer NI contributions start from this limit, respectively. Self-employed limit: self-employed contributions start from this limit. Personal Allowance: income taxes are due above this income level. 1st Income Tax Rate: marginal tax rate in the first income tax bracket.
Table 2.3: Number of Observations: Survey of Personal Incomes

<table>
<thead>
<tr>
<th>Year</th>
<th>All</th>
<th>Pay &lt; £30,000\textsuperscript{a}</th>
<th>Pay &lt; £10,000\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003 – 2004</td>
<td>433,536</td>
<td>177,545</td>
<td>79,308</td>
</tr>
<tr>
<td>2004 – 2005</td>
<td>521,406</td>
<td>223,028</td>
<td>102,218</td>
</tr>
<tr>
<td>2006 – 2007</td>
<td>566,103</td>
<td>232,789</td>
<td>103,780</td>
</tr>
<tr>
<td>2007 – 2009</td>
<td>591,054</td>
<td>246,269</td>
<td>114,188</td>
</tr>
<tr>
<td>2009 – 2010</td>
<td>674,715</td>
<td>269,302</td>
<td>120,768</td>
</tr>
<tr>
<td>2010 – 2011</td>
<td>677,442</td>
<td>287,306</td>
<td>110,217</td>
</tr>
</tbody>
</table>

Notes: Number of observations in the Survey of Personal Incomes, by year. \textsuperscript{a} Number of observations with nonzero employment income of less than £30,000. \textsuperscript{b} Number of observations with nonzero employment income of less than £10,000. Source: HM Revenue and Customs. KAI Data, Policy and Co-Ordination. (2012). Survey of Personal Incomes, 2000-2001 through 2010-2011: Public Use Tapes. UK Data Service.


<table>
<thead>
<tr>
<th>Age Group</th>
<th>2003-2007</th>
<th>2009-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>under 25</td>
<td>0.02***</td>
<td>0.01</td>
</tr>
<tr>
<td>25-34 year old</td>
<td>0.04***</td>
<td>0.07***</td>
</tr>
<tr>
<td>35-44 year old</td>
<td>0.09***</td>
<td>0.1***</td>
</tr>
<tr>
<td>45-54 year old</td>
<td>0.07***</td>
<td>0.13***</td>
</tr>
<tr>
<td>55-64 year old</td>
<td>0.07***</td>
<td>0.15***</td>
</tr>
<tr>
<td>over 65</td>
<td>0.01</td>
<td>0.04**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industry</th>
<th>2003-2007</th>
<th>2009-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>0.11***</td>
<td>0.28***</td>
</tr>
<tr>
<td>Transport, Storage and Communications</td>
<td>0.06***</td>
<td>0.2***</td>
</tr>
<tr>
<td>Agriculture, Fishery and Forestry</td>
<td>0.08**</td>
<td>0.19***</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.07***</td>
<td>0.12***</td>
</tr>
<tr>
<td>Real Estate, Renting and Business</td>
<td>0.05***</td>
<td>0.1***</td>
</tr>
<tr>
<td>Arts, Entertainment, Other Services</td>
<td>0.06***</td>
<td>0.07***</td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>0.05***</td>
<td>0.07***</td>
</tr>
<tr>
<td>Hotels and Restaurants</td>
<td>0.02**</td>
<td>0.06**</td>
</tr>
<tr>
<td>Financial Intermediation</td>
<td>0.03</td>
<td>0.15***</td>
</tr>
<tr>
<td>Education</td>
<td>0.04***</td>
<td>0.02</td>
</tr>
<tr>
<td>Public Administration and Defence</td>
<td>0.04</td>
<td>-0.07*</td>
</tr>
<tr>
<td>Health and Social Work</td>
<td>0.02</td>
<td>-0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th>2003-2007</th>
<th>2009-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>East of England</td>
<td>0.07***</td>
<td>0.11***</td>
</tr>
<tr>
<td>South East</td>
<td>0.07***</td>
<td>0.09***</td>
</tr>
<tr>
<td>South West</td>
<td>0.07***</td>
<td>0.07***</td>
</tr>
<tr>
<td>London</td>
<td>0.05***</td>
<td>0.11***</td>
</tr>
<tr>
<td>Yorkshire and the Humber</td>
<td>0.05***</td>
<td>0.08***</td>
</tr>
<tr>
<td>East Midlands</td>
<td>0.04***</td>
<td>0.07***</td>
</tr>
<tr>
<td>West Midlands</td>
<td>0.04***</td>
<td>0.08***</td>
</tr>
<tr>
<td>North West</td>
<td>0.04***</td>
<td>0.06***</td>
</tr>
<tr>
<td>Scotland</td>
<td>0.04***</td>
<td>0.03*</td>
</tr>
<tr>
<td>Wales</td>
<td>0.02</td>
<td>0.06**</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>0.03*</td>
<td>0.03</td>
</tr>
<tr>
<td>North East</td>
<td>0.01</td>
<td>-0.0156</td>
</tr>
</tbody>
</table>

Notes: This table shows the elasticities of employment earnings with respect to one minus the tax rate, where tax rate is the sum of employee and employer payroll taxes and personal income tax. Corresponding standard errors are shown in brackets. * statistically significant at 10%, ** at 5% and *** at 1%.
Table 2.5: Directors’ Wage Choices

<table>
<thead>
<tr>
<th>Wage Paid:</th>
<th>All Directors</th>
<th>Directors with:</th>
<th>&gt; £500 in Dividends</th>
<th>≤ £500 in Dividends</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>% as Wages</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>&lt; Threshold</td>
<td>11.15</td>
<td>57.12</td>
<td>9.92</td>
<td>13.21</td>
</tr>
<tr>
<td>≈ Threshold</td>
<td>19.17</td>
<td>40.26</td>
<td>24.02</td>
<td>11.04</td>
</tr>
<tr>
<td>Multiple of 5K</td>
<td>3.95</td>
<td>62.27</td>
<td>4.08</td>
<td>3.74</td>
</tr>
<tr>
<td>Multiple of 6K</td>
<td>7.56</td>
<td>49.13</td>
<td>9.03</td>
<td>5.10</td>
</tr>
<tr>
<td>Other Wages</td>
<td>58.66</td>
<td>68.00</td>
<td>53.37</td>
<td>67.54</td>
</tr>
</tbody>
</table>

Notes: Columns 1, 3 and 4 show the percent of directors with reported wages that are either at least £200 less than the secondary threshold, within £200 of the secondary threshold, or more than £200 greater than the secondary threshold and a multiple of £5,000 or £6,000. Column 2 shows the average percent of total profits taken out as wages, and is calculated as wages divided by the sum of wages and dividends.
Figure 2.1: Budget Constraint

Notes: From 2000 on, individuals were not required to pay NI taxes as long as their earnings did not exceed the Primary/Secondary threshold set above the LEL (marked “PT”). Earnings above the PT/ST were subject to 22.2% NI tax but only on the portion of earnings exceeding the PT/ST. (The combined rate fluctuated between 21.8% to 25.8% from 2000 to 2013.) Pension benefits are accrued for earnings at or above the LEL. Thus, upon reaching the LEL individuals earn credit toward the Basic Pension, equal to the LEL, and a State Second Pension, equal to the average lifetime earnings above the LEL times 20%. (The 20% replacement rate was increased to 40% in 2002.) In other words, earning the LEL precisely provides one with a 100% replacement rate, while earnings above the LEL earn a 20% marginal replacement rate. The budget constraint thus generates a notch at the LEL (assuming individuals value pension credits) and a kink at the PT/ST. Individuals should bunch at the LEL from the left and at the PT/ST from the right.
Figure 2.2: Employment Pay in 2003-2007 and 2009-2010

Notes: These figures show the distribution of wage earnings minus the secondary payroll threshold for wage earners. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. In 2003–2007 the marginal tax rate increased from 0% to \((10%+11%+12.8%)/(1+12.8\%\)) at the payroll threshold. In 2009–2010 the marginal tax rate increased from 0% to \((11%+12.8%)/(1+12.8\%)\) at the payroll threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
CHAPTER 2. LABOR SUPPLY RESPONSES TO PAYROLL TAXES IN THE UK

Figure 2.3: Employment Earnings in 2003-2010 around the UEL

Notes: These figures show the distribution of wage earnings minus the Upper Earnings Limit for wage earners. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass. In 2003–2010 the payroll tax rate decreased from 11%+12.8% to 1%+12.8% at the Upper Earnings Limit. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Figure 2.4: Employment Pay by Age Group

Notes: These figures show the distribution of wage earnings minus the secondary payroll threshold for wage earners by age group. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. In 2003–2007 the marginal tax rate increased from 0% to (10%+11%+12.8%)/(1+12.8%) at the payroll threshold. In 2009–2010 the marginal tax rate increased from 0% to (11%+12.8%)/(1+12.8%) at the payroll threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Figure 2.5: Employment Pay by Industry in 2003-2010

Notes: These figures show the distribution of wage earnings minus the secondary payroll threshold for wage earners by industry. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. In 2003–2007 the marginal tax rate increased from 0% to (10%+11%+12.8%)/(1+12.8%) at the payroll threshold. In 2009–2010 the marginal tax rate increased from 0% to (11%+12.8%)/(1+12.8%) at the payroll threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
CHAPTER 2. LABOR SUPPLY RESPONSES TO PAYROLL TAXES IN THE UK

Figure 2.6: Employment Pay by Region in 2003-2010

Notes: These figures show the distribution of wage earnings minus the secondary payroll threshold for wage earners by region. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. In 2003–2007 the marginal tax rate increased from 0% to (10%+11%+12.8%)/(1+12.8%) at the payroll threshold. In 2009–2010 the marginal tax rate increased from 0% to (11%+12.8%)/(1+12.8%) at the payroll threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Figure 2.7: Employment Pay in 2003-2010 and LEL Threshold

Notes: These figures show the distribution of wage earnings minus the Lower Earnings Limit (LEL) for wage earners. Bins of £100. Social Security credits are accumulated when yearly earnings are equal to the LEL or exceed it. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.

Figure 2.8: Employment Pay by Age Group and LEL Threshold

Notes: Notes: These figures show the distribution of wage earnings minus the Lower Earnings Limit (LEL) for wage earners by age group. Bins of £100. Social Security credits are accumulated when yearly earnings are equal to the LEL or exceed it. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Figure 2.9: Self-Employment Earnings in 2003-2007

Notes: Figures show the distribution of self-employment earnings minus the Lower Profit Limit. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. In 2003–2007, the Lower Profit Limit and Personal Allowance coincided and the marginal tax rate increased from 0% to (10%+8%) at the threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Notes: Figures show the distribution of taxable income minus the Personal Allowance. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. In 2003–2007, the Lower Profit Limit and Personal Allowance coincided and the marginal tax rate increased from 0% to (10%+8%) at the threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Figures show the distribution of self-employment earnings minus the Lower Profit Limit. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. In 2009–2010, the Lower Profit Limit was set at £5,715 and the Personal Allowance at £6,475. The marginal tax rate increased from 0% to 8% at the Lower Profit Limit and from 8% to 28% at the Personal Allowance threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Figures show the distribution of taxable income minus the Personal Allowance. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. In 2009–2010, the Lower Profit Limit was set at £5,715 and the Personal Allowance at £6,475. The marginal tax rate increased from 0% to 8% at the Lower Profit Limit and from 8% to 28% at the Personal Allowance threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
CHAPTER 2. LABOR SUPPLY RESPONSES TO PAYROLL TAXES IN THE UK  100

Figure 2.13: Taxable Income in 2003–2007 around 2nd Income Tax Kink

Notes: These figures show the distribution of taxable income minus the 2nd kink of the taxable income schedule. Bins of £100. In 2003–2007 the marginal income tax rate increased from 10% to 22% at the threshold. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
CHAPTER 2. LABOR SUPPLY RESPONSES TO PAYROLL TAXES IN THE UK

Figure 2.14: Taxable Income in 2003-2010 around 3rd Income Tax Kink

Notes: These figures show the distribution of taxable income minus the top kink of the taxable income schedule. Bins of £100. In 2003–2007 the marginal income tax rate increased from 22% to 40% at the threshold and in 2009-2010 from 20% to 40%. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Figure 2.15: Self-Employment Earnings in 2003-2010 around the UPL

Notes: These figures show the distribution of self-employment earnings minus the Upper Profit Limit. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass. In 2003–2010 the payroll tax rate decreased from 8% to 1% at the Upper Profit Limit. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
The first two figures show the distribution of taxable income minus Personal Allowance in 2003–2007 and 2009–2010 respectively. Bins of £100. The last figure shows the distribution of self-employment earnings minus the Lower Profit Limit 2009–2010. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass. In 2003–2007, the Lower Profit Limit and Personal Allowance coincided and the marginal tax rate increased from 0% to (10%+8%) at the threshold. In 2009–2010, the Lower Profit Limit was set at £5,715 and the Personal Allowance at £6,475. The marginal tax rate increased from 0% to 8% at the Lower Profit Limit and from 8% to 28% at the Personal Allowance threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Notes: These figures show the distribution of wage earnings minus the secondary payroll threshold for directors. Bins of £100. The vertical dashed red lines mark the bunching window used to estimate the excess mass and the corresponding elasticity of earnings. In 2003–2007 the marginal tax rate increased from 0% to \((10\% + 11\% + 12.8\%) / (1 + 12.8\%)\) at the payroll threshold. In 2009–2010 the marginal tax rate increased from 0% to \((11\% + 12.8\%) / (1 + 12.8\%)\) at the payroll threshold. Source: Survey of Personal Incomes, 2003–2010: Public Use Tape.
Figure 2.18: Directors’ Wages

*Notes:* These figures show the distribution of wage earnings reported by directors. Bins of £100. The vertical dashed red lines identify multiples of £6,000: £6,000, £12,000, £18,000, £24,000, £30,000 and £36,000. The vertical solid blue lines identify multiples of £5,000: £10,000, £15,000, £20,000, £25,000, £30,000 and £35,000. *Source:* Survey of Personal Incomes, 2003–2010: Public Use Tape.
Chapter 3

Optimal Reporting Thresholds: Theory and Evidence from Charitable Contributions

3.1 Introduction

Information reporting is an effective tool against evasion. However, even the simplest compliance rules can prove to be costly to taxpayers. Moreover, the resulting compliance burden falls not only on prospective cheaters but also on law-abiding individuals thus introducing a potentially large deadweight loss. The trade-off between evasion and compliance costs suggests that reporting should be imposed only on a subset of the population. This approach has been widely implemented in tax systems: most forms must be filled out only when a certain threshold is exceeded. For example, income taxes must be filed if one’s income exceeds a specific earnings threshold, value-added tax (VAT) is typically collected from firms with revenues above a certain minimum, Form 1099-INT is issued when interest gains exceed a fixed threshold.[1] What should determine the magnitude of these thresholds? This paper provides empirical evidence of the existence of trade-off between compliance and evasion in the case of charitable contributions in the U.S. and develops a theoretical and empirical framework to study reporting thresholds in general.

Since 1917 charitable contributions have been subsidized by the government in the form of a deduction on the federal income tax.[2] Such favorable treatment makes charitable deduction highly susceptible to evasion. To limit potential misreporting the IRS has developed a set of rules that make evasion costlier. In this paper I study a regulation change in 1985 that relaxed the substantiation requirements for noncash charitable contributions. Prior

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[1] Specifically, the 2014 tax return must be filed by single individuals when their income exceeds $10,150 and by married individuals when their income exceeds $20,300. Form 1099-INT is issued when interest exceeds $10 per year. The VAT threshold varies by country: for example, in the UK in 2015, firms must register to remit VAT if revenues exceed £82,000 per year.

to 1984 individuals had to submit a detailed statement regardless of the dollar value of noncash donations. Starting from 1985 a formalized statement, Form 8283, is required only when reported noncash donations exceed $500. By looking at the shifts in the distribution of noncash donations and using a revealed preference approach I can non-parametrically identify the share of new donations resulted from lower compliance costs and a share of new donations due to evasion, as well as estimate the hassle cost of compliance. I find that relaxing reporting requirements led to a steady increase in reported donations but that nearly 50% of these new donations were untruthful. The tax revenue loss, however, was offset by substantial savings for taxpayers because reporting requirements impose substantial hassle costs: $90 on average per person. Finally, I develop and calibrate a model and find that it would be more optimal to set the threshold at $180 given estimated levels of evasion and compliance costs. I proceed in three steps.

As a first step, I compare the distributions of noncash donations before and after the reform to the right of the reporting threshold to estimate the compliance cost associated with Form 8283. Since reporting requirements have not changed for taxpayers who wish to report more than $500, these individuals will choose to reduce their donations and report $500 only to avoid the hassle of filing Form 8283. Therefore, quantifying the missing mass to the right of the $500 threshold allows me to estimate the distribution of compliance costs. Results show that individuals are willing to forego an average of $82-102 in order to avoid having to fill out Form 8283 (in 2014 dollars). I also investigate the relationship between individuals’ adjusted gross income (AGI) and compliance cost and find that richer individuals would pay more to avoid filing Form 8283. On the other hand, individuals who employ the help of tax preparers or report some self-employed income incur substantially lower compliance costs. The magnitude of compliance costs is surprisingly high since it is unlikely that filling out Form 8283 would require more than half an hour of one’s time. The cost estimate, however, is in spirit of the recent findings of Benzarti (2015) who finds that individuals are willing to forego $644 on average (in 2014 dollars) to avoid having to file Schedule A (Itemized Deductions).

As a second step, I use my estimates of compliance cost to distinguish between truthful and untruthful donations. Recall that the 1985 reform led to an increase in reported donations just below the $500 threshold. To identify which portion of these new donations is due to evasion I must account for two effects. First, part of the increase in donations in the neighborhood of $500 is due to compliance costs: some taxpayers choose to reduce their donations and bunch at $500 to avoid the hassle of filling out Form 8283. To account for these individuals I adjust the after-the-reform distribution downward by redistributing part of the excess mass at $500 to fill in the missing mass to the right of the threshold. Second, since all individuals had to submit a detailed statement before the reform, individuals with high compliance costs who wished to donate smaller amounts chose to report $0 to avoid the hassle of writing a statement. To account for these taxpayers (who were missing from observed pre-reform distribution) I extrapolate the compliance cost found in step 1 to identify a counterfactual distribution of donations. This counterfactual distribution serves as an upper bound on the number of truthful donations prior to the reform if the statement
was not required. Finally, I quantify evasion as the difference between the adjusted after-the-reform distribution and the counterfactual before-the-reform distribution. The intuition is simple: once I have accounted for legitimate sources of increased donations (compliance rules before and after the reform), the remaining, unexplained increase in donations at the $500 threshold must be due to evasion.

