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Unwilling, Unable or Unaware to Respond? Decomposing Behavioral Responses to Tax Incentives

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Unwilling, unable or unaware to respond? Decomposing behavioral responses to tax incentives

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Abstract

Different tax incentives create visibly differing responses. The leading explanation in the literature for non-response is optimization frictions. This paper proposes a decomposition of these frictions into awareness and ability to respond to tax incentives. We hypothesize that the shape and characteristics of different tax systems and institutions create different reasons for not responding. Our analysis compares the significance of these different frictions with the underlying elasticity, the willingness to respond. Using Finnish register-based data, we estimate behavioral responses to kinks in the marginal tax rate schedule as well as notches and other sharp discontinuities related to individual and household social benefits within the same population and institutional setting. These institutions are different in tax salience, opportunities to respond and strengths of tax incentives. We find that taxpayers do not respond at all to small changes in income tax incentives, but do respond to stronger incentives. Moreover, the patterns of responding support the hypothesis that some taxpayers are unable to respond even to large incentives, and some are unaware of tax incentives.

Keywords: Income taxation, income transfers, behavioral responses
JEL Classification Codes: H21, H24, H31

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1 Introduction

Existing studies find greatly varying responses to similar tax incentives (see Saez *et al.* 2012 and Meghir and Phillips (2010) for surveys). The traditional explanation for differing responses is that elasticities are heterogeneous. Recent literature adds to this view by studying optimization frictions that potentially prevent taxpayers from responding to tax incentives (Chetty 2012, Kleven and Waseem 2013). These frictions include, for example, search costs (Chetty *et al.* 2011) and knowledge about tax rules and inattention (Chetty *et al.* 2013, Chetty and Saez 2013). This literature is primarily interested in to what extent optimization frictions prevent taxpayers from responding to tax incentives. The literature has not addressed systematically which different institutions cause which kind of frictions, and how these frictions interact with taxpayers' decision making.

This paper studies different optimization frictions as the source of varying responses to similar tax incentives. We utilize exogenous local variation in tax incentives created by different tax and transfer rules. This gives us several advantages over earlier literature. First, we are able to compare the same or similar individuals in different institutional settings. This allows us to keep the taxpayers' preferences constant and compare the impact of different incentives. Second, the local variation we utilize creates different optimization frictions through interaction with different institutions. This enables us to study the role of different frictions in taxpayers' behavior. Third, we have local variation in incentives affecting different sub-populations. Combining these pieces of evidence gives us a reliable overall picture of the taxpayers' response in general.

The nature and significance of frictions and the size of the behavioral response hold potentially important theoretical and practical implications. For example, if behavioral responses are attenuated by the inability to respond immediately, we would expect individuals to adjust their behavior in future. However, if individuals do not know or understand the tax incentives, they do not respond immediately, but neither the observed behavioral response might not increase over time. They do not adjust their behavior in the future if they never learn about the incentives. These considerations alter the interpretation of the true structural elasticities based on responses to particular tax incentives. Hence, in general different types of frictions might imply different patterns of responding, and ultimately lead to different welfare conclusions.

We utilize local variation created by different income tax and transfer schedules. First, jumps in marginal income tax rates (kinks) create variation in incentives. This variation is available for taxpayers with average incomes, who are not often subject to large tax reforms. If taxpayers bunch at the kink points, it can be seen as clear evidence that the marginal tax rates affect the behavior of taxpayers (Saez 2010). Second, we utilize stronger tax incentives in order to infer elasticities in cases when taxpayers do not bunch at kink points. These are the eligibility rules of means tested income transfers that often feature income thresholds. These thresholds create jumps in average tax rates, called notches (see Slemrod 2010). Third, we study subsidies related to participating in labor force. Sharp changes in eligibility rules related to these subsidies create exogenous and strong variation in participation tax rates.

We ask could the reasons for responding to tax incentives be decomposed to the size of the underlying elasticity (willingness), knowledge about tax rules (awareness) and possibilities to adjust behavior (ability to respond)? Taxpayers may not be aware of the location of the kink points, or, for example, what a marginal tax rate is (Chetty and Saez 2013). Furthermore, taxpayers, especially regular wage earners, may not be able to respond to local variation in tax incentives. For example, they might not able to choose their working hours freely (Chetty *et al.* 2011). However, the latter explanation may not apply to the self-employed. By comparing the responses of wage earners and self-employed individuals, we infer whether the ability to respond to tax incentives drives the lack of responses.

We study the ability to respond to tax incentives utilizing notches in income tax schedule. In our case students need to avoid earning just above certain threshold to avoid the sudden increase in the average tax rate. Thus the inability to respond relates to ability to control annual income perfectly. This occurs if students cannot choose their working hours freely, or predict their annual income precisely. The empirical evidence for inability to respond comes from the share of taxpayers just above the notch point (Kleven and Waseem 2013). At this dominated region in the income distribution, individuals lose disposable income (due to the loss of the transfer) compared to earning *less* income and locating below the notch. We think that this behavior is not due to awareness friction, since students are fairly aware of the income threshold creating the notch. The awareness stems from the need to apply for the income transfer, which makes it an active choice. Also, taxpayers are reminded to pay the income transfer back either partly or fully, if earnings exceed the income threshold.

In addition, we attempt to establish the size of the behavioral response in the absence of the two frictions. Subsidies related to staying out of the labor force provide the variation in incentives that allows us to estimate the participation elasticity. The subsidies we study are paid to mothers staying at home and taking care of their children. In general, mothers applying for these home care subsidies are aware of the institutional features. These subsidies need to be applied for, and the subsidy is paid to the recipients account every month. In addition, the Social Insurance Institution sends a pre-notification to mothers indicating the ending date of the child care benefit. Also, if a mother was employed before having children, she also has a conception of the salary she would receive if employed. Moreover, mothers who have a permanent job before having children are legally guaranteed to return to their previous employment up until the youngest child turns three years. Thus, the choice of whether or not participate in labor market depends heavily on financial incentives.

We estimate the size of the participation elasticity using sharp changes in participation tax rates stemming from child care subsidy rules based on the age of the youngest child. The eligibility ends at certain ages of the youngest child. Since no other factors affecting the participation choice change at the same time, any changes in the participation decisions are allocated to changes in participation incentives.

We study the impact of these different institutions using extensive and detailed Finnish register data. We do not find any bunching at kink points, which indicates that on top of the small structural elasticity, awareness and ability could play an important role. Interestingly, we do not find any bunching at kink points even for the self-employed. However, we find that the self-employed individuals bunch actively at round numbers (multiples of 10,000 euros) of gross earned income. Thus they are clearly able to affect reported income and/or work effort, which indicates that inability to respond does not prevent the self-employed to bunch at the kink points of taxable income.

We find that income notches create significant bunching behavior. At the same time, we find that many individuals are located in the dominated regions of behavior. This indicates that given strong enough incentives, taxpayers do react to local variation in the tax schedule, and that some individuals are still unable to respond even if they wanted to. Furthermore, we find clear responses to home care subsidies. This indicates that, in the absence of frictions, taxpayers respond actively to incentives.

In addition to optimization frictions, this study contributes to the literature on observed responses to kink points and notches. Many previous studies find only little bunching at the kink points of the marginal tax rate schedule for wage earners (Saez 2010, Bastani and Selin 2014 and Chetty *et al.* 2011). In contrast, Kleven and Waseem (2013) show that wage earners bunch actively at income tax notches in Pakistan. We contribute to the latter study by estimating responses to notches in a developed country where the tax system is strongly enforced, and thus the responses are more related to real labor supply decisions. Other existing evidence from notches comes from a range of different institutions, for example the medicaid notch in the US (Yelowitz 1995), eligibility for in-work benefits in the UK (Blundell and Hoynes 2004 and Blundell and Shepard 2012), social security and financial incentives in retirement rules (Gruber and Wise 1999 and Manoli and Weber 2011) and car taxes affecting the fuel economy of cars (Sallee and Slemrod 2012).

This paper proceeds by presenting the relevant institutions in Section 2. In Section 3 we present how economic theory predicts the behavioral responses caused by local variation in income tax rates. We then present empirical methodology in Section 4. Section 5 describes the data and Section 6 presents the results. Section 7 concludes the study.