I find that at least 40-50% of the new donations were untruthful. I explore whether cheating behavior changes with taxpayers’ marital status, type and level of income, and whether they employ tax preparers. I find that evasion increases with one’s income but otherwise I find similar levels of cheating. The overall level of evasion, however, is rather small and suggests that taxpayers find cheating costly. Even 10 years after the reform, the number of donations below $500 remains small. Low levels of cheating are consistent with previous findings, however, the case of noncash charitable donations is particularly interesting because cheating is very easy and the likelihood of getting caught is extremely low even if individuals are audited.

Empirical results thus suggest that compliance rules are effective at reducing evasion but they are costly to taxpayers. Was the $500 threshold chosen optimally? To answer this question I develop a framework which allows me to characterize optimal reporting thresholds. I show that the determination of optimal thresholds should take into account the utility loss from reporting experienced by individuals and a loss in externality benefits from charitable giving against the tax revenue loss generated by evasion and the utility gain of evaders. In the model individuals experience an increasing cost of evasion and a fixed cost of compliance. I show that the size of a reporting threshold is primarily governed by the type and magnitude of cheating. Moreover, as long as all costs are finite, optimal threshold is strictly positive and in most cases finite. While the model is presented within the framework of charitable deductions, it can be immediately extended to other environments, the framework can be used to determine optimal reporting thresholds for Child Care Tax Credit, Schedule D filing and etc. I calibrate a model where taxpayers have heterogeneous compliance and evasion costs. Calibrations of the model shows that in the case of noncash charitable donation deductions, the optimal threshold is $180 and thus is more than twice lower than the threshold chosen by the government.

The paper makes contributions to three areas of research. First, the paper contributes to the emerging literature that studies practical aspects of tax collection, such as threshold setting. Previous studies focused on determining optimal thresholds for exemptions from value-added taxes (Keen and Mintz (2004), Brashares et al. (2014), and Liu and Lockwood (2015)), as well as corporate and income taxes (see Dharmapala et al. (2011) and Kanbur and Keen (2014)). To the best of my knowledge, this is the first paper to consider optimal setting of thresholds that change reporting requirements rather than levels of taxation. Optimal determination of such thresholds requires more detailed understanding of both compliance

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4For an extensive review of tax administration issues see Slemrod and Gillitzer (2014). Also see Slemrod (2013) for a review of line-drawing in tax policy.
costs and evasion behavior, since it requires researchers to predict the levels of evasion below and above the threshold. This paper further contributes to this literature by providing empirical evidence on the effectiveness of self-reported information reporting against evasion: while the literature has carefully documented the potency of third-party reporting, less is known about how evasion changes with the amount of self-reported information. This result implies that information reporting plays an important role in taxation and should be taken into account in studies of optimal taxation (see discussions in Slemrod and Kopczuk (2002), Saez (2004), Saez et al. (2012a)).

Second, the paper suggests a novel nonparametric approach to measuring evasion. Accurately estimating evasion is difficult because researchers cannot directly observe cheating behavior. The approach used in this paper circumvents this problem by studying changes in aggregate distributions thus avoiding the need to tag individual cheaters. Several other papers studied changes in reporting requirements to identify cheating behavior, however, most of these studies cannot separate evasion responses from behavioral responses to compliance cost. The paper most related to this study is by Buchheit et al. (2005) who were the first to document the persistent and increasing spike at the $500 threshold for noncash charitable donations. The authors argue that the sharp increase in charitable donations after the reform is a sign of evasion. However, the authors do not attempt to differentiate between bunching due to compliance costs, due to inflation (that naturally “pushes” donations towards the limit) and due to evasion. The magnitude of evasion found in this study is consistent

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5 Third-party reporting has been studied in the setting of personal income taxes (Kleven et al. (2011)), corporate taxation (Gordon and Li (2009)), value-added taxes (Kopczuk and Slemrod (2006)). Also see Almunia and Lopez Rodriguez (2014) who study how third-party reporting interacts with monitoring rules.

6 For a comprehensive review of the literature on evasion see Andreoni et al. (1998), Slemrod and Yitzhaki (2002), Aaron and Slemrod (2004), Slemrod (2007), and Slemrod and Weber (2012). The literature has estimated evasion behavior in three general ways. The first approach directly quantifies evasion by looking at the results of tax audits, for examples see Clotfelter (1983), Klepper and Nagin (1989), Christian (1994). The problem with this approach is that some types of evasion are very difficult to detect. In case of charitable donations individuals could claim they have donated items that do not require written acknowledgment from the charitable organization. The second approach estimates evasion indirectly, by looking at discrepancies between reported values and actual spending. Most notable studies include Pissarides and Weber (1984), Schuetze (2002), Feldman and Slemrod (2007), Johansson (2005), Artavanis et al. (2012), and others. The limitation of this approach is in that it requires accurate expenditure data which is not easy to obtain. One way to measure charitable donations is to compare the aggregate values of donations reported on tax returns to those collected by charitable organizations. This strategy is essentially not feasible in the case of U.S. First, taxpayers report charitable donations only when itemizing deductions and not when claiming the standard deduction. Second, many qualifying organizations, for example religious organizations, are not required to disclose the value of acquired funds. In this paper, I adopt the third approach which relies on compliance reforms. This approach has been used by Buchheit et al. (2003), Serocki and Murphy (2013), Ackerman and Auten (2011), and Fack and Landais (2016) to study charitable donations, by LaLumia and Saied (2013) to study claiming of dependents, and by Marion and Muehlberger (2008) to study evasion in the in the market for diesel fuel.

7 Other papers that studied evasion in the domain of charitable donations include Ackerman and Auten (2011) who study the effects of the 2005 reform that tightened the valuation process for donations of cars, boats and airplanes. They find that prior to the reform these type of donations were largely overstated and
with evasion estimates from the 1982 Taxpayer Compliance Measurement Program (TCMP) study. Slemrod (1989) found that among taxpayers who claim a charitable deduction, 27% cheated and overstated their donation by approximately 9%. The average dollar adjustment was $96.4 (1982 dollars), which is slightly higher than what was estimated in this study – $80 (1985 dollars).

Finally, the paper contributes to the literature on tax compliance costs, being one of the few studies that rely on a revealed preference argument rather than survey evidence. Pitt and Slemrod (1989) and recently Benzarti (2015) estimate the cost of filing Schedule A. Pitt and Slemrod (1989) find an average cost of $100 per itemizing taxpayer, using a different methodology Benzarti (2015) estimates that an average household foregoes approximately $644 to avoid filing Schedule A. Benzarti (2015) argues that such large cost estimates are either due to extreme levels of tax filing aversion or due to behavioral bias, e.g. procrastination. Large compliance costs are consistent with findings of Gillitzer and Skov (2014) and Kotakorpi and Laamanen (2014) who show that the use of pre-filled forms lead to large changes in quantity and type of deductions. Similarly, Rehavi and Shack (2013) argue that a large portion of the tax-price elasticities of charitable giving represents changes in reporting as opposed to changes in actual donations. Finally, hassle costs are a likely explanation for the low take-up rates of many government benefits (see Currie (2006)), coupons and rebates (Tasoff and Letzler (2014), Immar (2014)), as well as other money-saving strategies (e.g. Keys et al. (2014) and Vesal (2014)).

3.2 Data and Institutional Background

1985 Reform

Since 1917 the Federal Tax Code allows individuals to include their charitable contributions on the list of itemized deductions. With the exception of a short period in the 1980s no such

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8See Blumenthal and Slemrod (1992), Slemrod and Sorum (1984), Tran-Nam et al. (2000), and European Commission (2013).

9The original estimate is $43 in 1982 dollars.

10For a detailed historical review of charitable contribution deduction see Lindsey (2002).
deductions are allowed for those who claim the standard deduction.\footnote{In 1982 and 1983 those claiming standard deductions could deduct 25\% of their charitable contributions up to a maximum of $25. This limit increased to a maximum of $75 in 1983. In 1984 the policy changed radically by allowing individuals to deduct 50\% of their charitable contributions with no upper limit. The rule became even more generous next year: 100\% of charitable contributions were deductible with no upper limit in 1986. Unfortunately for everybody claiming the standard deduction, the policy was cancelled in 1987.} Noncash contribution deduction is limited to 20\% of AGI and any excess contributions can be carried over to the future years.

To reduce the possibility of tax evasion, authorities designed a set of regulations which are summarized yearly as Publication 526 pertaining to what can be claimed as a charitable contribution and up to which amount. In this paper I focus on one of the most salient of these rules, namely the threshold beyond which individuals need to provide detailed description of their donations. Prior to 1985 individuals had to attach a statement detailing their noncash donations for any amount of contribution. In particular, individuals had to specify the kind of property given, who it was given to and on which date, how the value was calculated and whether it was a capital gain or ordinary income property. If the total asset contribution exceeded $200, individuals also had to specify the address of the charitable organization, a description of the property, conditions attached to the gift, how the individual initially obtained the property and more detailed information on the initial cost and current valuation of the property.\footnote{The following are the precise instructions in 1984: “If you gave property, attach a statement showing the kind of property you gave and the name of the organization you gave it to. Include the date you gave it, show how you figured its value at the time you gave it, and state whether it was capital gain or ordinary income property. If you determine the value of a gift by an appraisal, also attach a signed copy of it for gifts for which you claim a deduction of over $200. For gifts valued over $200, also include the following on your attached statement: a. The address of the organization. b. A description of the property. c. Any conditions attached to the gift. d. How you got the property. e. The cost or other basis of the property if: 1. You owned it less than 5 year, or 2. You must reduce it by an ordinary income or capital gain that would have resulted if the property had been sold at its fair market value. f. How you figured your deduction if you chose to reduce your deduction for contributions of capital gain property. g. If the gift was a “qualifies conservation contribution” under section 170(h), also include the fair market value of the underlying property before and after the gift, the type of legal interest donated, and describe the conservation purpose furthered by the gift.”} Starting from 1985, individuals have to fill out and attach Form 8283 only if they claim more than $500 in noncash charitable donations. Otherwise no forms need to be filled out. Form 8283 requires individuals to provide the same information as when donating more than $200 in the past. Depending on the actual amount claimed and the type of items given further restrictions apply: for example, for very large donations a formal appraisal might be required. In this paper I will focus on the charitable contributions around the $500 threshold for which appraisals and other restrictions do not apply.\footnote{\cite{ackerman2011} provide comprehensive analysis of contributions above $500, while \cite{serocki2013} focus on contributions around the $5,000 appraisal threshold.}

Remaining compliance requirements during 1980s were minimal. Individuals did not need to attach written proof of their contributions, but they were required to keep accurate records.
While actual receipts and written statements were preferred, “reliable written records” were deemed appropriate for any amount of contributions.

Data

I use annual cross-sections of individual tax returns constructed by the Internal Revenue Service (IRS) and commonly known as the Statistics of Income (SOI) Public Use Files, years 1970-2008. The annual cross sections are stratified random samples of approximately 80,000–200,000 observations per year with randomization over the Social Security Number (SSN). High-income taxpayers and those with business income are oversampled but weights are provides. In addition to the cross-sectional data I also look at a panel dataset that covers 1979-1990. This panel followed a random sample of taxpayers, again randomly chosen over SSNs. The sample sizes in this dataset are significantly smaller, ranging from 9,000 to 46,000 observations per year. Since for the majority of years charitable deductions could only be claimed by itemizers, I restrict the sample to those individuals. I further restrict the sample to taxpayers whose overall charitable contributions do not exceed 20% of AGI, which is the case for the vast majority of tax filers.

Sample sizes and summary statistics are provided in Table 3.1. In 1985, among taxpayers who filed a tax return and itemized, approximately 27% claimed noncash charitable donations for a total of $6.61 billion dollars. Among these, 97% reported contributions of less than $2,000. The average contribution for all individuals who donated a positive amount less than $2,000 is $302 (all in 1985 dollars). Overall, those who donated less than $2,000 accounted for 44% of the dollar value of noncash donations. The number of noncash contributions have substantially increased since then. In the latest year of data available, in 2008, approximately 48% of all itemizers reported noncash donations for a total of $36.1 billion dollars. Nevertheless, the majority of individuals – 91% – still donate less than $2,000 an average of $516 (in 2008 dollars). Once adjusted for inflation the numbers imply that overall donations have tripled since 1985 while the average donation has only slightly increased.

14The instructions in Publication 526 state that “records may be considered reliable if they were made at or near the time of the contribution, were regularly kept by you, or if, in the case of small donations, you have buttons, emblems, or other tokens, that are regularly given to persons making small cash contributions.” Records should include the name of the organization, the date of the contribution, and the amount of the contribution.

15The rules have since been tightened. Starting from 1994 an individual should have a receipt or a written statement for any individual gift of $250 or more. For noncash donations of less than $250 taxpayers “are not required to have a receipt where it is impractical to get one (for example, if you leave property at a charity’s unattended drop site).” In 2005, the deductions for car, boat and airplane donations became generally limited to the gross proceeds from their sale by the organization. And starting from 2006 clothing and household items can be deducted if they were donated in good used condition or better.

16In 1985, less than 2% of individuals reported charitable donations that exceeded 20% of AGI, donating on average $11,522 (in 1985 dollars).
CHAPTER 3. OPTIMAL REPORTING THRESHOLDS

3.3 Estimating Evasion and the Cost of Compliance

Empirical Strategy

Let us assume for the moment that there are no reporting regulations, in other words, once the individual has donated to charity, he does not need to keep the receipts or fill out any paperwork beyond Schedule A (Itemized Deductions) to qualify for a deduction. Further, let us assume that everybody reports their donations truthfully. Consider taxpayer \( i \) who earns after-tax income \( Y_i \) which he allocates between consumption, \( C \), and charitable giving, \( X \), by maximizing

\[
\max_{C,X} U_i(C, X) = C + u_{x_i}(X) \quad \text{s.t.} \quad C = Y_i - X + \tau X, \tag{3.1}
\]

where \( u'_{x_i} > 0, u''_{x_i} < 0 \) and \( \tau \) is the tax subsidy provided by the government to support charitable giving. Then the optimal contribution \( X_i^* \) solves

\[
u'_{x_i}(X_i^*) = (1 - \tau). \tag{3.2}\]

Heterogeneity in tastes for charitable giving would lead to a smooth distribution of positive charitable donations, for example as in Figure 3.1(a)\(^{17}\).

Now suppose the government introduces a reporting requirement that obligates all individuals claiming above $500 to fill out Form 8283. Further, suppose the cost of compliance is fixed and heterogeneous across population. Now taxpayer \( i \) solves

\[
\max_{C,X,R} U_i = C + u_{x_i}(X) \quad \text{s.t.} \quad C = Y_i - X + \tau R - \phi_i 1_{R>500}, \tag{3.3}
\]

where \( \phi_i \) is the fixed cost of compliance and \( R \) is the reported amount of charitable contributions. The new regulation will affect people differently. Those who wished to donate \( X_i^* \leq 500 \) are unaffected. On the other hand, those with \( X_i^* > 500 \) have several choices. First, if their compliance cost \( \phi_i \) is sufficiently low or their preference for charitable giving is very strong, they can continue donating \( X_i^* \) and bear the compliance cost \( \phi_i \). Others, however, may find this new regulation too bothersome to comply with. Since the cost of compliance is fixed, the only way to avoid it is to report $500 or less. These taxpayers therefore will report $500 and donate some amount \( \hat{X}_i \in [500, X_i^*] \)\(^{18}\) Thus the new reporting requirement will lead to some bunching at the $500 threshold and a missing mass to the right of it, as in Figure 3.1(b).

In practice, one cannot observe what the distribution of charitable donations would be in the U.S. if there were no reporting requirements as in Figure 3.1(a). Prior to 1985, the

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\(^{17}\)While in Figure 3.1(a) I show a decreasing distribution of donations, it need not be such. The donations can be normally distributed or uniformly, but the distribution should be smooth.

\(^{18}\)These individuals treat the subsidy as a fixed amount $500\(\tau \), hence, \( \hat{X}_i \) determines how much individuals would donate if they received no deduction. Nevertheless, these individuals will want to donate at least $500 because they strictly prefer donating to personal consumption up to true optimal donation \( X_i^* \).
reporting threshold was set at zero – everybody had to submit a written statement as long as they reported a positive donation. This means that some taxpayers “bunched” at $0 and thus the observed 1984 distribution of noncash charitable donations has a missing mass in the vicinity of the 1984 reporting threshold – as in Figure 3.1(c). When the threshold was moved to $500 in 1985, individuals who have previously bunched at $0 would now report their contributions as long as they are less than $500. At the same time, some individuals who have donated more than $500 in the past will now choose to bunch at $500. The observed 1985 distribution therefore should resemble the red line in Figure 3.1(d): it matches the true distribution (i.e. if there was no reporting) of charitable donations up to $500.

Until now we have assumed no cheating; now suppose that some individuals cheat but only when they are not required to fill out Form 8283 or write a statement. Since the threshold was set at $0 prior to 1985, nobody has cheated in 1984. Thus the observed 1984 distribution represents genuine donations – the dashed blue line in Figure 3.1(e). In 1985, however, cheating could be prevalent below $500. Therefore, instead of observing a true distribution as in Figure 3.1(d), we would now observe an exaggerated distribution, with an excess mass below $500 – the dashed green line in Figure 3.1(e).

To be able to determine whether the chosen reporting threshold is optimal, one needs to identify two behavioral responses: shifting of reported donations due to compliance costs and an increase in reported donations due to evasion. I proceed in two steps. I begin by identifying the genuine bunching at $500 due to compliance costs. To do so I compare the observed distribution of noncash donations in 1984 (dashed blue line in Figure 3.1(e)) to the observed 1985 distribution (dashed green line Figure 3.1(e)) above $500. Since the rules above $500 have not changed, by the revealed preference argument the only reason to switch from donating above $500 to precisely $500 is to avoid the cost of filling Form 8283. I then “fill in” the missing mass by redistributing some of the excess mass from $500 to the right of the threshold. This adjustment recovers the solid green line in Figure 3.1(f) which shows us what the distribution of donations would be in 1985 if there was no reporting threshold but people could only cheat up to $500.