2 Institutions

2.1 Income taxation and marginal tax rate kink points

First, we study the marginal tax rate kink points created by the central government income tax schedule.[1] It features several tax rate kinks. Small amounts of earned income are not taxed by the central government. The first kink appears at a point where the central government tax rate first applies. After the central government tax rate is first applied, it increases in a stepwise manner. This results in 4-6 kink points in the marginal tax rate schedule, depending on the year in question. The number of kink points has decreased over time. The central government announces the marginal income tax rate schedule on annual basis.

Different kink points are associated with MTR increases between 4-10 percentage points. At the first income threshold, there is a clear increase in the overall marginal tax rate (MTR). In 1995-2007, increase in the MTR associated with the first income threshold has varied between 5-14 in percentage points, which relates to a 20-53% decrease in overall net-of-tax rate on average (excluding employer social security payments). In addition to the first kink point, the last income threshold involves the most distinctive increase in the MTR. The last kink point is associated with 6-8 percentage points increase in the MTR, and 9-16% decrease in the overall net-of-tax rate.

[1]The Finnish income tax system comprises of three components: progressive central government income taxes, proportional municipal taxes and mandatory social security contributions. The average municipal income tax rate is 18.1 and the average social security contribution rate 5.3 (in 1995-2007). In general, municipal income taxation and social security contributions do not induce kink points since they are proportional. The main exception is the municipal earned income tax allowance which will be briefly discussed in Section 6. Since 1993, Finland has applied the dual income tax system. In dual income taxation, earned income (wages, fringe benefits, pensions etc.) is taxed with a progressive tax schedule, and capital income (interest, dividends from listed corporations etc.) is taxed with a flat tax rate. In this study we focus on the details of the earned income tax schedule.

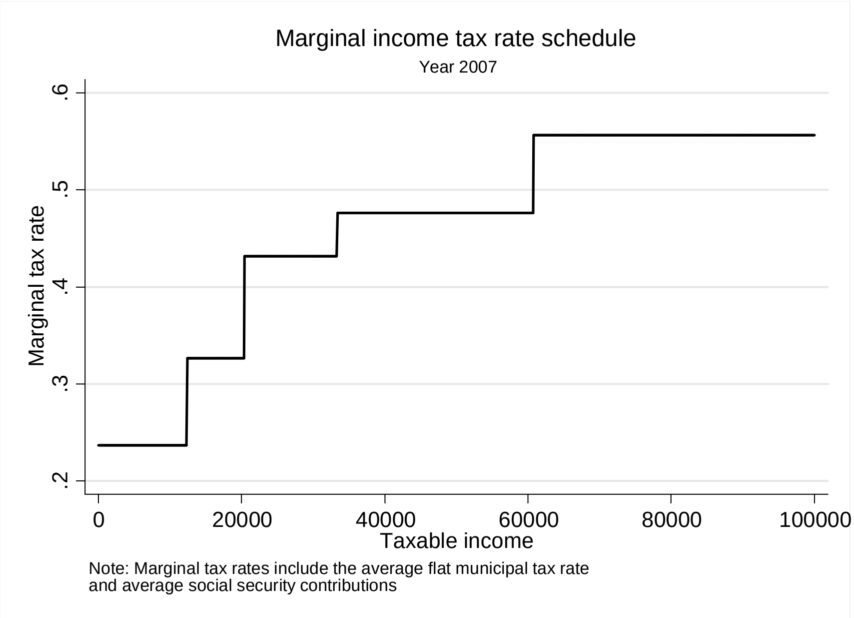


Figure 1: Marginal income tax rate schedule

Figure 1 presents the marginal income tax rate schedule for the year 2007. The Figure illustrates the discontinuous changes in the income tax rate at different levels of taxable income. Taxable income is the base for central government taxation, and it is roughly defined as gross earned income minus deductions. Table 1 in the Appendix presents the nominal MTR schedules of central government income taxation in 1995-2007. Figure 17 in the Appendix presents the overall average marginal income tax rates for earned income in 1995, 2001 and 2007 (including tax allowances and social security contributions).

2.2 Study subsidy

The first social benefit we analyze is the study subsidy. In Finland, all students enrolled in a university or polytechnic can apply for a monthly-based study subsidy.[2] The maximum amount of the subsidy is 461€ per month (in the academic year 2006/2007).[3] Eligible students can apply for the subsidy for a limited number of months per degree (max. 55 months). Study subsidy is usually applied when accepted to study for a university or college degree. The default number of study subsidy months per a study year is 9 (fall +

[2]The study subsidy is intended to enhance equal opportunities to acquire higher education, and to provide income support for students who often have low disposable income. In Finland, university education is publicly provided, and consequently there are no tuition fees. A large proportion of individuals receive higher education in Finland (ca. 40% of individuals aged 25-34 have a degree), and the study subsidy program is widely used among students.

[3]The full study subsidy includes a study grant and housing benefit. The standard study grant is 259€/month (in 2006/2007). The housing benefit depends on rent payments and other housing details. Maximum housing benefit is 202€/month (in 2006/2007). In addition to the study subsidy, students can apply for repayable student loans which are secured by the central government.

spring semester), which most of the students also receive. The study subsidy eligibility depends on academic progress[4], and it is limited if the gross earned income of the student is too large.

Students can earn a certain amount of gross income (earned income + capital income) per calendar year without an effect on the study subsidy. With the typical 9 months of the subsidy, the yearly gross income limit is 9,260€ (in 2006/2007). Students can alter the number of subsidy months from the default 9 months by making an application beforehand, or by returning already granted subsidies by the end of march in the next calendar year. More study subsidy months decrease the income limit, and less study subsidy months decrease it.[5] Table 2 in the Appendix shows the income limits for different number of study subsidy months, and the relative loss incurring when the income limit is exceeded (for 2006/2007).

If the income limit is exceeded without voluntarily returning the granted benefits, the study subsidy of one month is reclaimed with 15% interest. Additional month of the subsidy is reclaimed for an additional 1,180€ of gross income over the threshold. Once study subsidy months are reclaimed by the government, they cannot be re-granted for the student in future semesters.

The gross income threshold in the study subsidy program creates a notable notch in the tax system. Students face large incentives not to exceed the income limit. Since earning a little over the threshold results in losing one study subsidy month (with interest), this results in an effective marginal tax rate of over 100% just above the notch. Thus the study subsidy notch induces a strictly dominated region above the notch where students can earn more disposable income by decreasing their gross income level.

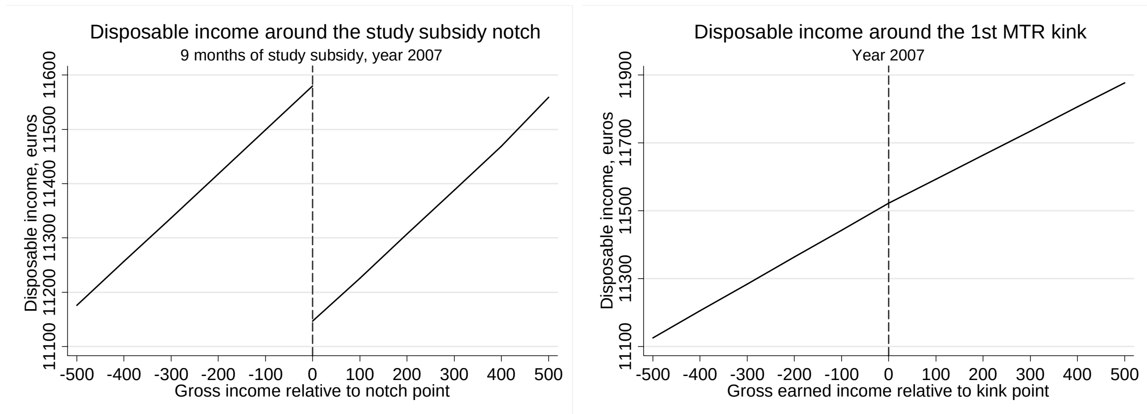


Figure 2: Disposable income around the study subsidy notch (left-hand side) and the first MTR kink point (right-hand side), year 2007

[4] The academic progress criteria requires that a student completes a certain number of credit points per academic year in order to be eligible for the subsidy.

[5] The gross income limits are 505€ per study subsidy month plus a fixed amount of 170€, and 1,515€ per month when no study subsidies are collected (in 2006/2007).

The left-hand side of Figure 2 illustrates the effect of the study subsidy notch on disposable income with the standard case of 9 study subsidy months. The Figure shows that once the income limit is exceeded, reclaiming of the study subsidy causes a dip in disposable income. Therefore, earning marginally over the notch point results in a lower level of disposable income. At the margin, earning one hundred euros above the threshold results in a loss of 360 euros in disposable income.