Attributing the entire difference between the redistributed 1985 distribution (the solid green line in Figure 3.1(f)) and the observed 1984 distribution (dashed blue line in Figure 3.1(e)) to evasion would be incorrect since this would not account for an increase of genuine donations when compliance rules relaxed. Therefore the next step is to recover the true distribution of charitable donations – the solid red line in Figure 3.1(e). To do so I make a simplifying assumption that the cost of writing a statement in 1984 was equivalent to the cost of filling out Form 8283 in 1985. The assumption relies on the fact the content of the statement is essentially equivalent to Form 8283, thus both actions should require approximately the same amount of effort. If the two costs are equivalent then the proportion

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19 The most profitable evasion strategy is to report precisely $500. However, if individuals bear psychological pain from evasion, the optimal amount could be smaller. For example, taxpayers might think it is ok to exaggerate their donation by just a little bit, but would never cheat by a lot. I model the nature of evasion in Section 3.4.

20 I discuss this assumption in greater detail in the following section.
of taxpayers who chose to forego the deduction in 1984 should correspond to the proportion of taxpayers who chose to bunch in 1985, bin by bin. Thus I can recover the true distribution (the solid red line in Figure 3.1(e)) by appropriately scaling the observed 1984 distribution.\footnote{The actual approach works as follows. Suppose 70\% of taxpayers who reported between $500 and $600 dollars in 1984 chose to bunch at $500 in 1985. I then adjust the first bin, $0 to $100, of the observed 1984 distribution by multiplying the number of donors in that bin by $1/(1 - 0.7)$ to account for the 70\% of missing donors. I repeat this procedure for the next bin, etc. The adjustment stops when the proportion of taxpayers who chose to bunch at $500 instead of reporting the actual number of donations in 1985 is zero.}

Finally, I define evasion as the difference between the redistributed 1985 distribution (solid green line in Figure 3.1(f)) and the reconstructed 1984 distribution (which should match the solid blue line in Figure 3.1(f)). The intuition is simple: to identify evasion we need to differentiate between legitimate donations of individuals who have previously bunched at zero from the cheating donations. The reconstructed 1984 distribution tells us what is the largest number of people who could have chosen to bunch at zero in the past. Any new donations in excess of this reconstructed distribution represent evasion.

**Identification Assumptions**

The approach described in the previous section relies on several assumptions: (1) absence of reform, the distribution of noncash donations in 1985 would resemble the distribution in 1984, (2) compliance costs are fixed and the distribution of compliance cost is similar across population, (3) cheating is only possible below the threshold. Now I briefly discuss the validity of each assumption.

I test the first assumption in Section 3.3 (see Figure 3.7) and show that prior to 1985, noncash donations remained extremely stable with minimal variation across years. Additionally, in contrast to noncash donations – which increased dramatically in 1985 – cash donations remained the same, suggesting that in absence of reform noncash donations in 1985 would closely resemble those in 1984.

The cost of filling out Form 8283 is likely to depend on the number of items described rather than the overall dollar value. Unfortunately, the available data does not provide details on the type and number of donations made. Since there is no reason to believe that individuals who make larger donations necessarily give more items rather than the same number of items but of higher value, one can reasonably assume that the cost of compliance is fixed, but heterogeneous. Individuals who have bunched at $0 in 1984 are poorer, have lower MTRs and lower opportunity cost of time than individuals who bunch at $500 in 1985. Thus the chosen approach is likely to overestimate the compliance cost of writing a statement in 1984 and therefore underestimate the amount of evasion. Therefore, the results in this study generate a lower bound on the true amount of evasion generated by the 1985 reform. I partially circumvent this concern by studying responses by adjusted gross income in Section 3.3.

If the existing regulations do not discourage taxpayers from cheating then the described approach underestimates the magnitude of total cheating. However, relaxing the third as-
assumption would not change the validity of the results, merely the interpretation. In this case, this study estimates evasion by taxpayers who are influenced by the existing policy—the ultimate group of interest from the policy perspective—and disregards individuals who would have cheated anyway. The main concern to my identification strategy is the possibility that some individuals chose to bunch at $500 instead of reporting higher amounts because the cost of cheating decreased discontinuously below the reporting threshold; in which case my estimate of compliance cost is biased upward. While this is possible, it is highly unlikely. The results in Section 3.3 will show that while individuals reported many untruthful noncash donations after the reform, the overall magnitude of response was rather weak, suggesting that even when information reporting is not required, the fixed and marginal costs of evasion are high. If the cost of cheating is even higher in presence of information reporting, the number of evaders prior to 1985 reform is likely to be very low. Thus while a change in compliance requirements affected all individuals—those who cheated and those who did not cheat—the change in evasion cost would only affect cheaters. Moreover, only decreases in fixed cost of evasion would persuade individuals to reduce reported donations, since for individuals who report more than $500 the marginal cost of evasion does not change (both before and after the reform they had to fill out Form 8283). Therefore, it is reasonable to assume that changes in the cost of evasion are of second order to the changes in compliance costs.

Finally, it is possible that individuals choose to bunch at the compliance threshold because they think that the probability of being audited is higher if their reported donations exceed the threshold, regardless of whether these individuals cheat on charitable donations or not. With this possibility in mind, the compliance cost should be interpreted broadly and include both the opportunity cost of time of filling out Form 8283, the psychological hassle cost of doing so, and the expected cost of future audits, if any of these change at the threshold.

Suggestive Evidence

I begin the analysis by looking at the unadjusted for inflation noncash charitable contributions over time, from 1979 to 2008. Two observations are striking in Figure 3.2. First, the effect of the reform in 1985, as previously documented by Buchheit et al. (2005), can be easily seen when comparing contributions in 1984 to those in 1985. Prior to the reform there was no visible spike at $500. Second, this spike has been steadily growing over the years. Since the threshold has not been changed since 1985, one would expect the entire distribution of noncash donations to shift rightward as a result of inflation. However, a very small increase in contributions above $500 suggests that it is unlikely that the entire spike should be attributed to inflation.

To study the effects of the reform I focus on the years immediately before and after the change in Figure 3.3. Here I plot distributions of reported charitable donations in the

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22 For the majority of taxpayers who are not self-employed, the probability of being audited is very small and is less than 0.5%. There is also no empirical evidence that indicates that the probability of audit increases if one submits Form 8283.
form of assets in 1984 and 1985, and in 1984 and 1986, all unadjusted for inflation. As expected, Figure 3.3 shows an increase in the number of reported donations below $500. Without further analysis it is not possible to tell whether this increase is due to evasion or due to genuine donations by taxpayers who previously bunched at $0 because of compliance costs. Figure 3.3 also shows a pronounced spike at the $500 threshold and a decrease in contributions above the threshold. It is notable that the size of the spike has increased from 1985 to 1986. It is possible that taxpayers discovered about the compliance rule change only when they started preparing their tax return at which point donations have already been made. Alternatively, cheating may increase over time as taxpayers learn about the rules.

Next I focus on individuals who have donated in the past. Using the panel dataset I identify taxpayers who have made noncash contributions in 1984 and compare their donations prior to the reform, i.e. in 1984, to those after the reform, i.e. in 1985, in Figure 3.4(a). Figure 3.4(a) should show smaller missing mass to the right of the $500 threshold as compared to Figure 3.3(a), because these individuals had sufficiently low compliance costs to continue reporting noncash donations when the compliance threshold was set at zero. This is precisely what we observe. At the same time, these individuals should report approximately the same amount of noncash donations below the $500 threshold after the reform as before the reform. Contrary to this expectation there is a decrease in the number of very small donations and an increase in donations in the [$200, $400] range, suggestive of evasion.

In Figure 3.4(b) I compare post-reform donations of those who have donated prior to the reform, i.e. in 1984, to those who have not donated in the immediate past, i.e. they have not donated neither in 1983 nor in 1984. One would expect the new donor donations to be more concentrated near zero because some of these donors might have chosen not to donate in the past because of the high cost of writing a statement. This is consistent with what we observe in Figure 3.4(b). New donors are more likely to donate smaller amounts, i.e. in the [$0, $200] range, while “experienced” donors are more likely to donate in the [$300, $500] region. Moreover, new donors are less likely to bunch at $500, possibly suggesting that evasion comes with experience.

Figure 3.5(a) shows that the 1985 reform triggered a lasting increase in the number of reported noncash donations. Here I plot the percent of itemizers who make noncash donations, cash donations, or both. Several observations are notable. First, the reform acutely increased the number of donors in 1985 and lead to a persistent growth of noncash donations until year 2003. Second, at the same time, the overall number of donors slightly decreased over the years. Figure 3.5(a) shows that the reform primarily increased the number of donors who make both cash and noncash contributions. The number of “only noncash” donors has also increased sixfold: from less than 1% of itemizers in 1979 to over 6% in 2008, as seen in Figure 3.5(b). Unfortunately the data on noncash donations is only available from

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23It is worth noting that some bunching at $200 might have occurred before 1985. Recall that for donations above $200 individuals had to submit a more detailed statement. Through visual observation of 1983 and 1984 distributions in Figure 3.2 I conclude that such bunching was very small and the missing mass was limited to [$200, $300] interval. The decrease in donations at $200 is too small to justify larger increases in reported contributions in the ($200, $400).
1979 on, so it is not possible to determine whether this increase could be attributed to the 1985 reform.

In Figure 3.6 I plot the 25th, 50th, and 75th percentiles of dollar value of contributions (all inflated to 2008 dollars). Figure 3.6 shows that an increase in noncash donations was not due to the crowding out of cash contributions. All percentiles of cash donations have not decreased in 1985 and actually increased after the passing of the 1986 Tax Reform Act. Meanwhile, noncash donations have steadily grown in value. Figure 3.7(a) shows even more clearly that there was no substitution whatsoever between the two types of donations in 1985: the distribution of cash donations has not been affected by the 1985 reform at all. The distributions overlap very well, suggesting that the observed changes to the distribution of noncash donations are driven by the change in compliance rules, since any changes to the attractiveness of charitable giving or itemizing would affect both cash and noncash donations. Figure 3.7(b) confirms that it is also unlikely that such substitution happened in later years, since cash contributions remained relatively stable, with an increase in the amount of cash donations after 1986 Tax Reform. As a final robustness check I plot the distributions of noncash donations prior to the reform in Figure 3.7(b). These distributions overlap closely – with the exception of the first bin – suggesting that while individual donations may vary substantially from year to year, aggregate donations are very stable. Therefore I can safely use the 1984 distribution as a counterfactual density to study the effect of the 1985 reform on noncash charitable giving.

Several channels might be responsible for the lasting effect of the reform. On the one hand, the simplicity of noncash donations might have triggered charitable organizations to advertise and promote this type of donations. On the other hand, fewer reporting requirements made evasion simpler. Yet another explanation is the mix of the two: the reform might have lead to a genuine increase in donations but claimed at the inflated values.

Identifying Evasion

It is likely that individuals learnt about the compliance change in the beginning of 1986, after they have already made their 1985 donations. For this reason I study changes in noncash donations both in 1985 and 1986. When comparing 1984 and 1985 distributions I choose not to adjust for inflation. It is unlikely that a 3.4% inflation in that year affected the size of donations. However, when comparing 1984 and 1986 distributions, I do adjust for inflation (a combined increase of 5.1%). Below I explain my approach to estimating evasion in terms of 1984 and 1985 distributions, but I use the same approach to estimate evasion in 1986 as well.

I start by comparing the number of people in each bin above $500 in 1985 and in 1984 using the results from Figure 3.3(a). First, I fit a fractional polynomial of degree 3 through the bins above $500 for each year. Next I identify the bins for which the difference between

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24 The extremely volatile nature of the 75th percentile of noncash donations is likely due to the outlier contributions that have not been removed.

25 It is, however, problematic to extend the analysis to later years because of Tax Reform Act of 1986.
the number of donors in 1984 and 1985 is positive. I then adjust the 1985 distribution to the right of the threshold upward by “filling in” the missing mass for all bins where the difference is positive. I do so by multiplying the number of donors in each bin $i = \$600, \$700, ...$ in 1985 by $\text{Poly}_{84}(i)/\text{Poly}_{85}(i)$, where $\text{Poly}_{84}$ and $\text{Poly}_{85}$ are the values of the fitted polynomials of the 1984 and 1985 distributions respectively. At the same time I reduce the size of the spike at $\$500$ accordingly by subtracting the respective amounts from the $\$500$ bin.

The results of this procedure are shown in Figure 3.8(a). The dashed green line and the solid orange lines are reproductions from Figure 3.3(a). The solid purple line is the redistributed 1985 density: it matches the original distribution up to 500 and above 1100. But it shows a much smaller spike at $\$500$ and approximately matches the observed 1984 distribution between $\$500$ and $\$1100$. Note that the persisting spike at $\$500$ is the first sign of evasion. If all of the excess mass at $\$500$ was due to the cost of filing Form 8283, the adjusted 1985 distribution would be smooth with no bunching at $\$500$. Figure 3.9(a) shows similar results for 1986, but the remaining excess mass at $\$500$ is larger.

The second step is to recreate the counterfactual 1984 distribution to account for the missing mass close to $\$0$. Recall that prior to 1985 all individuals who reported any amount of noncash contributions had to submit a written statement detailing their donations. As described in Section 3.3, I make a simplifying assumption that the cost of writing a statement in 1984 is equivalent to the cost of filling out Form 8283 in 1985. This means that I can adjust the observed 1984 distribution by multiplying it by $\text{Poly}_{84}/\text{Poly}_{85}$, bin by bin. Therefore I adjust the ($\$0, \$100$] 1984 bin by the ratio derived for ($\$500, \$600$] 1984/1985 bin, since in both cases individuals chose to forego approximately $\$50 \times MTR$. Similarly, I adjust ($\$100, \$200$] 1984 bin by the ratio derived for ($\$600, \$700$] and etc. As discussed in Section 3.3 this approach relies on the assumption that the distribution of compliance cost for individuals donating around $\$500-\$1000$ is approximately equal to the distribution of compliance costs for individuals donating around $\$0-\$500$. If individuals who make smaller donations have lower compliance costs, the estimated counterfactual represents an upper bound.

The recovered counterfactual is presented in Figure 3.8(b). The adjustment procedure grossly overestimates the number of potential new donors in ($\$0, \$300$] region. Two explanations are possible. First, compliance costs of these individuals might be significantly lower than assumed, leading to an overestimate of missing donations. I discuss this possibility when I perform heterogeneity analysis in Section 3.3. A more likely explanation is that some taxpayers do not bother reporting all charitable donations they make even when compliance requirements are low. The adjustment procedure suggests that all new donations below $\$400$ in 1985 are likely to be genuine. In other words, individuals who found it too costly to write a statement in 1984, have started to report donations in 1985. However, in the ($\$400, \$500$] region the redistributed 1985 density is greater than the recovered counterfactual 1984 density. This suggests that even after removing the excess mass from $\$500$ (to account for those who bunch from the right) and after accounting for legitimate new donors (who found it too costly to report in 1984) there remains an “unexplained” excess mass at $\$500$. These individuals must be cheating.

Figure 3.9(b) repeats the above procedure using the 1984 and 1986 distributions. The
results are similar, but the magnitude of evasion is much larger. This finding is not surprising in light of a large increase in donations around the $500 threshold in 1986. These results are consistent with individuals slowly learning and adjusting their behavior over time. Figures 3.8 and 3.9 suggest that the 1985 reform led to a substantial increase in evasion. At the same time, the reform also lead to an increase in genuine charitable donations and saved time and money to many individuals who donate less than $500. I quantify the results of the reform in the next section.

Quantifying Compliance Cost and Evasion

Quantifying Evasion

The 1985 reform had several effects. On the plus side it removed compliance costs for individuals donating less than $500. This decrease in compliance costs also lead to an increase in genuine donations. At the same time, the reform generated evasion and decreased the number of donations above $500. Table 3.2 summarizes the results of this cost-benefit analysis.

The reform generated approximately $324–$367 million of new genuine donations. I calculated these numbers as the area between the redistributed 1985/1986 distribution and the original 1984 distribution (in 1985/1986 dollars). At the same time the reform lead to approximately $70 million fewer reported donations in the [$500, $1000] range, calculated as the area between the redistributed 1985/1986 distribution and observed 1985/1986 distribution. Unfortunately, there is no way to know whether individuals actually reduced the amount of charitable giving or merely chose to forego part of the subsidy.

Quantifying evasion requires an additional assumption as one cannot observe how much, if at all, the evaders have actually donated. I assume that each evader has donated $100, which is equivalent to assuming that evaders are actual donors, coming from the observed 1984 distribution. I find that the reform lead to $83 million of false donations in 1985 and $235 million in 1986. This suggests that 22% of the observed increase in donations in 1985 and 48% in 1986 were due to evasion.\footnote{It may seem counterintuitive as to why these numbers are so large while the shaded areas in Figures 3.8(b) and 3.9(b) are small. The answer is simple: the majority of genuine new donations are small – less than $200. The cheating donations, on the other hand, are concentrated in the [$400,$500] region. Thus even after subtracting the assumed genuine portion – $100 – the cheating per donor is large.}

While an increased reporting threshold lead to evasion, the overall magnitude of observed cheating is rather small. If reporting requirements are the only barrier to cheating, one would expect to observe most individuals to report noncash donations of approximately $500 or more, with nobody reporting $100-$200 donations. Yet, this is not what we observe in Figure 3.3. The relatively small increase in donations in 1985 and 1986 (and even future years) suggests that individuals find cheating painful and are not willing to cheat by large amounts. One way to model the observed behavior is to assume that individuals experience
both a fixed cost of evasion, which requires them to cheat by at least some positive amount to make it worthwhile the effort, and a variable cost, which prevents individuals from cheating by large amounts.

The observed levels of cheating are consistent with findings from other studies (see Slemrod (2007) for a review), however, the case of noncash charitable donations is particularly interesting because cheating is very easy and the likelihood of getting caught is extremely low. As was described in more detail in Section 3.2, in contrast to cash donations for which receipts are generally required if a taxpayer is audited, receipts are not required for noncash donations if “it is impractical to get one (for example, if you leave property at a charity’s unattended drop site).” Thus in case of an audit, it would be virtually impossible for the IRS to accuse taxpayer reporting $500 worth of noncash donations of cheating.