The right-hand side of Figure 2 illustrates the effect of the first marginal income tax rate kink point on disposable income. Earning extra income after the kink point results in less disposable income than before the kink. For example, gross income of 100 euros results in 9 euros less disposable income than below the kink.

Figure 2 highlights that the difference between the study subsidy notch and the MTR kink points are notable. Even though kink points also change the incentives at the margin, the effect of the study subsidy notch is significantly larger.

2.3 Child care benefits

As a Nordic welfare state, Finland has extensive public child care systems. Typical Nordic institutions include publicly supported child care nurseries and generous parental leave policies. The Finnish child care benefit system features two subsidies for parents who stay at home to take care of their children. First, a parent can apply for a parental leave benefit. The parental leave benefit is directly linked to earnings before giving birth. As a general rule of thumb, the gross parental leave benefit is around 70% of previous wage income. There is also a minimum benefit available for individuals with small wage income or no income at all prior to giving birth. The eligibility for parental leave ends when the child turns 9 months.

If a parent wants to continue staying at home with a child older than 9 months, she or he can rely on home care allowance. The home care allowance is partly means-tested benefit, including a base allowance and a means-tested addition for low income households. The benefit also varies between municipalities, and is larger if siblings are also taken care of at home. Overall, the home care allowance varies from 315-700€ per month. The eligibility for the home care allowance requires that children are not taken care of at a public day care center. The eligibility to home care allowance ends when the youngest child turns 3 years.

Both of the child care benefits need to applied separately. Eligible parent receives the benefit on a monthly basis. Eligibility is carefully monitored by the Social Security Institution, which precisely observers the age of the youngest child from the population registers. Child care benefits are widely available for parents. Finnish labor regulation states that parents who have a permanent job before having children are legally guaranteed to return to their previous employment up until the youngest child turns three years.

Thus parents are not at risk of losing their permanent jobs while taking care of young children at home. This highlights the importance of financial participation incentives when deciding on labor force participation.

The child care benefit system features two discontinuities in labor participation incentives. They both depend on the age of the youngest child, and thus cannot be affected by parents once the child is born. The first discontinuity occurs when the youngest child turns 9 months, and the eligibility to parental leave ends. The discontinuity in incentives is comes from the fact that the parental leave benefit is usually larger than the child home care allowance, especially for individuals with regular jobs before the child was born. For an average mother who was in full-time work prior to parental leave, the drop in benefits is around 500-1000€ per month.

The second discontinuity occurs when the youngest child turns 3 years, and the eligibility for the home care allowance ends. After the home care allowance period, a parent can return to work or continue to be outside the labor force. In the case that a spouse is working with an average salary, a typical parent would not receive any means-tested social benefits after the eligibility for home care allowance ends. A typical parent thus has a clear incentive to return to employment when the home care allowance period ends.

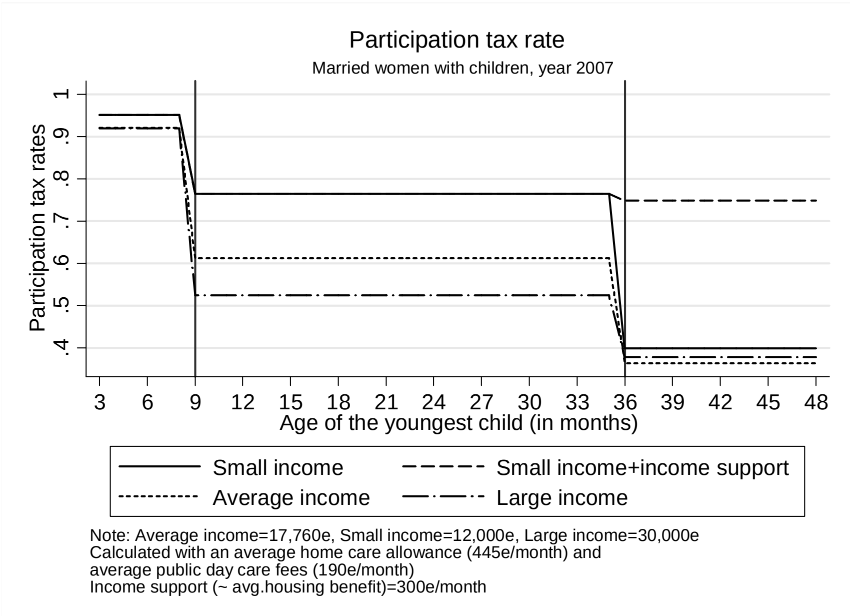


Figure 3: Changes in participation tax rates for married women with small children

In the empirical part, we focus on married women with small children[6], since they are mostly the ones who stay at home to take care of children. For example, in 2010, under 2% of all fathers of young children stayed home to care of their children and applied for

[6]In this study married women include women who are cohabiting without marriage. In Finland, marital status itself has only little effect on taxation and social benefits, but cohabitation status and household income are important parameters in many social benefit programs.

home care allowance (for children aged 1-3 years). Figure 3 illustrates the discontinuous changes in participation tax rates for married women with a small child at the two age thresholds. Participation tax rate measures the incentives to participate in labor force, taking into account both income taxes plus other work-related fees (such as day care fees) and social security benefits available when not working.[7]

Figure 3 shows that there is a clear increase in participation incentives after the parental leave ends for women with both average and large wage income. This is due to the fact that the parental leave benefit depends on wage income before giving birth. For low income women, moving from parental leave to home care allowance does not typically affect the participation tax rate as much, and the participation tax rate is relatively high in both cases.

Similarly, the end of the home care allowance eligibility creates a large drop in the participation tax rate. In general, women whose spouses are full-time workers are not eligible for supplementary benefits or other income support programs. This creates the large increase in participation incentives at the 36 month threshold. In contrast, unemployed or low income women with unemployed or low income spouses are eligible for income support after the child has turned 3 years. This drastically decreases labor participation incentives after the 3-year eligibility threshold. Thus for these women there are practically no large jumps in the participation tax rate with respect to the age of the youngest child.

3 Mechanisms

We analyze taxpayer's responses to kinks and notches under possible optimization frictions with a model that follows closely Saez (2010) and Kleven and Waseem (2013). We assume that individuals have a quasi-linear utility (no income effects), and that they have homogenous tastes and labor supply elasticities, but different abilities which gives rise to the shape of the income distribution.

We first analyze bunching behavior without optimization frictions, and then show how different frictions show up in the bunching formula. Individuals maximize a quasi-linear and iso-elastic utility function

$$u(c, z) = c - \frac{1}{1+1/e} \frac{z}{n}^{1+1/e}$$

[7]More formally, the participation tax rate is $(T(w) + T(0))/w$, where $T(w)$ is taxes on gross wage income w when participating in labor force. $T(0)$ denotes the net of social benefits available when not participating in labor force (and taking care of children at home). Participation tax rates in Figure 3 are calculated using the average day care fee (190€/month) for the first child. Participation tax rates are calculated using the SISU-microsimulation model

where c is consumption, z gross earnings, e the earnings elasticity and n ability. Individuals maximize their utility with respect to a budget constraint $c = z(1-t) + R$, where R denotes virtual income. We focus on linear income taxes t to simplify the problem. Maximizing this utility function with respect to the constraint gives the following earnings supply function

$$z = n(1-t)^e$$

We assume there is a continuous distribution of abilities giving rise to density function $f(n)$ and distribution function $F(n)$. Considering a baseline tax system which is linear and has no kinks, there is a baseline earnings distribution associated with a density and distribution, $H_0(z) = F(z/(1-t)^e)$ and $h_0(z) = H_0'(z) = f(z/(1-t)^e)/(1-t)^e$.

Next, we look at how kinks and notches transform these underlying distributions. For kinks, consider a small increase in the marginal tax rate, dt, at a point $z = k$. At k income is taxed with a flat tax rate t_1, and above the kink point the tax rate is $t_2 = t_1 + dt$. Individuals previously located at the kink do not need to change their behavior, but individuals just above the kink face a higher tax rate than before. dz denotes the behavioral changes in cross earning as a response to the increased tax rate. The behavioral responses can be written as

$$\frac{dz^*}{z^*} = e\frac{dt}{1-t_1}$$

Figure 4 illustrates the bunching effect. The vertical axis presents the net-of-tax income and horizontal axis the pre-tax income. The straight lines illustrate the tax rates, and curvy lines the indifference curves. As a result of the behavioral response dz individuals located within the income interval $(k, k+dz)$ before the tax rate change bunch at k. Individuals further up in the income distribution $z > k + dz$ do not move to the kink point. We express the bunching behavior as $B(dz) = \int_k^{k+dz} h_0(z)dz$.