Finally, the results also suggest that cheating behavior is mostly prevalent among experienced “donors.” Even if individuals experience high evasion costs, one would expect a surge in cheating donations over time – donations reported by individuals who were previously discouraged by reporting requirements. Yet, as can be seen in Figure 3.5, even 10 years after the reform, less than 45% of itemizers report noncash donations. One possible explanation is that taxpayers are unaware of this possibility because they are not familiar with rules. However, this explanation is somewhat inconsistent with the fact that more than 80% of itemizers report cash donations and therefore must be somewhat familiar with the rules.

**Quantifying Compliance Cost**

The greatest benefit of the 1985 reform was the removal of compliance cost for all individuals who donate $500 or less. To calculate the cost of filing Form 8283, I again turn to Figure 3.8(a). Individuals who chose to bunch at $500 either reduced donations, thus foregoing some utility from giving, or reported less, thus foregoing part of the tax deduction. Unfortunately I cannot observe which of the two approaches they have followed. So I consider both.

The first approach – assuming individuals choose to forego the subsidy – generates an upper bound on the cost of compliance, since reducing the actual donations by some amount would increase individuals’ utility by increasing own consumption. The advantage of the first approach, however, is in its simplicity, since it relies on a revealed preference argument to estimate compliance cost and requires no parametric assumptions. The second approach – assuming individuals actually reduce donations – generates a more accurate prediction of compliance costs, but requires an estimate of foregone utility due to suboptimal amount of donations given.

**Assumption 1: Individuals do not reduce donations.**

From (3.2) follows that a taxpayer $i$ will choose to donate $X_i^*$ but report $500$ if the utility from doing so is higher than donating and reporting $X_i^*$:

$$Y_i - (1 - \tau)X_i^* + u_{xi}(X_i^*) - \phi_i \leq Y_i - X_i^* + 500\tau + u_{xi}(X_i^*) \quad \text{or} \quad \phi_i \geq \tau(X_i^* - 500).$$

(3.4)

As discussed in Section 3.3 taxpayers might also choose to donate an amount between $500$ and $X_i^*$ and report $500$. I omit this possibility.
Therefore I can approximate the distribution of compliance cost \( \phi_i \sim F_{\phi} \) by quantifying the amount of foregone deductions above $500 in 1985 as compared to 1984. From (3.4) follows that the percentage of people who continue to contribute in 1985 gives us the values of the cumulative distribution function of compliance cost, \( F_{\phi} \), since for each bin \( b_j = ($500, $600], \) \( ($600, $700], \) etc. with average donation \( j = $550, $650, \) etc. we have

\[
\frac{\text{Poly}_{85}(b_j)}{\text{Poly}_{84}(b_j)} = \text{Prob}(\phi_i \leq (1 - \tau)(j - 500)) = F_{\phi}(\tau(j - 500)), \tag{3.5}
\]

where \( \text{Poly}_{84}(b_j) \) and \( \text{Poly}_{85}(b_j) \) represent the number of observations in bin \( b_j \) in 1984 and 1985 respectively.

**Assumption 2: Individuals reduce donations.** Alternatively, taxpayer \( i \) will report and donate $500 if the utility from doing so is higher than reporting and donating \( X^* \):

\[
Y_i - (1 - \tau)X_i^* + u_{xi}(X_i^*) - \phi_i \leq Y_i - 500(1 - \tau) + u_{xi}(500)
\]

or \( \phi_i \geq u_{xi}(X_i^*) - u_{xi}(500) - (1 - \tau)(X_i^* - 500) \).

Assume \( u_{xi} = A_i X^\varepsilon \) with \( \varepsilon \in (0, 1) \). Then using Taylor expansion of \( u_{xi}(\cdot) \) around \( X_i^* \) and (3.2) we find:

\[
u_{xi}(500) \approx u_{xi}(X_i^*) - (1 - \tau)(X_i^* - 500) + \frac{1}{2}(1 - \tau)(\varepsilon - 1)\frac{(X_i^* - 500)^2}{X_i^*}.
\]

Therefore, taxpayer \( i \) will report and donate $500 if \( \phi_i \geq \frac{1}{2}(1 - \tau)\frac{(500 - X_i^*)^2}{X_i^*} \). Thus for bins \( b_j \) with average donations \( j \) we have

\[
\frac{\text{Poly}_{85}(b_j)}{\text{Poly}_{84}(b_j)} = \text{Prob}\left(\phi_i \leq \frac{1}{2}(1 - \tau)(1 - \varepsilon)\frac{(500 - j)^2}{j}\right) = F_{\phi}\left(\frac{1}{2}(1 - \tau)\frac{(500 - j)^2}{j}\right). \tag{3.6}
\]

Equations (3.5) and (3.6) specify two approaches for estimating the cost of compliance. The first approach assumes donations remained the same but claiming decreased, while the second approach assumes both donations and reporting has decreased. In 1985, individuals who chose to donated in the range of \([$500, $1000]\) had an average marginal tax rate of 29.4%, while in 1986, the average tax rate was 30.11%. I use these tax rates to back out the cumulative distribution of compliance cost using formulas (3.5) and (3.6). To estimate the cost of compliance using (3.6) I set \( \varepsilon = 0.23 \) which corresponds to an estimate of elasticity of charitable giving of -1.3.

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28 Differentiation yields \( u'_{xi} = A_i \varepsilon x^{\varepsilon - 1} \) and therefore \( u''_{xi} = u' \cdot (\varepsilon - 1)/x \).

29 For utility \( u_{xi} = A_i X^\varepsilon \) with \( \varepsilon \in (0, 1) \), optimality condition (3.2) implies \( A_i \varepsilon X^{\varepsilon - 1} = 1 - \tau \). Hence elasticity of charitable giving with respect to net-of-tax rate is \( 1/(\varepsilon - 1) \).

30 See Andreoni (2006) for a recent review of elasticities of charitable giving.
Table 3.2 presents the results of the calculations. Under the first assumption I find that individuals are willing to forego up to $87–$91 on average in order to avoid filling out Form 8283 (in 1985/1986 dollars). Under the second assumption, I calculate an average cost of filling out Form 8283 to be $37-45 which is still substantial. In addition to the average cost of filing, Table 3.2 also shows cumulative savings from simplified compliance requirements. Assuming that the distribution of donations would stay the same as in 1984 if the reform did not happen, I calculate the cost of compliance for those individuals who would have donated under the old rules. Note that the cost for these individuals is lower since they self-selected into donating and therefore had lower-than-average compliance costs. The results show that even under more conservative assumption (using (3.6)), the 1985 reform decreased compliance costs by $17-35 million (1985/1986 dollars).

Even the more conservative estimates of compliance cost – $82-100 in 2014 dollars – are rather high considering it is very unlikely that filling out Form 8283 will take more than an hour of one’s time. Several explanations are possible. First, filling out Form 8283 might be time-consuming because doing so requires taxpayers to learn about the rules, potentially obtain Publication 526, request and organize receipts. Second, individuals might procrastinate on filing tax returns until the deadline at which point the cost of filing any additional tax forms can be particularly high. Third, individuals might choose not to exceed the reporting threshold because they think that doing so will increase the probability of being audited. In this study I am not able to differentiate between these alternative explanations. However, the results of Benzarti (2015), who studies the decision to itemize and explores various explanations for the high estimated cost of filing Schedule A, suggest that high hassle costs and procrastination are the most likely explanation for the observed behavior.

Response Heterogeneity

In this section I explore whether evasion is more prevalent among some demographic groups and whether the cost of filing Form 8283 varies across individuals. Unfortunately, careful

31 The third explanation is possible but unlikely because there is no reason to believe that reporting over $500 will trigger auditing. IRS provides very little information on the likelihood of being audited, but according to the 2012 IRS Data Book (available at http://www.irs.gov/pub/irs-soi/12databk.pdf) only 0.4% of nonbusiness returns without EITC and without Schedules C, E, F or Form 2106 have been audited. This probability increases to no more than 3.6% when individuals file above-mentioned Schedules or claim EITC. It is unlikely that tax preparers recommend reducing reported donations either, because tax preparers are not allowed to provide their clients with the likelihoods of being audited and strategize the return accordingly. For an interesting discussion see http://www.forbes.com/sites/anthonymitti/2013/03/25/what-are-your-odds-of-being-audited-by-the-irs/.

32 It can further be argued that the fear of being audited should one submit Form 8283 is somewhat counterintuitive. Consider the following thought exercise. If you were the IRS, who would you choose to audit: (a) somebody who reports $550 worth of noncash donations and provides you with details descriptions on Form 8283; or (b) somebody who reports $490 and provides no details?
CHAPTER 3. OPTIMAL REPORTING THRESHOLDS

heterogeneity analysis is limited because of small sample sizes and lack of demographic information. I start by breaking down itemizers by quartiles of income. Figure 3.10 and Table 3.3 present results comparing distributions in 1984 (inflation adjusted) and in 1986. Two observations are notable from Figure 3.10. First, richer individuals make substantially larger donations than poorer individuals. Second, richer individuals show much stronger response to the 1985 reform with substantial amount of donations likely to be untruthful. Estimates in Table 3.3 suggest that individuals in top quartile of adjusted gross income (AGI) evade almost twice as much as individuals in the bottom 2 quartiles of AGI. In general, the percent of evasion appears to increase monotonically with the AGI. I use (3.6) to estimate the compliance cost and find that the cost of filing Form 8283 also increases with AGI, though relationship is not perfectly monotonic. Unfortunately, due to large standard errors the differences across AGI quartiles are not statistically significant. However, the persistence of behavior over time suggest that AGI has a strong impact on the behavior of individuals. Further, my results are consistent with findings of Benzarti (2015) who also finds that richer individuals are willing to forego larger amounts to avoid the hassle of itemizing.

Figure 3.10 also allows me to investigate the validity of the adjustment procedure used in Section 3.3: recall that under assumption 2, discussed in Section 3.3, I assume that individuals who donate less than $500 experience similar compliance cost as individuals who donate $500 or more. Table 3.3 clearly shows that there is substantial heterogeneity in the population by AGI, with richer individuals willing to forego larger amounts in order to avoid the cost of filing Form 8283. However, Figure 3.10 also reveals that this heterogeneity primarily stems from differences in tax rates experienced by individuals. In fact, more individuals reduce their reported donations among low-income taxpayers than among high-income individuals, as can be seen by comparing the missing masses in Figure 3.10 (a) and (c). Further, Figure 3.10 clearly shows that even when restricted to a quartile of AGI, the adjustment procedure grossly overestimates the number of individuals who would have reported positive donations in 1984 if there were no reporting requirements. The most likely explanation for the observed behavior therefore is that many individuals choose not to deduct charitable donations when these amounts are small. It could be that many individuals are not aware they could deduct noncash contributions in addition to cash donations.

Next, I explore how responses differ depending on whether individuals use tax preparers, report some self-employment income and whether they are single or married. Table 3.4 summarizes the results, graphical evidence is available in Appendix Figure B.2. Surprisingly I find little variation in the amount of evasion across groups. However, there is substantial variation in the perceived costs of filing Form 8283. Individuals who use a tax-preparer incur nearly twice lower cost of filling out Form 8283 than those who do not use a tax preparer, the difference is statistically significant. Similarly, individuals who have to file Schedules C, E or F show a lower cost than those who do not file self-employment income schedules. Finally, single individuals experience slightly larger cost than joint filers, but these differences are not statistically significant. Observed heterogeneity is consistent with a straightforward explanation that the perceived cost is likely to be larger for individuals who are not used to filling out complicated tax return forms and that experience reduced tax filing costs.
3.4 Optimal Thresholds

The results in the previous section demonstrate that reporting requirements are important and indeed generate a trade off between compliance costs and evasion. In this section I study how the government should decide on a magnitude of reporting thresholds. At the end of the section, I calibrate my model and show that it would have been more optimal to set the threshold at approximately $180 in 1985 instead of $500.

Baseline Theoretical Model: No Evasion and No Compliance Cost

To begin, assume there are no compliance costs and evasion is not possible. Consider an individual $i$ who solves

$$
\max_{C, X} U_i(C, X) \quad \text{s.t.} \quad C = Y_i - X + \tau X,
$$

where $C$ is consumption, $X$ is charitable giving and $\tau$ is the tax subsidy provided by the government to support charitable giving. This individual will make charitable contributions by choosing an optimal allocation $(\hat{C}_i, \hat{X}_i)$ that satisfies

$$
U'_{ix}(C, X) = (1 - \tau) \cdot U'_{ic}(C, X).
$$

The government’s problem is to choose an optimal subsidy rate $\tau$ to maximize social welfare, which is a sum of individual welfare and externality benefits from charitable giving, minus the cost of raising funds to support the subsidy. Formally,

$$
\max_{\tau} W = \int g_i U_i(\hat{C}_i(\tau), \hat{X}_i(\tau))di + \int B \cdot \hat{X}_i(\tau)di - \int C_F \cdot \tau \hat{X}_i(\tau)di,
$$

where $g_i$ is individual’s social welfare weight, $B$ is the positive externality introduced by charitable giving and $C_F$ is the marginal cost of funds. At the optimum the government will pick $\tau$ that equalizes the sum of marginal private and social benefits of charitable giving to the marginal cost of acquiring the funding. $^{33}$

Theoretical Model with Compliance Costs and Evasion

Now suppose evasion is possible and current regulations require an individual to fill out some paperwork if his reported charitable contributions exceed a pre-determined threshold $T$. Now the individual may choose to report his true contributions, $X$, overstate his contributions by an amount $E$, thus reporting $R = X + E$, or underreport contributions, $R < X$. We

$^{33}$In reality, the externality from giving, $B$, is likely to decrease in the total amount of donations, while cost of acquiring funds, $C_F$, is likely to increase. The goal of this paper is to focus on optimal determination of reporting thresholds, rather than optimal subsidy $\tau$. For this reason, I assume $B$ and $C_F$ are fixed.
will assume that evasion is 100% detectable and thus unprofitable when individual reports $R > T$. The individual now maximizes

$$\max_{C, X, R} U_i(C, X) \quad \text{s.t.} \quad C = Y_i - X + \tau R - [h_{i0} + h_i(R - X)]1_{R > 0} - \phi_i(X)1_{R > T},$$

where $h_{i0} + h_i(\cdot)$ and $\phi_i(\cdot)$ are evasion and compliance costs respectively, and $R$ is the reported amount of charitable contributions. We assume that an individual experiences compliance cost only if he reports $R > T$ and he experiences evasion cost $h_{i0} + h_i(R - X)$ only if he cheats.

The government problem remains unchanged, except that now the government wants to determine both optimal level of subsidy $\tau$ and the optimal threshold $T$.

**Individual Decision**

Individual’s optimal choice might fall into two categories, which are best described relative to individuals’ choice $\hat{X}_i$ in the baseline scenario (no evasion and no compliance costs).

1. $\hat{X}_i \leq T$. These individuals will not incur compliance costs, however, they have an opportunity to evade. The first order conditions imply that optimal $(C_i^*, X_i^*, R_i^*)$ satisfy

$$\tau = h'(R - X),$$

$$U'_{ix}(C, X) = (1 - \tau) \cdot U'_{ix}(C, X),$$

and therefore

$$(X_i^*, R_i^*) = \begin{cases} (\hat{X}_i, \tilde{R}) & \text{if } \tau(\tilde{R} - \hat{X}_i) - h_{i0} - h(\tilde{R} - \hat{X}_i) \geq 0 \text{ and } \tilde{R} \leq T \\ (\hat{X}_i, T) & \text{if } \tau(\tilde{R} - \hat{X}_i) - h_{i0} - h(\tilde{R} - \hat{X}_i) \geq 0 \text{ and } \tilde{R} > T \\ (\hat{X}_i, \hat{X}_i) & \text{if } \tau(\tilde{R} - \hat{X}_i) - h_{i0} - h(\tilde{R} - \hat{X}_i) < 0 \end{cases}$$

(3.13)

where $\tilde{R}$ solves (3.11). These taxpayers will choose to evade if the benefit of evasion is greater than the cost of evasion, thus their indirect utility will be

$$U_i(C_i^*, X_i^*, R_i^*) = U_i(\hat{C}_i(\tau), \hat{X}_i(\tau)) + \Delta U_i^E(\tau, T),$$

(3.14)

where $\Delta U_i^E(\tau, T)$ measures an increase in utility due to evasion.

2. $\hat{X}_i > T$. Since evasion is not possible above the threshold, individuals with large baseline donations $\hat{X}_i$ will bear a loss in utility due to compliance as discussed in Sections

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34 Two justifications for this choice. First, if additional paperwork does not deter some individuals from evasion, the composition of this population and evasion behavior should not affect the choice of the threshold (though it would suggest that the chosen compliance regulations are not effective). Second, under some compliance rules evasion is in fact not possible above the threshold. For example, third party reporting of wage income is equivalent to setting the threshold at zero for this type of income. Underreporting of wage income would then immediately trigger an audit.
Some individuals, however, will choose to reduce their donations, with optimal combination \((C^*_i, X^*_i, R^*_i)\) satisfying

\[
\begin{align*}
(X^*_i, R^*_i) = & \begin{cases} 
(T, T) & \text{if } \tilde{X} < T \text{ and } Y_i - (1 - \tau)T > Y_i - (1 - \tau)\tilde{X}_i - \phi_i(\tilde{X}_i) \\
(\tilde{X}, T) & \text{if } \tilde{X} \geq T \text{ and } Y_i - \tilde{X} + \tau T > Y_i - (1 - \tau)\tilde{X}_i - \phi_i(\tilde{X}_i) \\
(\tilde{X}_i, \tilde{X}_i) & \text{otherwise,}
\end{cases}
\end{align*}
\]

(3.15)

where \(\tilde{X}\) solves

\[
U'_{ix}(C, X) = U'_{ic}(C, X).
\]

(3.16)

These taxpayers will now enjoy lower utility

\[
U_i(C^*_i, X^*_i, R^*_i) = U_i(\hat{C}_i(\tau), \hat{X}_i(\tau)) - \Delta U^\phi_i(\tau, T),
\]

(3.17)

where \(\Delta U^\phi_i(\tau, T)\) measures a decrease in utility due to compliance costs.