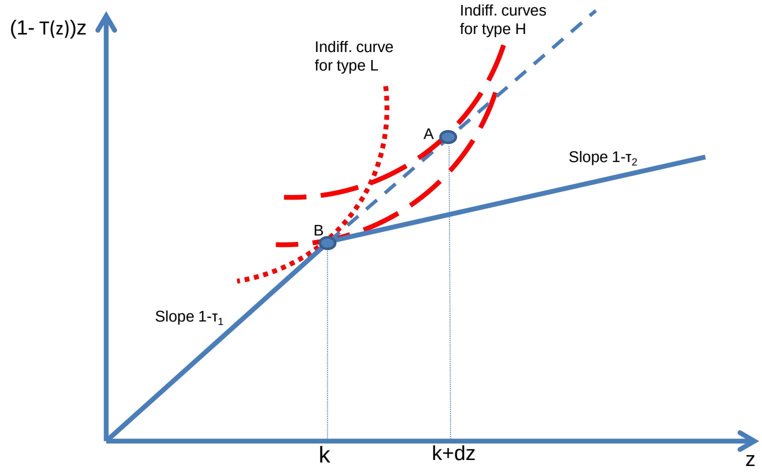


Figure 4: Bunching at a kink point

Notches can be analyzed in a similar fashion, but now the change in the tax rate is discontinuous. The tax schedule above the notch at $z = j$ is characterized as $t + \Delta t$. Thus for $z <= j$, the income tax rate is t, and if $z > j$, the whole income, including all income from below the notch, is taxed with a tax rate $t + \Delta t$.

All those who had income in the region $z > j + \Delta z$ will want to locate themselves below the notch point. The bunching behavior is denoted as $B(\Delta z) = \int_j^{j+\Delta z} h_0(z)dz$, which approximates the formula with a discontinuous Δz. What is different between notches and kinks is that since the tax rate change is (usually) inherently larger, more individuals will respond. Also, notches create a dominated region just above the notch point. Under normal preferences and absent any frictions, no individuals should locate themselves within the dominated region, as moving from the dominated region to the notch point results in more after-tax income.

Figure 5 illustrates the bunching effect related to notches. Individuals of type H located within $(j, j + \Delta z)$ will bunch at the notch point. In the figure, the dominated region is denoted as $(j, j + \Delta z^D]$. Throughout the paper, we define the dominated region such that upper limit of the region is a point where the net-of-tax income equals the net-of-tax income at the notch. By definition, all points between the notch and the upper limit of the dominated region produce less net-of-tax income compared to the notch point.

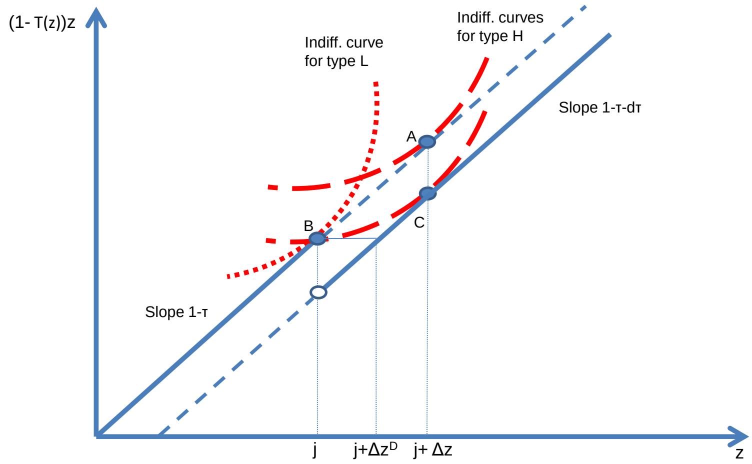


Figure 5: Bunching at a notch point

Following Saez (2010), using the expression for $B(dz)$ along with the taxable income elasticity formula derived by Feldstein (1999), we can express the local average elasticity of taxable income (ETI) at the kink point in proportion to the number of individuals bunching at the kink point

$$e(k) \simeq \frac{B(dz)}{k \times h_0(k) \times log(\frac{1-\tau_1}{1-\tau_2})} \tag{1}$$

Intuitively, larger excess bunching indicates larger behavioral responses and larger local elasticity, and vice versa. Also, with a given $b(k) = \frac{B(dz)}{h_0(k)}$, smaller difference of the tax rates τ_1 and τ_2 indicates larger local elasticity.

As the behavioral response to a notch is related to changes in average tax rates rather than marginal tax rates, deriving the earnings elasticity using excess bunching at notches is less straightforward. However, the earnings elasticity at a notch can be approximated in terms of the excess mass at the notch point and the implied change in marginal tax rate above the notch (Kleven and Waseem 2013). We discuss this in more detail in Section 6.

We now introduce optimization frictions to the analysis. We denote optimization frictions by a, $0 < a < 1$. In the forthcoming analysis, we decompose this optimization friction into two components, awareness and ability to respond. However, since these two terms have an *a priori* similar effect on behavior in a cross sectional context, it is not necessary to complicate the theoretical model by adding two similar terms instead of one. Nevertheless, the different frictions imply different reasons for not respond to tax incentives, which hold potentially important implications. We discuss these in more detail in when interpreting the results.

Intuitively, the higher a is, the larger the frictions are and the less individuals react to tax incentives. The fraction of individuals responding to tax incentives can be denoted as $(1-a)$. After including frictions, the two bunching formulas become $B_a(dz) = \int_k^{k+dz}(1-a)h_0(z)dz$ and $B_a(\Delta z) = \int_j^{j+\Delta z}(1-a)h_0(z)dz$. It is evident that the bunching behavior is reduced under the optimization frictions. It is possible that the combined effect from a small elasticity and a high friction leads to no behavioral changes in the income distribution, which in turn would indicate no bunching at kink or notch points. Nevertheless, the behavioral response absent frictions might still be non-negligible, giving rise to a baseline long-term structural earnings elasticity.

We also study the decision to participate in labor force. We assume that on top of receiving disutility from earning and reporting income z, there is a fixed cost q arising from participating in the labor market. An empirical counterpart for the fixed cost could be the cost of finding a job, or the cost or inconvenience to arrange for the care of children.

The quasi-linear utility function with fixed costs can be written as

$$v(c, z, q) = u(c, z) - q$$

When an individual is not participating in labor market, she receives utility $u(c_0, 0)$, where c_0 denotes consumption when not working. An individual participates in the labor force conditional on the utility from participating exceeding the fixed cost plus utility from not participating:

$$u(c_1, z_1) - q \geq u(c_0, 0)$$

$$\Rightarrow \bar{q} = u(c_1, z_1) - u(c_0, 0)$$

where $\bar{q}$ is the threshold for participation. We assume a continuum of smoothly distributed fixed costs, $f(q)$ and $F(Q) = 1$, where $q \in (0, Q)$, and $F(q)$ is a cumulative distributive function of q. The heterogeneous fixed costs give rise to the participation elasticity: those who have a fixed cost higher than the threshold will not participate. Changes in c_1 and c_0 through subsidies and income taxes affect the participation tax rates, which in turn change the location of participation thresholds. Thus more individuals will participate if, for example, subsidies received when not participating are reduced (and vice versa).

4 Empirical methodology

4.1 Bunching at kinks and notches

With kinks and notches, it is straightforward to verify visually whether there is bunching or not. The challenge is in estimating the size of the observed bunching from the counterfactual state of no kinks or notches. The excess mass of individuals, $b(k)$, at a kink or a notch is estimated by comparing the actual density function around the discontinuity point k to a smooth counterfactual density. The counterfactual density function describes how the income distribution at the notch or kink would have looked like without a change in the tax rate. The bunching method implicitly assumes that individuals in the neighborhood of a kink or a notch are otherwise similar except that they face a different slope or shape of the budget set.

Due to imperfect control and uncertainty about the exact amount of income in each year, the usual approach is to use a "bunching window" around k to estimate the excess mass (see Saez 2010 and Chetty *et al.* 2011). In other words, we compare the density of taxpayers within an income interval $(k - \delta_L, k + \delta_H)$ to an estimated counterfactual density within the same income range. δ_L denotes the lower income limit on the left of the kink, and δ_H denotes the income limit above k.

We follow Chetty *et al.* (2011) to estimate excess bunching at kink points. Intuitively, the counterfactual density is estimated by fitting a flexible polynomial function to the observed density function, excluding the region $[\delta_L, \delta_H]$ from the regression. First, we re-center income in terms of the discontinuity point, and group individuals into small income bins of 100€. Next, we estimate the counterfactual density by regressing the following equation

$$c_j = \sum_{i=0}^{p} \beta_i (z_j)^i + \sum_{i=\delta_L}^{\delta_H} \eta_i \cdot \mathbf{1}(z_j = i) + \varepsilon_j \tag{2}$$

by omitting the bunching window from the regression. In equation (2), c_j is the count of individuals in bin j, and z_j denotes the income level in bin j. The order of polynomial is denoted by p. Thus the fitted values for the counterfactual density are given by

$$\hat{c}_j = \sum_{i=0}^{p} \beta_i (z_j)^i \tag{3}$$

The relative difference of observed individuals and the counterfactual density within the bunching window defines the excess bunching measure. More formally, for kink points, the excess bunch is calculated as

$$\hat{b}(k) = \frac{\sum_{i=\delta_L}^{\delta_H} (c_j - \hat{c}_j)}{\sum_{i=\delta_L}^{\delta_H} \hat{c}_j / (\delta_H - \delta_L + 1)} \tag{4}$$

As in the earlier literature, parameters δ_L, δ_H and p are determined visually and based on the fit of the model. In general, our results are not very sensitive to the choice of the omitted region or the degree of the polynomial.

The method for analyzing excess mass at notches is based on similar principles. The main difference with notches is that the excess mass should locate below the notch, and not as a diffuse mass around both sides of it. Thus in the case of notches, the excess bunching is measured by comparing the observed distribution and the counterfactual within the interval $(k - \delta_L, k)$.

Furthermore, with notches it is slightly more difficult to define the income limit above the kink point when estimating the counterfactual density. We follow Kleven and Waseem (2013) and define the upper limit for the excluded region δ_H such that the excess mass below the notch $\hat{b}_E(k) = (\sum_{i=\delta_L}^{k} c_j - \hat{c}_j)$ equals the missing mass above it $\hat{b}_M(k) = (\sum_{z>k}^{\delta_H} \hat{c}_j - c_j)$. Intuitively, this condition implies that the excess bunching comes from the missing mass above the notch, and that we can define the earnings response $\triangle z$ and the marginal buncher using the estimated excess mass and this convergence condition.[8] This definition for δ_H also denotes the upper bound for the excluded range (Kleven and Waseem 2013).

In order to assess frictions related to responding to notches, we measure the relative proportion of individuals who locate at the dominated region just above the notch. Following Kleven and Waseem (2013), individuals at the dominated region are inherently not able to respond to the notch because of frictions, as these individuals would have more disposable income by earning (marginally) less. We define the share of individuals in the dominated region as $a = c^D/\hat{c}^D$, where c^D is the observed individuals in the dominated region $(k, k + D)$, and $\hat{c}^D$ is the counterfactual estimate for the individuals within the same region. D denotes the upper limit of the dominated region.

As in Chetty *et al.* (2011) and Kleven and Waseem (2013), standard errors for all the estimates are calculated using a parametric bootstrap procedure. We generate a large number of earnings distributions by randomly resampling the residuals from equation (2). The standard errors for each estimate are defined as the standard deviation in the distribution of the estimate.

4.2 Regression discontinuity design and child care benefit eligibility

Age thresholds in child care benefit eligibility induce discontinuous changes in the participation tax rate for women with small children. In the empirical analysis, we study whether there are significant jumps in the employment of women with young children at the eligibility limits of parental leave and home care allowance. Our dependent variable is employment status among women with young children. We measure employment and

[8]With kink points, Chetty *et al.* (2011) adjust the counterfactual density above the kink such that it includes the excess bunch at the kink, making the area under the estimated counterfactual equal to the observed density. Due to the relatively small observed excess bunching at kink points, this has only a trivial effect for our empirical analysis, and thus we estimate the counterfactual for kink points by simply excluding the bunching window from the regression as described above. Intuitively, this provides an upper bound estimate for the excess bunching at kink points.

the age of the youngest child at the month level using employment information from mandatory pension insurance registers and population registers.

In general, mothers could participate in labor force at any time. Usually there is a positive relationship between the age of the child and employment of the mother. In the absence of discontinuities in child care benefits, we assume this relationship to be continuous. Our main identifying assumption is that the mother cannot affect the eligibility thresholds which are based on the age of the youngest child (9 months for parental leave and 36 months for home care allowance). In other words, mothers cannot manipulate the assignment variable (change in participation tax rates) once the child is born. Secondly, we need to assume that the distribution of other individual characteristics defined before the birth of the child are similar just below and above the threshold.

Following Lee and Lemieux (2010), the estimable RD model can be characterized as

$$S_i = \alpha_i + \delta E_i + f(a_i - c) + \gamma X_i + v_i \tag{5}$$

where S_i is employment status and E_i is an indicator variable for the eligibility for either parental leave or home care allowance. $f(a_i - c) = f_L(a_i - c) + f_H(a_i - c))$ is a function of the difference of the age of the youngest child a_i and the age threshold c (9 or 36 months). $f_L(a_i - c)$ denotes the functional form below the age threshold, and $f_H(a_i - c)$ denotes the functional form above the age threshold. In the baseline specification we use quadratic functions on both sides of the threshold. X_i is a matrix of exogenous individual characteristics, such as age and county of residence. These variable are added to the model to increase precision. Finally, δ is the parameter of interest, the intention-to-treat effect of the child care benefit eligibility on employment.

There are some caveats to the RD design and the interpretation of the employment effect. Firstly, mothers have indirect control over the assignment variable through fertility decisions. However, it is difficult to perfectly predict the birth date of a child, at least before insemination. More importantly, the eligibility rules are known beforehand, which allows mothers to anticipate the change in the participation tax rate. Therefore, we can only analyze the effect of the jump in the labor participation locally at the threshold given that the eligibility rule might affect the participation decision already before the threshold age of the child. Moreover, there is substantial heterogeneity in the effects of age thresholds on participation incentives. As shown in Section 2, some groups face only small changes in participation tax rates, and for some groups changes in participation incentives are larger.

In addition, we cannot precisely measure individual employment status with our current data. Our data contain information on starting and ending dates of each work spell for each individual. The work spell information comes from the public pension insurance register (Eläketurvakeskus), and it is based on the information that an individual has or has not a public pension insurance based on an employment contract or entrepreneurial activity. Public pension insurances are mandatory in Finland. Individuals may also purchase private pension insurance on top of the mandatory public contributions.

However, a pension insurance spell does not necessarily guarantee that an individual is actually working throughout the whole period, and vice versa. One common case is that a pension insurance spell is continuing even when a mother begins the parental leave period, provided she still has an active employment contract with the employer. However, the pension insurance spell is always discontinued if an individual is not earning wage income at all for one year.

Nevertheless, differences in actual work spells and pension insurance spells are *not* a function of the sharp eligibility rules or other tax incentives we study. Thus we can evaluate the effect of a change in tax incentives on the working status. However, with our current data we overestimate average employment when studying mothers around the 9-month parental leave threshold because many mothers who stay at home still have an active pension insurance spell. This results in a underestimation of the relative jump in employment at the threshold, and thus we are only able to estimate the lower bound participation elasticity for the 9-month threshold. The estimation of the participation elasticity is discussed in detail in Section 6.

5 Data description

5.1 Data

We use three different data sets to analyze the behavioral effects of local tax changes. All data sets comprise of register-based information from both Statistics Finland and the Finnish Tax Administration.

We use an individual-level panel from 1995-2007 provided by Statistics Finland. This data set consists of approximately 550,000 observations per year (ca. 9% of the Finnish population). The data set contains a wide variety of individual-level variables from different statistics, including the tax register information from the Finnish Tax Administration and information on study subsidies from the Social Insurance Institution of Finland. The data set contains all the necessary information to study excess bunching at marginal tax rate kink points and study subsidy notches. In addition, we use tax register data for all Finnish entrepreneurs to study excess bunching among entrepreneurs (sole traders and partners of partnership firms). These data are provided by the Finnish Tax Administration.