**Government Decision**

Using (3.14) and (3.17) we can now write down the government decision problem in terms of the baseline model and changes in utility due to evasion and compliance cost. First, individuals will experience an increase in utility due to evasion and a decrease in utility due to compliance cost. Second, the total size of truthful donations will decrease because of positive compliance costs and so will the externality from giving. Third, the increase in evasion and the decrease in donations will affect the funds needed to sustain the subsidy. Define \(\Delta X^*_i = X^*_i - \hat{X}_i\) and \(\Delta R^*_i = R^*_i - \hat{X}_i\). Then the government wishes to maximize (3.9) which can be rewritten as

\[
\max_{\tau, T} W = \int g_iU_i(\hat{C}(\tau), \hat{X}(\tau))di + B \cdot \hat{X}_i(\tau)di - \int C_F \cdot \tau \hat{X}_i(\tau)di - \int g_i\Delta U^\phi(\tau, T)di - \int B \cdot \Delta X^*_i(\tau, T)di - \int C_F \cdot \tau \Delta R^*_i(\tau, T)di + \int g_i\Delta U^E(\tau, T)di.
\]

(3.18)

The first part of the equation (3.18) is identical to maximization problem under the baseline scenario, (3.9), and does not depend on \(T\). Thus if the government is interested in finding
the optimal threshold $T$, it is sufficient to minimize:

$$\min_T \Delta W = \int g_i \Delta U^\phi(\tau, T) di + \int B \cdot \Delta X_i^*(\tau, T) di$$

Utility Loss due to Compliance \hspace{1cm} Externality Loss due to Compliance

$$+ \int C_F \cdot \tau \Delta R_i^*(\tau, T) di - \int g_i \Delta U^E(\tau, T) di.$$ Funding Cost Change due to Evasion and Compliance \hspace{1cm} Utility Gain due to Evasion

(3.19)

### Optimal Threshold

#### Simplifying Assumptions

To solve (3.19) I make several simplifying assumptions. First, I assume a quasilinear utility function

$$U_i(C, X) \equiv C + A_i X^\varepsilon,$$

with heterogeneous tastes for charitable giving $A_i \sim F_A$. Second, I assume the cost of compliance is fixed and equal to

$$\phi_i(X) \equiv \phi_i \geq 0, \quad \phi_i \sim F_\phi.$$

I choose to focus on the fixed cost of compliance because this cost is likely to vary with the type of donations rather than the dollar value of donations. Third, I set the evasion cost $h_{i0} + h_i(\cdot)$ to be a quadratic function of the amount of evasion $R - X$, i.e.

$$h_i(R - X) \equiv \begin{cases} 0 & \text{if } E = 0 \\ \gamma_{1i} + \gamma_{2i}(R - X)^2 & \text{if } E > 0 \text{ and } R \leq T \\ +\infty & \text{if } E > 0 \text{ and } R > T \end{cases}$$

(3.20)

with $(\gamma_{1i}, \gamma_{2i}) \sim F_\gamma$. From (3.20) follows that individual experiences zero cost when he does not evade, a fixed plus quadratically increasing cost when he evades, and infinitely large cost if he evades and reports above the threshold $T$. From (3.11) follows that the optimal evasion amount is $R_i^* - X_i^* = \tau/(2\gamma_{2i})$. However, we need to ensure evasion is profitable considering the fixed cost of evasion, i.e.

$$\tau \cdot \frac{\tau}{2\gamma_{2i}} - \gamma_{1i} - \gamma_{2i} \left(\frac{\tau}{2\gamma_{2i}}\right)^2 > 0 \quad \text{or} \quad \frac{\tau^2}{4\gamma_{2i}^2} - \gamma_{1i} > 0.$$

Therefore individual will cheat by

$$R_i^* - X_i^* = \begin{cases} \frac{\tau}{2\gamma_{2i}} & \text{if } \frac{\tau^2}{4\gamma_{2i}^2} - \gamma_{1i} > 0 \text{ and } T - \hat{X}_i \geq \frac{\tau}{2\gamma_{2i}} \\
\quad T - \hat{X}_i & \text{if } \frac{\tau^2}{4\gamma_{2i}^2} - \gamma_{1i} > 0, \quad (T - \hat{X}_i) > \frac{\tau}{2\gamma_{2i}} - \sqrt{\frac{\tau^2}{4\gamma_{2i}^2} - \frac{\gamma_{1i}}{\gamma_{2i}}} \text{ and } T - \hat{X}_i < \frac{\tau}{2\gamma_{2i}} \\
0 & \text{otherwise.} \end{cases}$$

(3.21)
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From (3.21) follows that if the fixed cost \( \gamma_{1i} = 0 \), individuals will always evade and the amount of evasion will depend on the variable cost \( \gamma_{2i} \). On the other hand, if \( \gamma_{2i} = 0 \) then individuals would want to evade infinitely much but won’t be able to because of the threshold \( T \). Instead they will evade \( T - \hat{X}_i \) as long as \( T - \hat{X}_i > \gamma_{1i}/\tau \). Since the framework is interesting only when people can evade, we assume condition \( \frac{\gamma^2}{4\gamma_{2i}} - \gamma_{1i} > 0 \) is satisfied.

Define \( E_i = \frac{\tau}{2\gamma_{2i}} \) and \( ME_i = E_i - \sqrt{E_i^2 - \frac{\tau}{\gamma_{2i}}} \), then \( E_i \) determines the ideal amount by which an individual would like to cheat and \( ME_i \) the minimum amount of cheating an individual would find worthwhile.

Fourth, I assume that individuals who wish to avoid the compliance cost and bunch at the threshold will reduce donations to \( T \) and set \( X^*_i = R^*_i = T \). Fifth, I will estimate the forgone utility of these individuals using Taylor approximation \( u(X) - u(T) = (1 - \tau)(X - T) + \frac{1}{2}(1 - \tau)(1 - \varepsilon)(\frac{X - T}{X})^2 \) as was done in Section 3.3. Define \( TC_i = T + \frac{\phi_i}{(1 - \tau)(1 - \varepsilon)} + \sqrt{T\frac{2\phi_i}{(1 - \tau)(1 - \varepsilon)} + \frac{\phi_i^2}{(1 - \tau)^2(1 - \varepsilon)^2}} \), then individuals with optimal donations \( \hat{X}_i \in [T, TC_i] \) choose to bunch at the threshold, while those with \( \hat{X}_i < TC_i \) donate optimally and bear the full cost of compliance \( \phi_i \). Finally, let \( g_i = 1 \) if the person is not an evader, and \( g_i = \Omega \) if the person is an evader. Setting \( \Omega = 0 \) thus allows us to disregard the positive utility derived from evasion.

The heterogeneity in tastes for charitable giving \( A_i \) maps into heterogeneity in ideal donations \( \hat{X}_i \), in other words in absence of evasion and compliance costs the distribution of charitable tastes \( F_A \) can be translated into a distribution of donations \( F_X \). The five assumptions allow me to write problem (3.19) in terms of distribution \( F_X \). Specifically, the utility loss due to compliance can be calculated as

\[
\int g_i \Delta U^\phi(\tau, T) di = \mathbb{E}_\phi \left[ \int_{TC} \phi dF_X + \int_T^{TC} u(X) - u(T) - (1 - \tau)(X - T)dF_X \right],
\]

(3.22)

\[
\approx \mathbb{E}_\phi \left[ \int_{TC} \phi dF_X + \int_T^{TC} \frac{1}{2}(1 - \tau)(1 - \varepsilon)(\frac{X - T}{X})^2 dF_X \right],
\]

(3.23)

while the loss of externality benefits is given by

\[
\int B \cdot \Delta X^*_i(\tau, T) di = \mathbb{E}_\phi \left[ \int_T^{TC} B(X - T)dF_X \right] \]

(3.24)

\footnote{In other words, I disregard the possibility that some individuals will chose to partially reduce their donations and donate between \( T \) and \( \hat{X}_i \).}

\footnote{\( TC_i \) thus solves \( \phi_i = \frac{1}{2}(1 - \tau)(1 - \varepsilon)(\frac{X_i - T}{X})^2 = u(\hat{X}_i) - u(T) - (1 - \tau)(\hat{X}_i - T) \).}
CHAPTER 3. OPTIMAL REPORTING THRESHOLDS

The amount of funding needed to support the subsidy increases due to evasion and decreases due to fewer donations reported above the threshold and is equal

\[ \int C_F \cdot \tau \Delta R^*(\tau, T) \, di = \mathbb{E}_\gamma \left[ \int_0^{T-E} C_F \tau E dF_X + \int_{T-E}^{T-ME} C_F \tau (T-X) dF_X \right] - \mathbb{E}_\phi \left[ \int_T^{TC} C_F \tau (X-T) dF_X \right]. \]

(3.25)

Finally, the utility gain from evasion can be calculated as

\[ \int g_i \Delta U^E(\tau, T) \, di = \mathbb{E}_\gamma \left[ \int_0^{T-E} \Omega [\tau E - \gamma_1 - \gamma_2 E^2] dF_X + \int_{T-E}^{T-ME} \Omega [\tau (T-X) - \gamma_1 - \gamma_2 (T-X)^2] dF_X \right]. \]

(3.26)

Optimal threshold can be determined by substituting equations (3.22)-(3.26) into problem (3.19):

\[ T^* = \arg \min_T \left\{ \mathbb{E}_\phi \left[ \int_T^{TC} \phi dF_X + \int_T^{TC} \Omega [\tau E - \gamma_1 - \gamma_2 E^2] dF_X + \int_{T-E}^{T-ME} \Omega [\tau (T-X) - \gamma_1 - \gamma_2 (T-X)^2] dF_X \right] + \mathbb{E}_\gamma \left[ \int_0^{T-E} C_F \tau \Omega f(T) dF_X + \int_{T-E}^{T-ME} C_F \tau (T-X) \Omega f(T) dF_X \right] \right\}. \]

(3.27)

Optimal Threshold

Careful examination of problem (3.27) allows us to characterize the optimal threshold \( T^* \). All proofs are available in Appendix B.1. As results in Section 3.3 showed compliance costs are likely to be finite for most individuals. However, Section 3.3 provides less guidance on the magnitude of cheating costs. Intuitively, if individuals experience low cost of evasion and are willing to cheat by large amount, optimal threshold should be low. Differentiating (3.27) generates the following first order condition:

\[ \mathbb{E}_\gamma \left[ C_F \tau \cdot M Ef(T - ME) + \tau [c_F - \Omega] [F(T - ME) - F(T - E)] + \int_{T-E}^{T-ME} \Omega 2 \gamma_2 (T - X) dF_X \right] = \mathbb{E}_\phi \left[ -[C_F \tau - B] [F(TC) - F(T)] + (C_F \tau - B) (TC - T) TC' f(TC) + \int_T^{TC} (1 - \tau)(1 - \varepsilon) \frac{X - T}{X} dF_X \right]. \]

(3.28)

**Proposition 1.** The optimal threshold \( T^* \) is the greater of \( \min_i \{ ME_i \} \) and solution to first order condition (3.28).
A corner solution might be possible. Specifically, if $ME_i > 0$, then setting the threshold to $\min\{ME_i\}$ would eliminate evasion completely.

**Proposition 2.** If $\gamma_1i, \gamma_2i, \text{ and } \phi_i$ are finite for all individuals and $\phi > 0$, then optimal threshold $T^*$ is strictly positive for any distribution of preferences $F_X$.

The intuition for this result is simple. One should not set $T = 0$ because individuals can never cheat by more than $T - X$. Therefore, optimal threshold will always be greater than zero. Note that setting the threshold to $\min\{ME_i\}$ eliminates evasion completely while reducing compliance costs and therefore is preferred to a zero threshold. At the same time, a threshold equal to approximately $\min\{\phi_i\}_{CF\tau}$ ensures that all individuals below the threshold impose a smaller cheating cost on society than the cost of compliance.

For most distributions it is also not optimal to set $T = \infty$ because not all individuals to the right of the threshold pay the full compliance cost $\phi$ – many choose to not pay the cost and bunch at the threshold instead. Moreover, the distribution of donations $f_X(x)$ is decreasing as $x \to \infty$. Therefore, for a sufficiently high threshold $T^*$, cheating expenditures should exceed compliance savings. **Proposition 3.** Optimal threshold $T^*$ increases in $\Omega$ and decreases in $C_F$. Optimal threshold $T^*$ increases in $B$ when the distribution of donations $f_X$ is strictly decreasing and decreases in $B$ when the distribution $f_X$ is strictly increasing.

For high values of $\Omega$, evasion is less wasteful and resembles a transfer of utility from society to evaders. Note that even for $\Omega = 1$, evasion generates some deadweight loss unless $\gamma_{1i} = 0$ and $\gamma_{2i} = 0$. Higher marginal cost of funds make evasion costlier and hence calls for a lower threshold. The intuition for the last result is more nuanced. Regardless of the threshold value, all individuals donate their optimal donation amount $\hat{X}_i$ with the exception of individuals with $\hat{X}_i \in (T,TC_i)$. When $f_X$ is decreasing, an increase in threshold $T^*$ leads to an increase in the overall amount of donations, however, the opposite is true when $f_X$ is strictly increasing.

**Proposition 4.** Suppose $\gamma_{1i} = \gamma_1, \gamma_{2i} = \gamma_2, \phi_i = \phi$ for all individuals. Then optimal threshold $T^*$ decreases in $\gamma_1$ if $f_X$ is strictly decreasing and optimal $T^*$ is not a corner solution, and increases in $\gamma_1$ otherwise. Further, $T^*$ increases in $\gamma_2$ and $\phi$ for most distributions $F_X$.

Lower $\gamma_2$ leads to more cheating and necessitates a lower threshold. Higher compliance cost $\phi$ makes reporting particularly painful and calls for a higher threshold. However, magnitude of $\gamma_1$ affect only a small portion of individuals – those with ideal donations $\hat{X}_i \in (T - E, T)$. Higher value $\gamma_1$ makes evasion less profitable for these individuals, reducing cheating. For a decreasing distribution, it is therefore optimal to slightly decrease the threshold in order to take advantage of larger fraction of individuals who are unable to cheat. The opposite is true when the distribution $f_X$ is increasing. However, when evasion

\[\text{Optimal threshold could be lower than } \min\frac{\phi_i}{CF\tau}, \text{ because not all individuals to the right of the threshold experience the full compliance burden } \phi_i. \text{ Nevertheless, } \min\frac{\phi_i}{CF\tau} \text{ provides an intuitive lower bound.} \]
CHAPTER 3. OPTIMAL REPORTING THRESHOLDS

levels are much higher than compliance cost, optimal threshold is equal to $ME$ and therefore increases in $\gamma_1$.

Calibration

So what should the threshold be in case of noncash charitable donations in the U.S.? To answer this question, I use estimates of compliance cost $\phi$ obtained in Section 3.3 and observed evasion behavior described in Section 3.3 to estimate optimal threshold $T^*$. Table 3.5 summarizes calibration results. I consider a subsidy rate $\tau = 0.25$ and marginal cost of funds $C_F = 1.2$. I further set the externality benefit $B = C_F \tau$ and do not put any weight on the utility of cheaters $\Omega = 0$. Setting $C_F \tau - B$ and $\Omega = 0$ allows me to focus on the trade off between compliance and evasion. Finally, as before, I assume the elasticity of charitable giving equal to $1/(1 - \varepsilon) = 1.3$. I consider several choices for the compliance cost $\phi$. First, I assume the compliance cost is fixed for all individuals and is equal to $\$37$ – an estimate of compliance cost based on analysis in Section 3.3. Second, I consider how the threshold changes if all individuals experience a higher compliance cost – equal to $\$87$ – which corresponds to the average upper bound on compliance cost, again derived in Section 3.3. Finally, I consider the full distribution of compliance cost as estimated in Section 3.3 (this full distribution implies an average compliance cost of $\$37$).

A more difficult task is generating reliable estimates of evasion costs $\gamma_1$ and $\gamma_2$ as it is not possible to observe how the donation amount changed for different individuals. I choose to follow the simplest approach. I assume that all individuals who have donated in 1984 would cheat by the same fixed amount and then compare this prediction to the observed 1986 distribution. The results of this calibration exercise are available in Appendix Figure B.1. This exercise suggests that the best fit is achieved when individuals cheat by $\$70-\$80$ each.

Calibration results are available in Table 3.5. For low levels of compliance cost, model predicts a low threshold of $\$180-\$190$. At this level of compliance cost evasion burden for each individual is a little bit smaller than the cost of compliance – $1.2 \times 0.25 \times 70 = 21 < 37$. The threshold is quite low to account for the fact that most individuals donate smaller amounts, and therefore the average cost of compliance for all individuals above the threshold rapidly decreases below maximum evasion burden of $\$21$. On the other hand, when compliance costs are very high and overshadow evasion burden – $1.2 \times 0.25 \times 70 = 21 << 87$ – the model predicts a very high optimal threshold of $\$9080-\$9090$. Note that the threshold remains finite, as discussed in Proposition 1. Finally, the threshold decreases slightly when I consider the full distribution of compliance costs.

Table 3.5 also shows that for small levels of evasion, fixed cost of cheating does not play an important role, because it is only binding for a very small portion of the population.

\[38\text{Suggestions on how to estimate evasion behavior are welcome.}\]
3.5 Conclusion

The results of this paper highlight the importance of the trade off between evasion and the cost of complying with information regulations. I show that despite low probabilities of audit and straightforward opportunities to cheat, many individuals choose not to exaggerate their noncash charitable contributions. Even 20 years after reporting rules were simplified, less than 50% of itemizers report any amount of noncash donations. This finding suggests that individuals are likely to experience high fixed and marginal cost of evasion, in line with previous studies that document low levels of evasion given observed rates of audit, see Slemrod (2007). The low rate of cheating is unlikely to be due to the lack of information: nearly 90% of itemizers report making cash contributions and therefore are likely to be somewhat familiar with tax rules.

At the same time, the results suggest that individuals experience substantial hassle costs when filling out tax forms, evidence that is consistent with recent finding of Benzarti (2015) who also finds that individuals are willing to forego large amounts of tax savings to avoid the hassle of filing Schedule A (itemized deductions). Altogether, the high value of hassle costs and potentially low levels of cheating imply that government should not impose substantiation requirements on all citizens but only on part of the population. The paper provides theoretical insights on how the government should determine the optimal reporting thresholds.