Table 3 in the Appendix shows the descriptive statistics for the tax register data. Table 4 shows the summary statistics for all students who receive study subsidies, as well as for the default student group who receive 9 months of the study subsidy. In the data we define a student to be an individual who received at least one month of university/polytechnic study subsidy in a year.

For the child care benefit analysis, we use the Finnish Linked Employer-Employee Data (FLEED) provided by Statistics Finland. This panel data consist of approximately 1,2 million observations per year, and they include detailed employment information on Finnish individuals over the period 2001-2009, including starting and ending dates for each work spell for each individual based mandatory pension insurance registers. To this data we have linked the birth months of the two youngest children for each individual in order to analyze the effects of the eligibility to child care benefits using monthly-level data.

Table 5 in the Appendix shows the descriptive statistics for women aged 16-55 years in the FLEED data. Table 6 presents the overall income and employment characteristics for women with different aged youngest child, as well as income information from the year before giving birth. Finally, Table 7 shows the percentage of women in different groups who receive home care allowance. From Table 7 we can see that a large fraction of women with small children receive home care allowance and are not working. For example, on average over one third of all women with a two-year old youngest child receive home care allowance and are out of the labor force.

6 Results

6.1 Marginal tax rate kinks

We present taxable income distributions around different kink points for all taxpayers and for certain subpopulations. The figures plot the observed income distributions and counterfactual distributions relative to each MTR kink point in bins of 100€ in the range +/- 5000€ from the kink. The kink point is marked with a vertical dashed line. The figures denote the excess mass estimates (with standard errors) and the implied observed elasticity estimates. The excluded counterfactual region (the bunching window) is marked with vertical lines. In each graph, the bunching window is +/- 7 bins from the kink. The counterfactual density is estimated using a 7th-order polynomial function. In general, our results and conclusions are not sensitive to these choices.

Figure 6 presents the income distributions around different kink points of the central government income tax schedule for all taxpayers in 1995-2007. The Figure illustrates bunching at the first, second, third and last kink point using pooled data for the years 1995-2007. The Figure shows that there is no bunching at the marginal tax rate kink points in Finland. The only conceivable exception might be the third kink, which however is very likely to produce upward-biased excess bunching because of the locally hollow shape of the income distribution around the kink. Consequently, the elasticity estimates are very close to zero around all kink points.

In terms of the size of the tax rate change and the characteristics of the Finnish tax system, we should in particular find excess bunching at the first and last kink point of the tax schedule. However, there seems to be no significant responses at these kink points. The irregularities in the income distributions on further left of the first kink are due to a relatively large number of low-income individuals who receive only taxable social benefits (e.g. unemployment and sickness benefits). These benefits tend to cluster at certain values. There is no significant bunching at the first kink even if we do not include individuals with taxable benefits.

The result of no bunching holds also for other central government kink points that are not shown in Figure 6. Also, there is no bunching at any kink point in any separate year in 1995-2007. Thus there is no increase in excess bunching over time, and no differences in responses to kinks of different size. Also, in addition to central government taxation, we find no bunching at the marginal tax rate kink points associated with graduated tax credits or allowances, including the municipal earned income tax allowance.

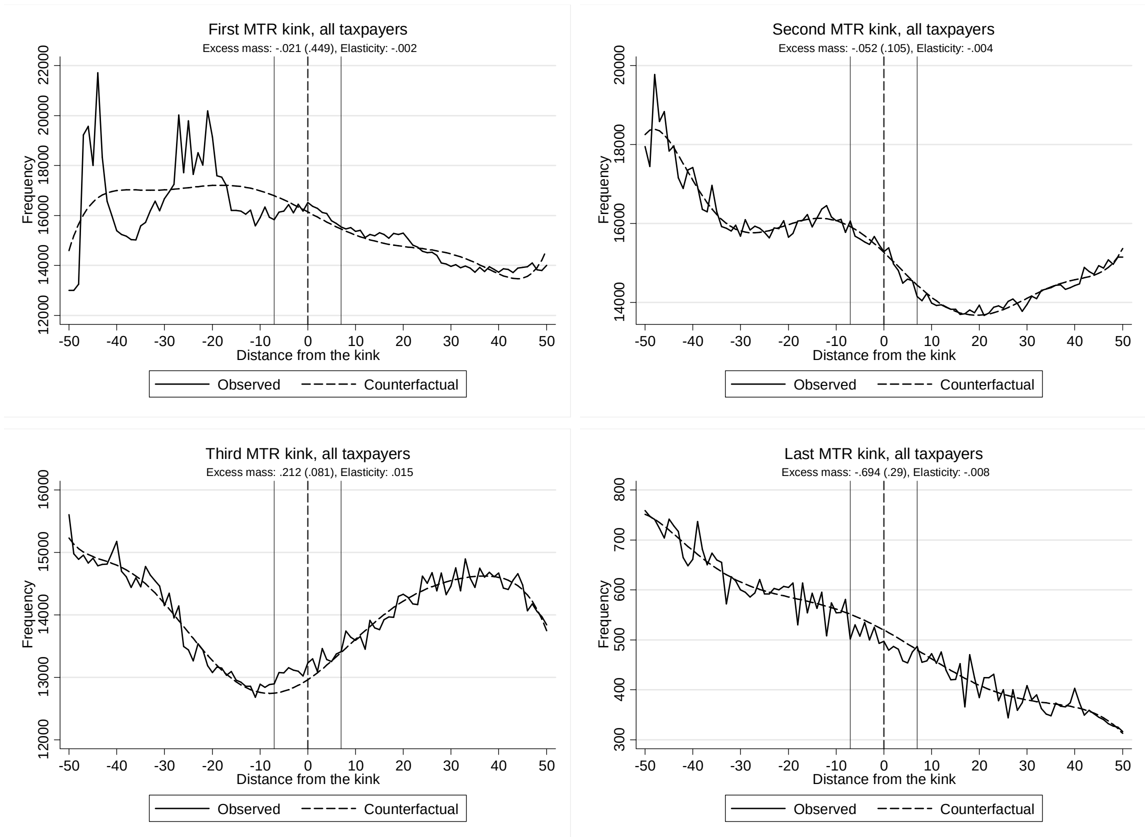


Figure 6: Income distributions around MTR kink points, 1995-2007

The result of no bunching indicates that marginal tax rate kinks induce no behavioral responses. This can be explained by both the low underlying tax elasticity and frictions. It might be that the relatively small changes in incentives induce no behavioral responses, even absent any frictions. However, it might also be that especially regular wage earners cannot adjust their reported income and/or working hours with reasonable costs. Finally, it might be that taxpayers do not know the minute details of the tax schedule, or do not know or understand their marginal tax rates.

In order to assess the significance of the different explanations, we study the behavior of entrepreneurs. In this study, entrepreneurs include sole proprietors and partners of partnership firms (i.e. all non-corporate entrepreneurs). In many previous bunching studies, entrepreneurs bunch much more actively than wage earners. Saez (2010) finds clear and significant excess bunching for the self-employed in the US, Chetty *et al.* (2011) in Denmark, and Bastani and Selin (2014) in Sweden. One explanation for this finding is that entrepreneurs can more easily affect their labor supply and effort. Also, self-employed individuals have more opportunities to adjust their reported incomes. Combining the ability to respond and the large observed changes in behavior, earlier results indicate that entrepreneurs are aware of the incentives around kink points and respond to them actively.

In contrast to earlier findings form other Nordic countries (Chetty *et al.* 2011, Bastani and Selin 2014), we do not find excess bunching for the self-employed at any kink point of the earned income tax schedule. As an example, the two graphs in Figure 7 show the income distributions around the first and last kink point for all Finnish self-employed individuals in 1995-2007. This result indicates no significant responses to marginal tax rates among the self-employed in Finland.

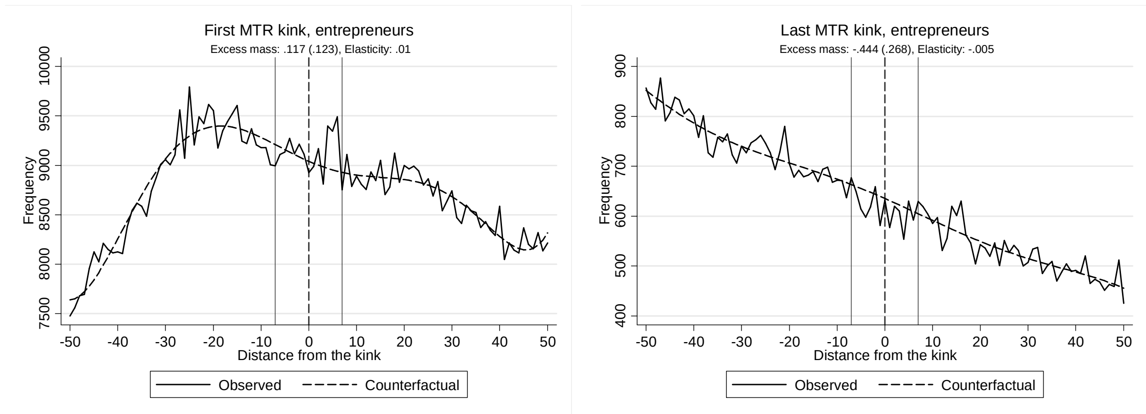


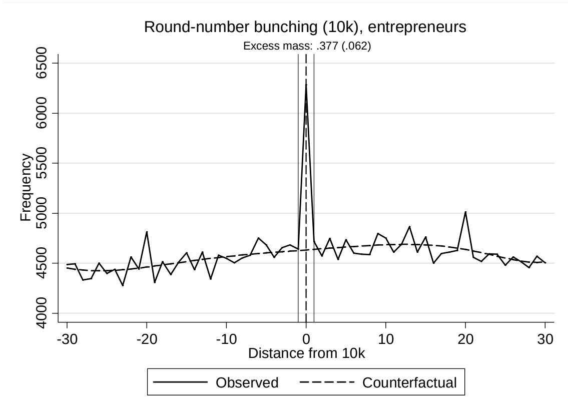
Figure 7: Bunching at MTR kink points: Entrepreneurs, 1995-2007

In order to assess the ability to affect reported income, we also study bunching at round numbers in terms of *gross* earned income among entrepreneurs[9]. Round-number

[9]The connection between gross earned income and taxable earned income is that latter is calculated by deducting tax allowances and tax deductions from the former.

bunching would indicate that at least some entrepreneurs can easily affect the gross income they report to tax authorities. Thus if we find evidence of entrepreneurs bunching at convenient round numbers, it strongly implies that entrepreneurs have the ability to affect their location in the income distribution.

Indeed, Figure 8 shows that the self-employed bunch very sharply at gross earned income of 10,000€ and 20,000€.[10] This behavior also occurs in larger round numbers (30k, 40k, 50k etc.) as well as in round numbers of Finnish marks (100k, 200k, 300k) before the implementation of the euro in 2002. Furthermore, we find that visible round-number bunching never occurs among wage earners.



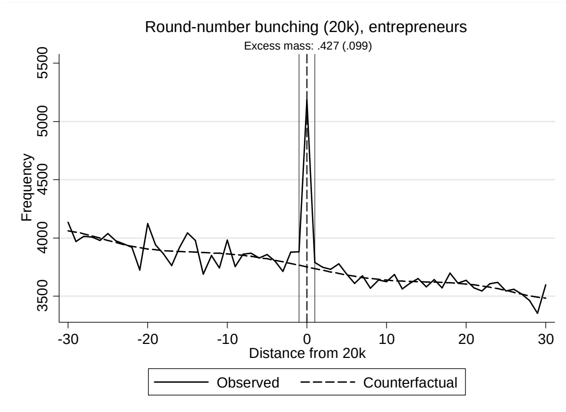


Figure 8: Round-number bunching, gross earned income: Entrepreneurs, 2002-2010

Combining the evidence from Figures 7 and 8 suggests that inability to respond is not explaining the no bunching result at kink points for entrepreneurs. Instead, it seems that either unawareness or low elasticity is driving the results, but we cannot precisely separate the two mechanisms.

Compared to Sweden and Denmark, the Finnish income tax schedule includes more kink points. In Sweden and Denmark there are only 2 distinctive jumps in marginal tax rates (see Chetty *et al.* 2011 and Bastani and Selin 2014). In Finland, there are 4-6 kink points in the schedule in the period we study. At least to some extent, this might make the tax schedule more transparent in Denmark and Sweden, compared to the Finnish system with many local jumps in marginal tax rates. The size of the change in incentives is similar in Denmark and Sweden compared to the largest kinks in Finland.[11]

On the other hand, Finnish entrepreneurs as a whole are not completely unaware of *any* income tax incentives. Harju and Matikka (2013) find that the owners of privately

[10] As round-number bunching is very sharp by nature, we use a bunching window of +/- 1 bin on both sides when defining excess bunching at round numbers.

[11] For Denmark, the first jump causes (approximately) 11% fall in net-of-tax rate, and the second kink 30% (Chetty *et al.* 2011). For Sweden, the first kink point decreases net-of-tax rates by around 34%, and the second kink by 10% (Bastani and Selin 2014). In Finland, the first kink point causes a jump of 20-53% in net-of-tax rates, and the last kink decreases net-of-tax rates by 9-16%.

held corporations bunch sharply at the tax rate kink point in the dividend tax schedule. This response is largely driven by income-shifting incentives, which highlights that the owners are aware of tax incentives. Nevertheless, Harju and Matikka (2013) find no bunching at the kink points of the earned income tax schedule for private corporate owners in Finland, which support our findings above. Thus it seems that both unawareness and unwillingness might contribute to the observed zero bunching of entrepreneurs.

6.2 Study subsidy notch

Figure 9 shows the gross income distribution around the notch point (relative to the notch in bins of 100€ in the range of +/- 5000€ from the notch) induced by the income limit in the study subsidy system for all students and students with the default number of study subsidy months (9) in 1998-2007. In the figure, the dashed line denotes the notch point above which a student loses one month of the subsidy. The vertical lines denote the excluded range (see Section 4 for details on defining the upper limit of the excluded range). The pointed line shows the upper limit for the dominated region above the notch. The figure also includes the estimates and standard errors for the excess mass and the share of individuals in the dominated region. In each figure the counterfactual density is estimated using a 7th-order polynomial function. Our conclusions are not very sensitive to this choice.

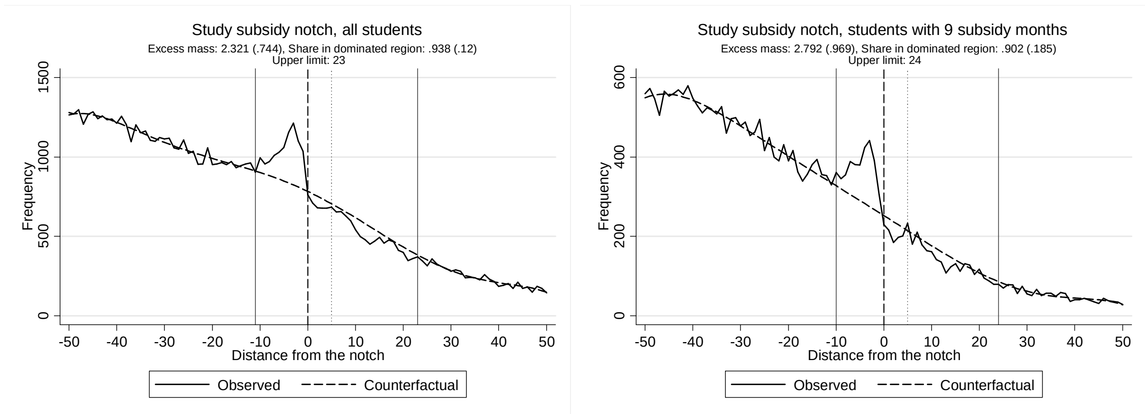


Figure 9: Bunching at the study subsidy notch, 1998-2007

Figure 9 indicates a clear and statistically significant excess mass on the left of the notch. This indicates that students are both aware of the notch and respond to the strong incentives created by it. However, the results also imply that students cannot affect their working hours or reported income very precisely. Firstly, the excess mass below the notch is rather diffuse. Secondly, there is an economically and statistically significant mass at the strictly dominated region where students can increase their net income by lowering their gross income. In fact, the share of individuals in the dominated region relative to the counterfactual is not statistically different from one. This also indicates that in addition to the ability to respond, some students might also not be aware of the notch, at least when exceeding the income limit for the first time.

We approximate the earnings elasticity at the study subsidy notch using a similar approach as Kleven and Waseem (2013). We derive an upper bound reduced-form earnings elasticity by relating the earnings response of a marginal buncher at $j + \Delta z$ to the implicit change in tax liability between the notch point j and $j + \Delta z$ (see Figure 2 in Section 3).