The external validity of these results and recommendations for optimal thresholds in other settings will largely depend on what drives the evasion behavior. Policymakers would need to understand how cheating behavior depends on the substantiation requirements, likelihood of being caught, visibility of evasion channel, and ethical considerations. Optimal thresholds are large when the marginal cost of evasion is high and low when the marginal cost of cheating is low.
### Table 3.1: Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>All returns</td>
<td>79,556</td>
<td>108,840</td>
<td>75,400</td>
<td>139,651</td>
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<tr>
<td>All itemizers</td>
<td>54,976</td>
<td>76,908</td>
<td>54,411</td>
<td>86,929</td>
</tr>
<tr>
<td>All donors</td>
<td>52,518</td>
<td>73,650</td>
<td>52,118</td>
<td>78,333</td>
</tr>
<tr>
<td>All asset donors</td>
<td>18,412</td>
<td>28,404</td>
<td>21,279</td>
<td>39,286</td>
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<tr>
<td>Core sample&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12,930</td>
<td>20,754</td>
<td>14,555</td>
<td>29,457</td>
</tr>
<tr>
<td>AGI 1st quartile&lt;sup&gt;b&lt;/sup&gt;</td>
<td>954</td>
<td>1,343</td>
<td>838</td>
<td>3,056</td>
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<tr>
<td>AGI 2nd quartile&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1,004</td>
<td>1,390</td>
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<td>2,533</td>
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<td>AGI 3rd quartile&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1,849</td>
<td>2,790</td>
<td>2,434</td>
<td>2,857</td>
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<td>All cash donors</td>
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<td>73,085</td>
<td>51,684</td>
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<tr>
<td>Core sample&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28,647</td>
<td>38,744</td>
<td>26,506</td>
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<td>Total noncash donations</td>
<td>$5.83 bil</td>
<td>$6.61 bil</td>
<td>$10.6 bil</td>
<td>$36.1 bil</td>
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<tr>
<td>Less than $2,000:</td>
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<td></td>
<td></td>
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<tr>
<td>Mean</td>
<td>$302</td>
<td>$284</td>
<td>$302</td>
<td>$516</td>
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<tr>
<td>% of donors</td>
<td>97</td>
<td>97</td>
<td>97</td>
<td>91</td>
</tr>
<tr>
<td>% of dollars</td>
<td>41</td>
<td>44</td>
<td>32</td>
<td>30</td>
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</table>

**Notes:** All itemizers, all donors, all asset donors, and all cash donors: unweighted number of individuals who itemize, donate cash or assets, donate assets, or donate cash respectively.

<sup>a</sup> Individuals who donate between 0 and $2000 and whose overall charitable donations do not exceed 20% of AGI.

<sup>b</sup> Single and joint filers from the core sample by AGI quartile. AGI quartiles determined among all individuals with positive noncash donations and whose overall charitable donations do not exceed 20% of AGI. Unadjusted for inflation. **Source:** Cross-sectional data from SOI Public Use Tax Files.
### Table 3.2: Evasion and compliance cost savings

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<th>1985</th>
<th>1986</th>
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<tbody>
<tr>
<td><strong>New Donations (in mil. $)</strong></td>
<td>366.64</td>
<td>324.29</td>
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<tr>
<td></td>
<td>(40.05)</td>
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<td><strong>(Potentially) Lost Donations (in mil. $)</strong></td>
<td>70.27</td>
<td>70.13</td>
</tr>
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<td></td>
<td>(9.83)</td>
<td>(11.6)</td>
</tr>
<tr>
<td><strong>Evasion (in mil. $)</strong></td>
<td>83.32</td>
<td>235.02</td>
</tr>
<tr>
<td></td>
<td>(41.57)</td>
<td>(53.79)</td>
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#### Assuming donations above $500 are reduced

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<tr>
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<tr>
<td><strong>Percent Evasion (%)</strong></td>
<td>21.95</td>
<td>48.04</td>
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<td><strong>Average Cost of Filing Form 8283 (in $)</strong></td>
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<td>(8)</td>
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<td><strong>Compliance Cost Saved (in mil. $)</strong></td>
<td>17.93</td>
<td>35.51</td>
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<td>(5.48)</td>
<td>(4.72)</td>
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#### Assuming donations above $500 are not reduced

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<tr>
<td><strong>Percent Evasion (%)</strong></td>
<td>18.52</td>
<td>42.02</td>
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<td><strong>Average Cost of Filing Form 8283 (in $)</strong></td>
<td>91.36</td>
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<td><strong>Compliance Cost Saved (in $)</strong></td>
<td>122.22</td>
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<td></td>
<td>(17.68)</td>
<td>(15.08)</td>
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</table>

| **Average Tax Rate 1985**      | 29.4  | 30.08 |

Table 3.3: Evasion and compliance cost savings: Results by quartile of AGI

<table>
<thead>
<tr>
<th></th>
<th>All AGI</th>
<th>1st &amp; 2nd quartile</th>
<th>3rd quartile</th>
<th>4th quartile</th>
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<tr>
<td>New Donations (in mil. $)</td>
<td>324.29</td>
<td>152.10</td>
<td>84.29</td>
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<td></td>
<td>(55.41)</td>
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<td>(Potentially) Lost Donations (in mil. $)</td>
<td>70.13</td>
<td>26.34</td>
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<td>(5.03)</td>
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<td>Evasion (in mil. $)</td>
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<td>(43.59)</td>
<td>(23.08)</td>
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<td>Percent Evasion (%)</td>
<td>48.04</td>
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<td></td>
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<td>(17)</td>
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<td>59.14</td>
<td>66.30</td>
<td>20.48</td>
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<tr>
<td></td>
<td>(8)</td>
<td>(19)</td>
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<td>(5)</td>
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<td>(4.72)</td>
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<td>Average Tax Rate 1986</td>
<td>30.08</td>
<td>19.60</td>
<td>29.65</td>
<td>38.94</td>
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Table 3.4: Evasion and compliance cost savings: Heterogeneity Analysis

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<tr>
<th>New Donations (in mil. $)</th>
<th>Filed Sch. C, E, or F</th>
<th>No Sch. C, E, or F</th>
<th>Singles Only</th>
<th>Joint Only</th>
<th>Used Tax Preparer</th>
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<tr>
<td></td>
<td>30.50</td>
<td>33.88</td>
<td>75.79</td>
<td>213.14</td>
<td>134.53</td>
<td>189.98</td>
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<td></td>
<td>(9.56)</td>
<td>(12.18)</td>
<td>(29.89)</td>
<td>(41.04)</td>
<td>(36.47)</td>
<td>(44.62)</td>
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<tr>
<td>(Potentially) Lost Donations (in mil. $)</td>
<td>8.56</td>
<td>9.84</td>
<td>7.42</td>
<td>56.60</td>
<td>35.69</td>
<td>34.10</td>
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<tr>
<td></td>
<td>(2.72)</td>
<td>(3.25)</td>
<td>(3.81)</td>
<td>(9.21)</td>
<td>(9.1)</td>
<td>(7.54)</td>
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<tr>
<td>Evasion (in mil. $)</td>
<td>34.91</td>
<td>43.28</td>
<td>63.13</td>
<td>158.86</td>
<td>96.85</td>
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<td></td>
<td>(11.87)</td>
<td>(14.12)</td>
<td>(27.14)</td>
<td>(42.02)</td>
<td>(31.45)</td>
<td>(42.8)</td>
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<td>Percent Evasion (%)</td>
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<td>64.29</td>
<td>48.01</td>
<td>50.37</td>
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<tr>
<td>Average Cost of Filing Form 8283 (in $)</td>
<td>15.74</td>
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### Table 3.5: Optimal Thresholds: Calibration

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*Notes:* This table shows the results of calibrating the model described in Section 3.4.
CHAPTER 3. OPTIMAL REPORTING THRESHOLDS

Figure 3.1: Empirical Approach Illustration

(a) Statement Not Required

(b) $500 Threshold

(c) 1984: $0 Threshold, No Evasion

(d) 1985: $500 Threshold, No Evasion

(e) 1985: $500 Threshold, With Evasion

(f) 1985: $500 Threshold, With Evasion

Notes: This graph shows hypothetical distributions of noncash donations in 1984 and 1985.
Notes: Noncash contributions of individuals who have itemized deductions and whose overall charitable contributions did not exceed 20% of AGI. Unadjusted for inflation $50 bins. Source: Cross-sectional data from SOI Public Use Tax Files.
Figure 3.3: Noncash contributions in 1984–1986

(a) 1984 vs. 1985

(b) 1984 vs. 1986

Notes: Noncash contributions of individuals who have itemized deductions and whose overall charitable contributions did not exceed 20% of AGI. Unadjusted for inflation $100 bins. Source: Cross-sectional data from SOI Public Use Tax Files.

Figure 3.4: Previous Donors and New Donors

(a) Year-to-Year Donors: in 1984 and 1985

(b) Year-to-Year vs. New Donors in 1985

Notes: Noncash contributions of individuals who have itemized deductions and whose overall charitable contributions did not exceed 20% of AGI. Unadjusted for inflation $100 bins. (a) Charitable contributions in 1984 and in 1985 of individuals who have donated in 1984. (b) Charitable contributions in 1985 of individuals who have donated in 1984 and those who have not donated in 1984. Source: Panel data from SOI Public Use Tax Files. Number of observations: 773 donations in 1984, 517 donations by the previous donors and 1486 donations by new donors in 1985.
Figure 3.5: Type of Donations

(a) Donations by Type

(b) “Only Noncash” Donors

Notes: (a) Percent of itemizers who make noncash, cash or both types of contributions. (b) Percent of itemizers who report only noncash contributions. Source: Cross-sectional data from SOI Public Use Tax Files.

Figure 3.6: Quartiles of Donations

(a) Cash Donations

(b) Noncash donations

Notes: Quartiles of cash and noncash donations by year, inflated to 2008 dollars. Source: Cross-sectional data from SOI Public Use Tax Files.
Figure 3.7: Robustness Checks

(a) Cash Donations Before and After Reform

(b) Cash Donations After Reform

(c) Noncash donations Before Reform

Notes: Noncash and cash contributions of individuals who have itemized deductions and whose overall charitable contributions did not exceed 20% of AGI. Unadjusted for inflation $100 bins. Source: Cross-sectional data from SOI Public Use Tax Files.


Figure 3.8: Comparing 1984 and 1985 Donations

(a) Redistributed 1985 Density

(b) Evasion

Notes: noncash contributions of individuals who have itemized deductions and whose overall charitable contributions did not exceed 20% of AGI. Unadjusted for inflation $100 bins. Cross-sectional data from SOI Public Use Tax Files.
Figure 3.9: Comparing 1984 and 1986 Donations

(a) Redistributed 1986 Density

(b) Evasion

Notes: noncash contributions of individuals who have itemized deductions and whose overall charitable contributions did not exceed 20% of AGI. Adjusted for inflation $100 bins. Cross-sectional data from SOI Public Use Tax Files.
Figure 3.10: Noncash contributions in 1984–1986 by income quartiles, adjusted for inflation.

(a) First and Second Quartiles

(b) Third quartile

(c) Fourth quartile

Notes: Based on SOI Public Use Tax Files, 1984–1986. Noncash contributions of individuals who itemized deductions whose overall charitable contributions did not exceed 20% of AGI.
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Appendix A

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

A.1 SIAB Data and Sample Selection

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

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

Next, I remove duplicate entries. First, I delete all perfect duplicates – 99 observations. Second, I remove all duplicate observations that differ only by notification reason (“grund”) – 22 observations deleted. Third, I remove all duplicate observations that differ only by employment status (“erwstat”) – 3 observations. Fourth, I drop observations that differ only by occupational status and working hours (“stib”) – 2 observations. Fifth, I drop observations that differ only by occupation (“beruf”) – 2 observations. Sixth, I keep observations

1For more detailed information, see IAB’s webpage at http://fdz.iab.de/en/FDZ_Individual_Data/integrated_labour_market_biographies/SIAB_Outline.aspx
with the largest reported earnings when observations only differ by the amount of earnings — 13,533 deleted. Finally, I keep observations with the largest earnings when observations differ only by reason for notification (“grund”) — 1,145 deleted. The remaining sample consists of 10,062,006 unsplit episode observations or 7,599,850 person-year observations, and covers 1,019,061 individuals who have worked at 1,102,561 distinct establishments.

A.2 Robustness Checks

Income Tax Notch and Marginal Tax Rate Calculations

To calculate income tax notches and marginal tax rates I use a 95% extract from the longitudinal version of the Socio-Economic Panel (SOEP), version 30\(^2\). There are a total of 592,864 non-duplicate year-person observations for years 1984 through 2013 with nonempty and nonzero household and personal weights covering 72,842 individuals (including children and elderly). I restrict my sample to individuals who reported posted wage earnings between \([€300,€325]\) in 1996–2003 or \([€375,€400]\) in 2004–2013. I also drop all individuals whose spouses report earning more than €20,000 per month or whose spousal labor earnings are missing (married individuals only). My final sample thus includes 6,068 year-person observations over 1996–2013 and 4,413 over 1990-2010, of these 3,283 between ages 25 and 60. I restrict my sample to workers in mini-jobs earning in a narrow €25 bracket below or at the threshold for two reasons. First, we are interested in estimating the tax notch and marginal tax rate at the threshold, therefore the narrowest window should offer the most accurate estimates of tax incentives. Second, despite the self-reported nature of the data, most individuals report earning the threshold amount, closely resembling distributions observed in the SIAB data. Third, increasing the size of the bracket to €50 or €75 decrease the size of the estimated notch. Therefore elasticity calculations present a lower bound on labor earnings elasticities with respect to net of social security and income tax rates.

To calculate the notch, I first calculate the amount of income tax the household must pay if the individuals remains in a mini-job, i.e. \(T(12 \cdot Y^{\text{spouse}}_i)\). Second, I calculate the amount of income tax due should the individual get a regular job that pays a salary equal to the mini-job threshold, i.e. \(T(12 \cdot (Y^{\text{spouse}}_i + K))\) and the corresponding marginal tax rate associated with income \(12 \cdot (Y^{\text{spouse}}_i + K)\). The income tax notch is then calculated as the difference between the two tax amounts, \(T(12 \cdot (Y^{\text{spouse}}_i + K)) - T(12 \cdot Y^{\text{spouse}}_i)\).

Ideally, one would want to observe the spousal income of all mini-jobbers in every year and calculate tax notches and marginal tax rates accordingly. Unfortunately, such administrative data is not available. The SOEP data contains spousal earnings but sample sizes are small, with only 170-350 observations per year. To improve the quality and consistency of estimates across years I consider three approaches to calculating income tax notches and MTRs. First, I calculate the true average in year \(j\) by restricting the sample to mini-job workers in year \(j\).

\(^2\)In accordance with the German law only a 95% random sample can provided to researches from outside the European Union.
Second, I expand the sample to also include mini-job workers in years \( j - 3 \) through \( j + 3 \). While the sample is selected based on the true notch in those years, i.e. when calculating the average notch in year 2004, I consider workers who earned between \( €300-€325 \) in 2001–2003 but \( €375-€400 \) in 2004–2007, the size of the notch is based on the actual threshold in the target year \( j \). Therefore for 2004, I calculate \( T(12 \cdot (Y_{i\text{spouse}} + 400)) \), since the mini-job threshold was set at \( €400 \) in 2004. Finally, the third approach mimics the second approach but further expands the sample by including mini-job workers from 1999 through 2010.

I further consider four definitions of spousal income. The first, and simplest, only includes spouse’s labor earnings, including those from self-employment. The second definition includes social security pensions in addition to labor earnings: old-age, disability, and widowhood. Note that prior to 2005, statutory pensions were not subject to income tax. Starting from 2005, 50% of the pension is subject to income tax, and this percentage share increases by 2% percentage points every year. While the majority of pensioners in Germany rely on statutory pension only, some individuals also receive income from private pensions. Thus, the third definition of income further includes private pensions: supplementary civil servant pension income, company pensions, private pensions and pension income from “other” sources as reported in SOEP. Taxation of private pensions vary, but for simplicity I assume that the entire amount of pension is subject to income tax. Finally, the fourth definition of income also includes household asset income: from interest, dividends, and rent. Once again, taxation of financial income depends on income but for simplicity the entire amount is assumed to be subject to income tax. Whenever any of the additional income information is missing, it is set to zero, however, observations with missing spousal labor income have been dropped. My preferred definition of income is the third specification, that includes both labor and all pension income. I choose not to include financial earnings since these are not accurately reported in the survey data and thus are likely to introduce more bias.

The results of these calculations are presented in Tables A.3–A.2. In Table A.3 I use my preferred definition of income (the 3rd – labor plus pension earnings) to compare income tax notches and marginal tax rates by sample selections. The first column shows calculations of the “true income” notches and tax rates. The results are very volatile across years. The second column is based on spousal earnings of mini-job workers within 3 years of the target year. Finally, the third column includes all mini-job workers from years 1999-2010. Table A.3 show that the estimated tax rates and notches are very similar across all three specifications for both men and women, despite chosen samples.

Tables A.1 and A.2 compare notches and tax rates by definition of income, relying on 3rd sample approach (all years 1999-2010 included). As expected, the notch and marginal tax rate are smallest when only labor earnings are included. The magnitude of the notch increases as pension and asset incomes are included, especially in the later years (after 2005), when the statutory pension becomes partially subjected to income tax. Nevertheless the difference is not substantial and has negligible effect on the magnitude of elasticities. Note that the income definition matters more for women than men, since spouses of women are more likely to have larger statutory or private pensions. Also note that when calculating tax notches and marginal tax rates by age, true samples are included, i.e. only mini-job

**Elasticity Estimation**

The elasticity estimation procedure relies on several parameters: (a) the bin width used to generate the observed distribution, (b) the degree of the polynomial that is fit to the observed distribution, (c) the width of the estimation window, and (d) the width of the bunching window. Of these parameters, (d) is estimated visually and in most applications of bunching method — including this study — the choice is practically unambiguous. For empirical distributions in €25 bins, \( z_t = 3 \) in 1999–2002, \( z_t = 6 \) in 2003–2006, \( z_t = 5 \) in 2007–2010 for women, and \( z_t = 2 \) in 1999–2002, \( z_t = 4 \) in 2003–2005, \( z_t = 5 \) in 2006, and \( z_t = 4 \) in 2007–2010 for men. For empirical distributions in €12.5 bins, \( z_t = 7 \) in 1999–2001, \( z_t = 6 \) in 2002, \( z_t = 10 \) in 2003–2005, \( z_t = 11 \) in 2006, \( z_t = 10 \) in 2007–2010 for women, and \( z_t = 3 \) in 1999–2002, \( z_t = 10 \) in 2003–2005, \( z_t = 11 \) in 2006, and \( z_t = 9 \) in 2007–2010 for men. Parameter (c) – the width of the estimation window – identify which part of the observed distribution is used to estimate the counterfactual distribution. A window that is too short will make estimation of the counterfactual imprecise, while too large of a window can put too much emphasis on the global, rather than local fit of the counterfactual. In this study, the estimation window is bounded on the left by zero — since no individuals report earning negative wages. I choose to limit the estimation window to the right by €1500 for women and by €1750 for men. Note that earnings distribution of women is highest around €1,500 per month and the earnings distribution of men is highest around €2,500. The amount of bunching at the mini-job threshold is not sufficient to generate a one-peaked distribution, thus the resulting counterfactual (shown in Web Appendix), display two small humps: around the mini-job threshold and at approximately €1,500/2,500. The windows were chosen to avoid “over-fitting”. The results are not very sensitive to the choice of the window.

In Table A.4 I show how the elasticity estimates vary with (a) the bin width used to generate the observed distribution and (b) the degree of polynomial fitted. Specification (1) shows the amount of bunching \( b \) (recall definition (1.8)) and elasticity \( e \) estimated using an empirical distribution of €12.5 bins. Specifications (2)–(4), on the other hand, use distribution of €25 bins. For convenience, specification (3) repeats the results from Figure 1.7. Elasticity estimates in specifications (1) and (3) are very similar for all years. Note that the amount of bunching \( b \) is inversely proportional to the bin size, therefore to compare bunching amounts, the result of specification (1) should be divided by 2 to be comparable to the amount of bunching from specifications (2)–(4). Specifications (2)–(4) show elasticity estimates when the counterfactual is estimated by fitting a polynomial of 4th, 5th and 6th degrees respectively. Because 4th degree polynomials are less flexible than polynomials of the 5th degree, the elasticity estimates are larger in earlier years in specification (2) when the density rose sharply as earnings increased from €0 per month to €400. The estimates in specifications (2) and (3), however, are nearly identical starting from 2006 on. Polynomials of 6th degree, on the other hand, are much more flexible than polynomials of the 5th degree.
For this reason, elasticity estimates are much larger in specification (4) for later years – from 2008 on – but the results in specifications (3) and (4) are very similar in earlier years. The results in Table A.4 suggest that higher degree polynomial provide similar results in earlier years (1999–2005), and lower degree polynomial provide similar results in later years (2006–2010). The shape of the observed empirical distribution dictates a polynomial fit that is neither too restricted, e.g. 4th degree or lower, nor is too flexible, e.g. 6th degree or higher. A polynomial of the 5th degree offers the best compromise. Overall Table A.4 suggests that the elasticity estimates are robust across specifications, though some variation is present. Specification (3) – which is presented in the main body of the paper – provides the best fit across specifications and also generates the most conservative elasticity estimates.

Wage Differential Robustness Checks

A natural concern is whether the results in Table 1.4 are driven by outlier observations within the 1st to 99th percentiles of gross wages. Table A.7 presents several robustness checks by repeating specifications (3), (4) and (9) of Table 1.4. In columns (1), (2) and (7) I consider a different definition of gross wage, which includes overtime hours and pay. Since overtime hours are paid at a higher rate and are more likely to be reported for regular employees, we would expect a smaller wage differential. This is precisely what we observe in columns (1), (2) and (7) (which can be directly compared to columns (3), (4) and (9) of Table 1.4). The wage differential decreases by approximately 1 percentage point. Next, I restrict the sample to individuals earning gross wages of more than €6 in columns (3), (4) and (8). The results remain unchanged. Finally, I restrict the sample to individuals earning a gross wage of more than €6 but less than €15 per hour in columns (5), (6) and (9). The coefficients decrease slightly, by approximately 1 percentage point. In addition to results shown in Table A.7 I have verified that the results are not sensitive to the earnings interval studied and inclusion of higher order wage trends. As an additional robustness check, I show the firm survey results by year in the Web Appendix. Robustness checks confirm that the results in Table 1.4 are not driven by the definition of hours used or due to sample selection.

The quality of the household data is of substantial concern because so many individuals report earning less than €5 per hour (especially among regular workers) and more than €21. Therefore the large wage differential observed in Table 1.5 and Figure 1.11 could be driven by outlier observations. As a robustness check, I repeat specifications (3), (5), (8) and (9) from Table 1.5 in Table A.8 but restrict the interval of allowed gross wages. Requiring the gross wage to be at least €3 does not have a strong effect on the estimates (see columns (1)-(2) and (7)-(8)). Requiring wages to be at least €5 per hour removes the wage differential. This result is not surprising in light of Panel B of Figure 1.11: more regular workers report larger gross wages (€15 and more) than mini-job workers. Finally, restricting the sample to individuals earning between €5 and €15, makes the coefficient statistically insignificant in columns (5) and (6) and marginally significant in columns (11) and (12). The coefficients are positive but smaller than in Table 1.5. The smaller magnitude of the coefficients is consistent with the presence of the negative bias due to measurement errors and with our inability to
control for firm selection. These robustness checks suggest that while the magnitude of the wage differential estimated using household data is inaccurate, the wage differential between mini-job and regular jobs is positive and statistically significant.

\footnote{Recall that adding firm fixed effects increases the wage gap between mini-job and regular gross wages.}
Table A.1: Income Tax Notches and MTRs. Women: Comparison of Income Definitions

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Notes: This table shows the average income tax notch and marginal tax rates experienced by women at the mini-job threshold. Notch is the average lump-sum payment of income tax an individual must make upon exceeding the mini-job threshold. MTR is the average marginal tax rate at the mini-job threshold. For single individuals, spousal income is set to zero. For further details see Appendix [A.2] Source: Socio-Economic Panel (SOEP), version 30.
Table A.2: Income Tax Notches and MTRs. Men: Comparison of Income Definitions

<table>
<thead>
<tr>
<th></th>
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<td>29 8</td>
<td>29 8</td>
<td>31 9</td>
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<td>30 9</td>
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<td>1 1</td>
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<td></td>
<td></td>
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<tr>
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<td>41 13</td>
<td>44 14</td>
<td></td>
<td></td>
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<tr>
<td>over 60</td>
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<td>12 5</td>
<td>12 5</td>
<td>16 7</td>
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<td>2003-2011: under 25</td>
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<td>52 14</td>
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<td>over 60</td>
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<td>10 3</td>
<td>14 4</td>
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</tr>
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</table>

Notes: This table shows the average income tax notch and marginal tax rates experienced by men at the mini-job threshold. Notch is the average lump-sum payment of income tax an individual must make upon exceeding the mini-job threshold. MTR is the average marginal tax rate at the mini-job threshold. For single individuals, spousal income is set to zero. For further details see Appendix A.2. Source: Socio-Economic Panel (SOEP), version 30.
### Table A.3: Income Tax Notches and MTRs. Comparison of Sample Selections

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<th>True Average</th>
<th>Plus/Minus 3 Years</th>
<th>All Years</th>
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<tr>
<td></td>
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<td>Notch MTR N Income</td>
<td>Notch MTR N Income</td>
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<tr>
<td>Women:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1999</td>
<td>92 29 148 2677</td>
<td>87 27 1347 2587</td>
<td>86 27 2860 2689</td>
</tr>
<tr>
<td>2000</td>
<td>83 25 320 2453</td>
<td>84 26 1560 2550</td>
<td>85 27 2860 2689</td>
</tr>
<tr>
<td>2001</td>
<td>81 24 313 2606</td>
<td>78 24 1677 2564</td>
<td>80 25 2860 2689</td>
</tr>
<tr>
<td>2002</td>
<td>75 23 309 2504</td>
<td>78 24 1761 2586</td>
<td>80 25 2860 2689</td>
</tr>
<tr>
<td>2003</td>
<td>90 23 252 2490</td>
<td>96 24 1849 2609</td>
<td>99 25 2860 2689</td>
</tr>
<tr>
<td>2004</td>
<td>91 22 202 2708</td>
<td>92 23 1766 2661</td>
<td>94 24 2860 2689</td>
</tr>
<tr>
<td>2005</td>
<td>91 23 217 2774</td>
<td>90 23 1669 2701</td>
<td>92 24 2860 2689</td>
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<tr>
<td>2006</td>
<td>94 24 236 2900</td>
<td>92 24 1581 2774</td>
<td>92 24 2860 2689</td>
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<td>2007</td>
<td>94 26 236 2819</td>
<td>94 24 1518 2829</td>
<td>92 24 2860 2689</td>
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<td>2008</td>
<td>94 25 217 2774</td>
<td>94 25 1579 2794</td>
<td>92 24 2860 2689</td>
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<tr>
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<td>97 26 221 2922</td>
<td>93 25 1591 2814</td>
<td>91 23 2860 2689</td>
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<tr>
<td>2010</td>
<td>95 24 189 2780</td>
<td>92 24 1593 2767</td>
<td>90 23 2860 2689</td>
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<tr>
<td>Men:</td>
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<td></td>
<td></td>
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<tr>
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<td>30 10 130 647</td>
<td>31 11 310 755</td>
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<tr>
<td>2000</td>
<td>37 11 28 752</td>
<td>27 10 142 638</td>
<td>30 10 310 755</td>
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<td>2001</td>
<td>49 15 24 1213</td>
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<tr>
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<td>24 8 31 591</td>
<td>23 8 168 597</td>
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<tr>
<td>2003</td>
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<td>32 9 179 666</td>
<td>34 9 310 755</td>
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<tr>
<td>2004</td>
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<td>31 9 180 746</td>
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<tr>
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<td>2006</td>
<td>36 9 31 783</td>
<td>31 9 181 803</td>
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<tr>
<td>2007</td>
<td>49 14 29 1231</td>
<td>31 9 189 811</td>
<td>30 8 310 755</td>
</tr>
<tr>
<td>2008</td>
<td>40 10 27 1110</td>
<td>33 9 193 882</td>
<td>30 8 310 755</td>
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<tr>
<td>2009</td>
<td>34 10 29 863</td>
<td>34 10 198 952</td>
<td>29 8 310 755</td>
</tr>
<tr>
<td>2010</td>
<td>24 6 26 679</td>
<td>33 9 197 948</td>
<td>28 8 310 755</td>
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</tbody>
</table>

**Notes:** This table shows the average income tax notch and marginal tax rates experienced by women, age 26 through 59 inclusive, at the mini-job threshold. *Notch* is the average lump-sum payment of income tax an individual must make upon exceeding the mini-job threshold. *MTR* is the average marginal tax rate at the mini-job threshold. *N* is the number of observations used to calculate the average marginal tax rate, income notch and average spousal income. *Income* is the average income of a spouse of a mini-job worker earning [€K-25, €K] per month, where K denotes the mini-job threshold. For single individuals, spousal income is set to zero. Spousal income includes labor earnings, as well as social security and private pensions. For further details see Appendix A.2. *Source:* Socio-Economic Panel (SOEP), version 30.
Table A.4: Elasticity Estimates Robustness Check

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<th>Year</th>
<th>(1) Bins €12.5</th>
<th>(2) Degree 4</th>
<th>(3) Degree 5</th>
<th>(4) Degree 6</th>
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</thead>
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<td>$b$ s.e.($b$)</td>
<td>$e$ s.e.($e$)</td>
<td>$b$ s.e.($b$)</td>
<td>$e$ s.e.($e$)</td>
</tr>
<tr>
<td>Women:</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>15.67 0.60 0.25 0.02</td>
<td>9.60 0.56 0.36 0.03</td>
<td>8.15 0.27 0.27 0.01</td>
<td>7.94 0.34 0.26 0.02</td>
</tr>
<tr>
<td>2000</td>
<td>16.79 0.68 0.28 0.02</td>
<td>10.12 0.55 0.39 0.03</td>
<td>8.72 0.34 0.31 0.02</td>
<td>8.65 0.44 0.30 0.02</td>
</tr>
<tr>
<td>2001</td>
<td>16.70 0.70 0.29 0.02</td>
<td>9.97 0.57 0.39 0.04</td>
<td>8.61 0.42 0.31 0.02</td>
<td>8.57 0.66 0.31 0.04</td>
</tr>
<tr>
<td>2002</td>
<td>15.19 0.56 0.25 0.01</td>
<td>9.35 0.42 0.35 0.03</td>
<td>8.29 0.68 0.30 0.04</td>
<td>8.25 0.64 0.29 0.04</td>
</tr>
<tr>
<td>2003</td>
<td>13.25 0.65 0.17 0.01</td>
<td>8.80 0.53 0.27 0.02</td>
<td>7.43 0.40 0.21 0.02</td>
<td>10.75 1.79 0.35 0.08</td>
</tr>
<tr>
<td>2004</td>
<td>13.62 0.68 0.19 0.02</td>
<td>8.42 0.59 0.26 0.03</td>
<td>7.16 0.45 0.20 0.02</td>
<td>9.27 1.04 0.30 0.05</td>
</tr>
<tr>
<td>2005</td>
<td>14.41 0.61 0.20 0.01</td>
<td>8.76 0.62 0.27 0.03</td>
<td>7.49 0.39 0.21 0.02</td>
<td>7.97 0.51 0.24 0.02</td>
</tr>
<tr>
<td>2006</td>
<td>15.60 0.55 0.22 0.01</td>
<td>9.26 0.43 0.29 0.02</td>
<td>8.78 0.39 0.26 0.02</td>
<td>9.35 1.06 0.29 0.05</td>
</tr>
<tr>
<td>2007</td>
<td>17.52 0.69 0.17 0.01</td>
<td>9.80 0.53 0.27 0.02</td>
<td>7.43 0.40 0.21 0.02</td>
<td>9.47 0.79 0.30 0.04</td>
</tr>
<tr>
<td>2008</td>
<td>19.15 1.76 0.30 0.05</td>
<td>10.15 0.45 0.33 0.02</td>
<td>10.16 0.51 0.33 0.03</td>
<td>10.28 0.89 0.34 0.04</td>
</tr>
<tr>
<td>2009</td>
<td>18.85 1.31 0.30 0.03</td>
<td>10.11 0.40 0.33 0.02</td>
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<td>10.58 1.41 0.36 0.08</td>
</tr>
<tr>
<td>2010</td>
<td>20.29 2.14 0.33 0.06</td>
<td>10.86 0.45 0.37 0.02</td>
<td>10.79 0.53 0.37 0.03</td>
<td>11.77 1.20 0.42 0.07</td>
</tr>
</tbody>
</table>

| Men: | | | | | | | | | | | | | | |
| 1999 | 7.84 0.68 0.11 0.02 | 4.76 0.49 0.17 0.03 | 4.18 0.43 0.13 0.02 | 4.09 0.56 0.13 0.03 |
| 2000 | 7.96 0.82 0.12 0.02 | 4.70 0.56 0.16 0.03 | 4.16 0.54 0.13 0.03 | 3.89 0.53 0.12 0.03 |
| 2001 | 7.53 0.73 0.11 0.02 | 4.28 0.51 0.14 0.03 | 3.74 0.59 0.11 0.03 | 3.51 0.60 0.10 0.03 |
| 2002 | 6.75 0.60 0.09 0.02 | 3.92 0.49 0.12 0.03 | 3.29 0.47 0.09 0.02 | 3.03 0.50 0.07 0.02 |
| 2003 | 6.63 0.99 0.10 0.03 | 4.29 0.78 0.17 0.05 | 3.39 0.65 0.11 0.03 | 3.92 0.74 0.15 0.04 |
| 2004 | 5.80 1.12 0.09 0.03 | 4.19 0.75 0.17 0.04 | 3.05 0.67 0.10 0.04 | 3.19 0.83 0.11 0.05 |
| 2005 | 7.27 0.99 0.13 0.03 | 4.79 0.62 0.21 0.04 | 3.55 0.59 0.13 0.03 | 3.82 1.52 0.15 0.11 |
| 2006 | 7.32 0.90 0.12 0.03 | 4.87 0.68 0.20 0.05 | 3.81 0.57 0.14 0.03 | 5.17 8.61 0.23 0.92 |
| 2007 | 9.48 1.00 0.19 0.03 | 5.57 0.61 0.25 0.04 | 4.91 0.61 0.21 0.04 | 6.56 4.18 0.32 0.39 |
| 2008 | 11.48 1.35 0.26 0.05 | 6.13 0.65 0.29 0.05 | 5.59 0.63 0.25 0.04 | 7.95 4.81 0.43 0.45 |
| 2009 | 10.06 1.22 0.21 0.04 | 5.75 0.73 0.27 0.05 | 5.17 0.73 0.23 0.05 | 6.77 3.29 0.35 0.29 |
| 2010 | 10.69 1.23 0.24 0.04 | 5.65 0.63 0.26 0.04 | 5.12 0.75 0.22 0.05 | 6.81 5.15 0.35 0.48 |

Notes: Excess bunching and elasticities are estimated using the procedure outlined in Section 1.3. In specification (1) I fit 5th degree polynomial to an empirical distribution of gross earnings of €12.5 bins. In specifications (2), (3) and (4) I fit 4th, 5th and 6th degree polynomials respectively to an empirical distribution of gross earnings of €25 bins. Bootstrap standard errors are based on 100 iterations. Source: Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2010, Nuremberg 2013.
## Table A.5: Summary Statistics (Firm Survey VSE)

<table>
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<th>Income: [€50, €375]</th>
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<th>Income: [€400, €500]</th>
<th>Income: [€500, €1000]</th>
<th>Income: [€1000, €1500]</th>
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<tr>
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<td>N = 21,082</td>
<td>N = 186,503</td>
<td>N = 379,117</td>
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<td>Male</td>
<td>Male</td>
<td>Male</td>
<td>Male</td>
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<tr>
<td>mean</td>
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<tr>
<td>sd</td>
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<td>0.43</td>
<td>0.30</td>
<td>0.11</td>
</tr>
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<td>Age: 26-40 year old</td>
</tr>
<tr>
<td>mean</td>
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<td>0.25</td>
<td>0.10</td>
<td>0.18</td>
</tr>
<tr>
<td>sd</td>
<td>0.48</td>
<td>0.43</td>
<td>0.30</td>
<td>0.11</td>
</tr>
<tr>
<td>p50</td>
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<td>Age: 40-60 year old</td>
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<tr>
<td>mean</td>
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<td>0.36</td>
<td>0.10</td>
<td>0.22</td>
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<tr>
<td>sd</td>
<td>0.48</td>
<td>0.49</td>
<td>0.32</td>
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<td>0.00</td>
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<tr>
<td>Age: 60-65 year old</td>
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<td>Age: 60-65 year old</td>
<td>Age: 60-65 year old</td>
<td>Age: 60-65 year old</td>
</tr>
<tr>
<td>mean</td>
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<td>0.07</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>sd</td>
<td>0.26</td>
<td>0.24</td>
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<tr>
<td>mean</td>
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<td>sd</td>
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</table>

Notes: This table shows summary statistics (mean, standard deviation and median) for the combined 2006 and 2010 waves of the VSE Survey. The following categories have been omitted: 25 year old or younger, unskilled salaried workers. HS stands for High School, Voc. Tr. stands for Vocational Training. Company tenure is measured in months. Vacation days represent the full-time equivalent number of vacation days per year based on a 5-day working week. Subcompany refers to establishments that are part of larger firms. Number of male and female employees at the establishment of the employee, rather than the larger firm. Source: FDZ der Statistischen Ämter des Bundes und der Länder, Verdienststrukturerhebung, 2006 and 2010, author's calculations.
Table A.6: Summary Statistics (Household SOEP)

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<th>Income: (\text{€400, €500})</th>
<th>Income: (\text{€500, €1000})</th>
<th>Income: (\text{€1000, €1500})</th>
</tr>
</thead>
<tbody>
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<td>N=2,509</td>
<td>N=20,622</td>
<td>N=34,114</td>
</tr>
<tr>
<td>Male</td>
<td>0.17</td>
<td>0.38</td>
<td>0.00</td>
<td>0.18</td>
</tr>
<tr>
<td>Age: 26-40 year old</td>
<td>0.32</td>
<td>0.47</td>
<td>0.00</td>
<td>0.35</td>
</tr>
<tr>
<td>Age: 40-60 year old</td>
<td>0.38</td>
<td>0.49</td>
<td>0.00</td>
<td>0.42</td>
</tr>
<tr>
<td>Age: 60-65 year old</td>
<td>0.08</td>
<td>0.27</td>
<td>0.00</td>
<td>0.06</td>
</tr>
<tr>
<td>Age: &gt; 65 year old</td>
<td>0.06</td>
<td>0.23</td>
<td>0.00</td>
<td>0.06</td>
</tr>
<tr>
<td>Married</td>
<td>0.11</td>
<td>0.22</td>
<td>0.00</td>
<td>0.05</td>
</tr>
<tr>
<td>Partner (Not married)</td>
<td>0.05</td>
<td>0.99</td>
<td>0.00</td>
<td>0.05</td>
</tr>
<tr>
<td>No HS</td>
<td>0.02</td>
<td>0.15</td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>HS, No Voc. Tr.</td>
<td>0.17</td>
<td>0.37</td>
<td>0.00</td>
<td>0.14</td>
</tr>
<tr>
<td>HS + Voc. Tr.</td>
<td>0.39</td>
<td>0.79</td>
<td>0.00</td>
<td>0.30</td>
</tr>
<tr>
<td>Further Voc. Tr</td>
<td>0.03</td>
<td>0.14</td>
<td>0.00</td>
<td>0.03</td>
</tr>
<tr>
<td>College/University</td>
<td>0.11</td>
<td>0.22</td>
<td>0.00</td>
<td>0.06</td>
</tr>
<tr>
<td>Company Tenure</td>
<td>0.68</td>
<td>0.23</td>
<td>36.00</td>
<td>0.34</td>
</tr>
<tr>
<td>Monthly Hours</td>
<td>57.85</td>
<td>43.33</td>
<td>50.00</td>
<td>70.17</td>
</tr>
<tr>
<td>Posted Hourly Wage</td>
<td>5.79</td>
<td>3.44</td>
<td>5.21</td>
<td>7.14</td>
</tr>
<tr>
<td>Net Hourly Wage</td>
<td>5.37</td>
<td>3.27</td>
<td>4.88</td>
<td>6.53</td>
</tr>
<tr>
<td>Yearly Bonus</td>
<td>71.51</td>
<td>104.29</td>
<td>25.21</td>
<td>78.57</td>
</tr>
<tr>
<td>Full Time Experience</td>
<td>7.14</td>
<td>5.30</td>
<td>3.60</td>
<td>7.31</td>
</tr>
<tr>
<td>Part Time Experience</td>
<td>6.06</td>
<td>3.60</td>
<td>3.60</td>
<td>6.06</td>
</tr>
<tr>
<td>Training Matching</td>
<td>0.29</td>
<td>0.46</td>
<td>0.00</td>
<td>0.30</td>
</tr>
<tr>
<td>Firm Size: &lt;20</td>
<td>0.48</td>
<td>0.50</td>
<td>0.00</td>
<td>0.50</td>
</tr>
<tr>
<td>Firm Size: 20-200</td>
<td>0.21</td>
<td>0.41</td>
<td>0.00</td>
<td>0.27</td>
</tr>
<tr>
<td>Firm Size: 200-2000</td>
<td>0.09</td>
<td>0.29</td>
<td>0.00</td>
<td>0.08</td>
</tr>
<tr>
<td>Firm Size: &gt;2000</td>
<td>0.07</td>
<td>0.26</td>
<td>0.00</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Notes: This table shows summary statistics (mean, standard deviation and median) for the combined 2004–2011 waves of the Socioeconomic Panel (SOEP). The following category has been omitted: 25 year old or younger. a HS stands for High School, Voc. Tr. stands for Vocational Training. b Company tenure is measured in months. Source: Socio-Economic Panel (SOEP), version 30.
### Table A.7: Robustness Checks (Firms Survey VSE)

<table>
<thead>
<tr>
<th>Monthly Income €375–€500</th>
<th>Monthly Income €50–€1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incl. Overtime Wage &gt; €6</td>
<td>Incl. Overtime Wage &gt; €6</td>
</tr>
<tr>
<td>Wage ∈ (€6,€15]</td>
<td>Wage ∈ (€6,€15]</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Dependent Variable: Log(Hourly Gross Wage)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-Job</td>
<td>0.0485***</td>
<td>0.080***</td>
<td>0.057***</td>
<td>0.085***</td>
<td>0.052***</td>
<td>0.074***</td>
<td>0.057***</td>
<td>0.042***</td>
<td>0.055***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Occupation Controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Linear Wage Trend</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Quadratic Wage Trend</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>107,239</td>
<td>107,239</td>
<td>105,637</td>
<td>105,637</td>
<td>93,760</td>
<td>93,760</td>
<td>887,183</td>
<td>862,420</td>
<td>674,859</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Monthly Income €375–€500</th>
<th>Monthly Income €50–€1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage &gt; €3</td>
<td>(1)</td>
</tr>
<tr>
<td>Wage &gt; €5</td>
<td>(2)</td>
</tr>
<tr>
<td>Wage ∈ ($5, €15)</td>
<td>(3)</td>
</tr>
<tr>
<td>Wage &gt; €3</td>
<td>(7)</td>
</tr>
<tr>
<td>Wage &gt; €5</td>
<td>(8)</td>
</tr>
<tr>
<td>Wage ∈ ($5, €15)</td>
<td>(9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent Variable: Log(Hourly Gross Wage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-Job</td>
</tr>
<tr>
<td>0.084**</td>
</tr>
<tr>
<td>(0.033)</td>
</tr>
<tr>
<td>-0.017</td>
</tr>
<tr>
<td>(0.029)</td>
</tr>
<tr>
<td>-0.025</td>
</tr>
<tr>
<td>(0.031)</td>
</tr>
<tr>
<td>0.027</td>
</tr>
<tr>
<td>(0.023)</td>
</tr>
<tr>
<td>0.022</td>
</tr>
<tr>
<td>(0.023)</td>
</tr>
<tr>
<td>0.106***</td>
</tr>
<tr>
<td>(0.029)</td>
</tr>
<tr>
<td>-0.002</td>
</tr>
<tr>
<td>(0.026)</td>
</tr>
<tr>
<td>0.003</td>
</tr>
<tr>
<td>(0.026)</td>
</tr>
<tr>
<td>0.038*</td>
</tr>
<tr>
<td>(0.020)</td>
</tr>
<tr>
<td>0.039**</td>
</tr>
<tr>
<td>(0.020)</td>
</tr>
<tr>
<td>Indiv. Notch</td>
</tr>
<tr>
<td>-0.001</td>
</tr>
<tr>
<td>(0.001)</td>
</tr>
<tr>
<td>-0.001</td>
</tr>
<tr>
<td>(0.001)</td>
</tr>
<tr>
<td>0.000</td>
</tr>
<tr>
<td>(0.001)</td>
</tr>
<tr>
<td>0.003***</td>
</tr>
<tr>
<td>(0.000)</td>
</tr>
<tr>
<td>0.003***</td>
</tr>
<tr>
<td>(0.000)</td>
</tr>
<tr>
<td>0.002***</td>
</tr>
<tr>
<td>(0.000)</td>
</tr>
</tbody>
</table>

Year Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes
Indiv. Controls (subset) | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No
Indiv. Controls (full) | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes
Firm Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes
Linear Wage Trend | No | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes
Quadratic Wage Trend | No | No | No | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes
Number of Observations | 3,264 | 2,934 | 2,933 | 2,648 | 2,662 | 2,417 | 20,007 | 18,436 | 18,893 | 17,455 | 15,857 | 14,695

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

Optimal Reporting Thresholds: Theory and Evidence from Charitable Contributions

B.1 Proofs of Propositions 1–3

Recall first order condition (3.28) (repeated here for convenience):

\[ FOC(T) = \mathbb{E}_\phi \left[ C_F \tau \cdot ME f(T - ME) + \tau [c_F - \Omega] [F(T - ME) - F(T - E)] \right. \]
\[ + \int_{T - ME}^{T - E} \Omega 2\gamma_2 (T - X) dF_X \left. - [C_F \tau - B] [F(TC) - F(T)] + (C_F \tau - B) (TC - T) TC' f(TC) \right. \]
\[ + \int_T^{TC} (1 - \tau) (1 - \varepsilon) \frac{X - T}{X} dF_X \right]. \quad (B.1) \]

**Proof of Proposition 1.**
Setting \( T^* = \min_i ME_i \) eliminates evasion completely, and therefore the threshold should never fall below \( \min_i ME_i \), even for how levels of \( E_i \). Otherwise, the solution is given by equation by setting \( T = \arg \{ FOC(T) = 0 \} \) with \( FOC'(T) > 0 \).

**Proof of Proposition 2.** From (B.1) follows that

\[ FOC(0) = \mathbb{E}_\phi \left[ (C_F \tau - B) F(TC) - (C_F \tau - B) TC \cdot TC' f(TC) - (1 - \tau) (1 - \varepsilon) F(TC) \right] < 0 \]

when \( C_F \tau - B \) is close to zero or \( C_F \tau - B \leq 0 \). Hence, optimal threshold should be strictly positive. Moreover, if \( \gamma_{ii} > 0 \) for all individuals, then \( ME_i \equiv E_i - \sqrt{E_i^2 - \frac{2\mu}{\gamma_{ii}}} > 0 \) for any \( E_i \). Since individuals only find evasion worthwhile as long as they can cheat by \( ME_i \) or more, then setting \( T = \min_i ME_i \) is preferable to setting \( T = 0 \) because the higher threshold reduces disutility from compliance without generating any evasion.
Proof of Proposition 3.
Differentiating (B.1) with respect to $\Omega$ yields

$$\frac{\partial FOC}{\partial \Omega} = \mathbb{E}_\gamma \left[ -\tau [F(T - ME) - F(T - E)] + \int_{T - ME}^{T - E} 2\gamma_2 (T - X) dF_X \right]$$

$$= \mathbb{E}_\gamma \left[ \int_{T - E}^{T - ME} -\tau + 2\gamma_2 (T - X) dF_X \right]$$

$$\leq 0$$

since for individuals cheating by less than amount $E$, the marginal cost of evading, $2\gamma_2 (T - X)$ is smaller than the benefit of evasion $\tau$. Therefore

$$\frac{dT^*}{d\Omega} = -\frac{\partial FOC}{\partial \Omega} \cdot \frac{\partial FOC}{\partial T^*} \geq 0,$$

because $\frac{\partial FOC}{\partial T^*} \geq 0$ as $T^*$ determines a global minimum. On the other hand, differentiating (B.1) with respect to $C_F$ yields

$$\frac{\partial FOC}{\partial C_F} = \mathbb{E}_\gamma \left[ \tau ME f(T - ME) + \tau [F(T - ME) - F(T - E)] \right]$$

$$+ \mathbb{E}_\phi \left[ \tau [F(TC) - F(T)] - \tau (TC - T) TC' f(TC) \right].$$

If density $f_X$ is decreasing then the second term is positive and therefore $\frac{\partial FOC}{\partial C_F} \geq 0$. If density $f_X$ is increasing the second term will be negative, but for sufficiently smooth distributions it will be small and close to zero. Therefore the increase in evasion – the first term – will dominate any such second order effects and $\frac{\partial T^*}{\partial C_F} \leq 0$. Hence,

$$\frac{dT^*}{dC_F} = -\frac{\partial FOC}{\partial C_F} \cdot \frac{\partial FOC}{\partial T^*} \leq 0.$$

Finally, differentiating (B.1) with respect to $B$ gives

$$\frac{\partial FOC}{\partial B} = \mathbb{E}_\phi \left[ -[F(TC) - F(T)] + (TC - T) TC' f(TC) \right].$$

Note that whether $\frac{dT^*}{dB}$ is positive or not depends on whether distribution $f_X$ is increasing or decreasing. For decreasing distributions, $\frac{\partial FOC}{\partial B} \leq 0$ and therefore optimal threshold increases in $B$. However, when the distribution $f_X$ is increasing, the opposite is true.

Proof of Proposition 4.
From definitions of $ME$ and $E$ follows that

$$\frac{\partial E}{\partial \gamma_1} = 0, \quad \frac{\partial E}{\partial \gamma_2} \leq 0,$$
APPENDIX B. OPTIMAL REPORTING THRESHOLDS

\[ \frac{\partial ME}{\partial \gamma_1} \geq 0, \quad \frac{\partial ME}{\partial \gamma_2} \geq 0. \]

Setting \( \gamma_{1i} = \gamma_1, \gamma_{2i} = \gamma_2, \phi_i = \phi \) and differentiating (B.1) with respect to \( \gamma_1 \) yields

\[ \frac{\partial FOC}{\partial \gamma_1} = \Omega \left[ \tau - 2\gamma_2 ME \right] f(T - ME) \frac{\partial ME}{\partial \gamma_1} - C_F \tau ME f'(T - ME) \frac{\partial ME}{\partial \gamma_1}. \]

Note that for individuals cheating by an amount \( ME < E \) the marginal cost of evading, \( 2\gamma_2 ME \) is smaller than the benefit of evasion \( \tau \), therefore the first term is always positive. The sign of the second term depends on the slope of the distribution of donations \( f_X \).

For a decreasing distribution, \( \frac{\partial FOC}{\partial \gamma_1} \geq 0 \) and optimal \( T^* \) decreases in \( \gamma_1 \). However, if the distribution \( f_X \) is strictly increasing, the opposite can be true. Note that these statements only hold when first order conditions determine optimal \( T^* \). For low levels of \( \gamma_1 \) and \( \gamma_2 \) and thus high levels of potential evasion, optimal threshold is equal to \( ME \), in which case it will increase with \( \gamma_1 \).

Differentiating with respect to \( \gamma_2 \) gives

\[ \frac{\partial FOC}{\partial \gamma_2} = \Omega \left[ \tau - 2\gamma_2 ME \right] f(T - ME) \frac{\partial ME}{\partial \gamma_2} - C_F \tau ME f'(T - ME) \frac{\partial ME}{\partial \gamma_2} \]

\[ + \left[ \tau (C_F - \Omega) f(T - E) + \Omega 2\gamma_2 Ef(T - E) + \int_{T-E}^{T-2ME} 2\Omega (T - X) dF_X \right] \frac{\partial E}{\partial \gamma_2} \]

\[ \leq 0 \]

for most distributions \( F_X \). Note that \( \frac{\partial E}{\partial \gamma_2} >> \frac{\partial ME}{\partial \gamma_2} \) because an increase in \( \gamma_2 \) has a first order effect on \( E \) and only second order effect on \( ME \); \( \gamma_2 \) makes evasion less attractive in general and hence increases the minimum amount of evasion necessary. Therefore, because the third term is negative, the \( \frac{\partial FOC}{\partial \gamma_2} < 0 \). Thus, optimal threshold increases in \( \gamma_2 \).

Finally, differentiating with respect to \( \phi \) gives

\[ \frac{\partial FOC}{\partial \phi} = -(C_F \tau - B) [TC_T' - 1] f(TC) TC_\phi - (C_F \tau - B)(TC - T)[TC_T' T_\phi f(TC)] \]

\[ + TC_T' [TC_\phi f'(TC)] - (1 - \tau)(1 - \varepsilon) \frac{TC - T}{TC} TC_\phi f(TC). \]

Note that \( TC_T' - 1 \geq 0, TC_\phi \geq 0 \). Therefore, \( \frac{\partial FOC}{\partial \phi} < 0 \) if \( C_F \tau - B \geq 0 \) and \( \frac{\partial FOC}{\partial \phi} \) can be positive or negative if \( C_F \tau - B < 0 \). However, for most parameters, the last term will dominate and \( \frac{\partial FOC}{\partial \phi} < 0 \) is likely to be negative.
B.2 Appendix Figures and Tables

Figure B.1: Calibration of Cheating Behavior

(a) Everybody Cheats by $50

(b) Everybody Cheats by $70

(c) Everybody cheats by $90

Notes: This table shows the observed 1984 distribution, the observed 1986 distribution adjusted for bunching from above the $500 threshold, and a distribution of predicted donations if everybody who donated in 1984 cheated by the same fixed amount. Based on SOI Public Use Tax Files, 1984–1985. Noncash contributions of individuals who itemized deductions whose overall charitable contributions did not exceed 20% of AGI.
APPENDIX B. OPTIMAL REPORTING THRESHOLDS

Figure B.2: Noncash contributions in 1984 and 1986.

(a) Used Tax Preparer

(b) No Tax Preparer

(c) Filed Schedule C, E, or F

(d) No Schedules C, E, or F

(e) Only Single Filers

(f) Only Joint Filers

Notes: Based on SOI Public Use Tax Files, 1984–1985. Noncash contributions of individuals who itemized deductions whose overall charitable contributions did not exceed 20% of AGI.