The marginal buncher and the associated earnings response Δz are defined based on the estimated excess mass and the convergence condition which states that the excess mass at the notch is equal to the missing mass above it, thus resulting $\delta_H = j + \Delta z$. Intuitively, this approach treats the notch as a hypothetical kink which creates a jump in the marginal tax rate from that just below the notch point to the increase in tax rate which is resulted by exceeding the notch point by Δz. This convergence approach also gives the upper bound for the structural elasticity (Kleven and Waseem 2013).[12]

The point estimates for earnings elasticities for all students and students with 9 subsidy months are 0.044 and 0.056, respectively.[13] Thus even though excess bunching is evident and notable earnings responses occur (around 15% of income at the notch for marginal bunchers), the underlying elasticities are still modest. This stems from the fact the changes in incentives are also very distinctive, as notches induce very high implicit marginal tax rates above the income thresholds.[14]

We study the awareness, ability and willingness to respond by dividing students into subsamples. First, we divide students into two groups based on the number of years they have studied (under and over three years). In order to eliminate the effect of dropouts and graduates, we include only students who also study in the next year. It is presumable that students with more study years are more aware of the income notch, as they (and their fellow students) have been within the study subsidy system for a longer period. Also, it is presumable that the ability to predict and adjust annual income enhances over time. In addition, if behavioral responses are attenuated by the inability to respond, these frictions might decrease over time. Thus we would expect to see that students with more study years bunch more actively, and that less students are located in the dominated region. In contrast, we have no reason to assume that willingness to respond would be

[12]More formally, the reduced-form earnings elasticity is calculated with a quadratic formula $e(j) = (\triangle z/j)^2/(\triangle t/(1-t))$, where $(1-t)$ is the net-of-tax rate at the notch, and $\triangle t$ defines the change in the implied marginal tax rate for the marginal buncher with an earnings response of Δz (see Kleven and Waseem 2013).

[13]For all students we use the mean study subsidy months (8) at the notch point when calculating the change in incentives.

[14]In addition, implicit marginal tax rates remain relatively high (>50%) even further away above the notch, as an extra month of the subsidy is reclaimed (with interest) after additional 1,180€ above the income limit. Thus the effective tax schedule for students inherently includes many notches. However, we only observe significant bunching at the first notch, which justifies the analysis of the first notch only.

different *locally* around the notch point for students with more or less study years.

Figure 10 partly supports the above hypothesis. There is visibly more excess bunching for more senior students. Nevertheless, the difference is not statistically significant. The implied point estimates of earnings elasticities for students with less or more than three study years are 0.028 and 0.049, respectively.[15] However, the share of individuals at the dominated region is practically unaffected. This implies that the increased awareness and learning does not decrease or eliminate all frictions, and suggests that a notable fraction of students are (still) not able to respond by adjusting their working hours or reported income.

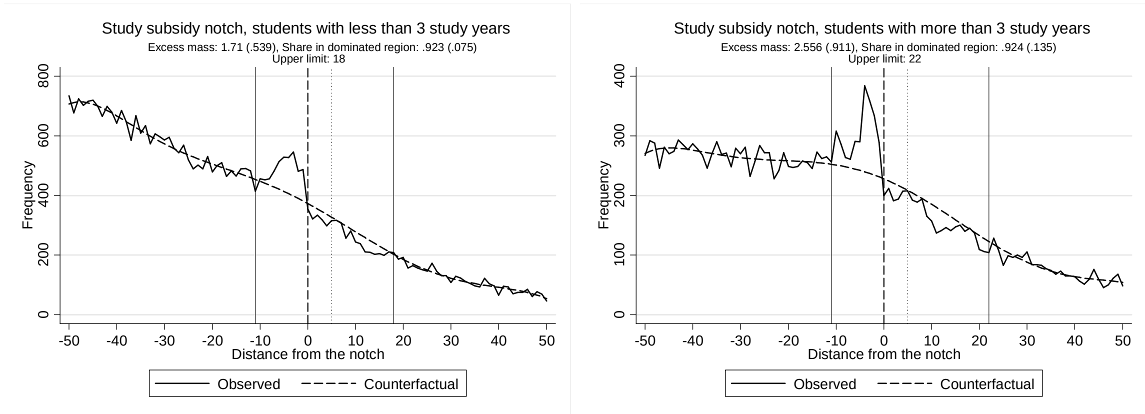


Figure 10: Bunching at the study subsidy notch: Students with more or less than 3 study years, 1998-2007

Second, we divide students with the number of study subsidy months they apply for. The default number of study subsidy months is 9, which students receive every year while studying if they do not wish to apply for additional subsidy months or decrease the number of months. To remove the default effect, we look at students who have 2-5 and 6-8 study subsidy months. Both of these two groups have decided to opt out from the default option by making an active decision. Again, in order to eliminate the possible curious effects of dropouts and graduates, we only include students who also study in the next year.

There is an income threshold associated with each number of months that is inversely related to the number of months (see Table 2 in the Appendix). Therefore, the difference between these groups is that the size of the tax incentive at the notch is weaker for the group that had only few months of the study subsidy than for the group that applied for more subsidy months. Both groups still lose disposable income if they go marginally over the income threshold. However, the income loss is larger in proportion of gross income for students with more study subsidy months and lower income thresholds.

[15]For both groups the change in incentives is calculated assuming 9 months of the subsidy, which is the most typical case for both groups.

Figure 11 presents the bunching evidence at the study subsidy notch for students with different number of study subsidy months (2-5 months and 6-8 months). The former group shows very little bunching, whereas the latter group shows a clear response at the notch. Consequently, the earnings elasticity is low (0.006) for students with a few months, and notably larger for students with 6-8 months (0.070).[16] These support the notion that the relative strength of tax incentives matter, which corresponds to larger responses for larger tax incentives. In general, we have no explicit reason to assume that the two groups differ in awareness, especially as both groups have actively deviated from the default option. However, there is a possibility that the ability to respond decreases for some students along with income (i.e. along with more permanent jobs and/or more regular hours), which would also indicate lower bunching when the income threshold is higher.

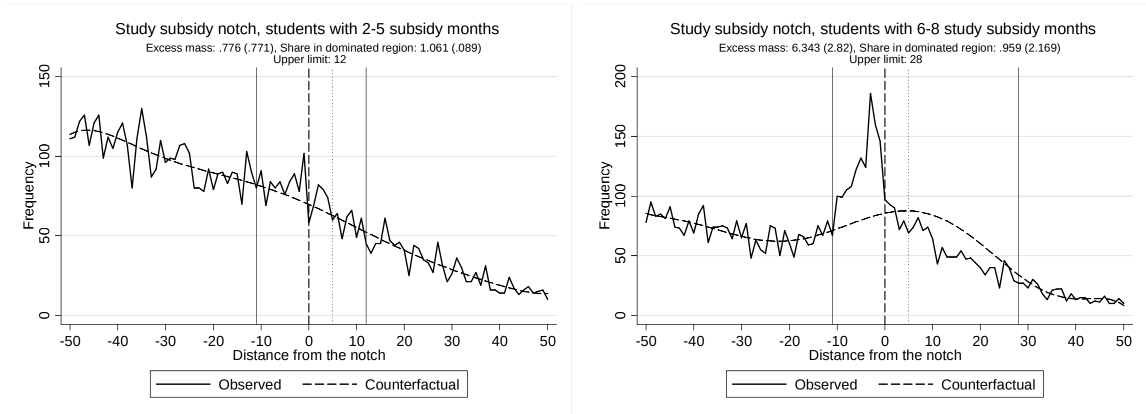


Figure 11: Bunching at the study subsidy notch: Students with different number of study subsidy months, 1998-2007

Finally, there is a striking difference between bunching at notches and bunching at MTR kink points. Figure 12 shows excess bunching at kink points for current students (first kink), university graduates (last kink) and students who previously bunched at the study subsidy notch (first kink). For any of these groups we find no significant bunching at any MTR kink point in any year. Thus it seems that even though students are clearly responding to large incentives induced by the notch, they do not respond to smaller incentives created by MTR kinks. For current students this cannot be explained by the inability to respond at all, as we see the same individuals bunching at income notches. In other words, there is no reason to assume that students are less able to affect their labor supply at the MTR kink compared to the study subsidy notch. However, in addition to the size of the incentive and the size of the underlying elasticity, it might be that the MTR schedule is too obscure for most of the students.

[16] We use the average subsidy months in both groups (4 and 7) to calculate the elasticities.

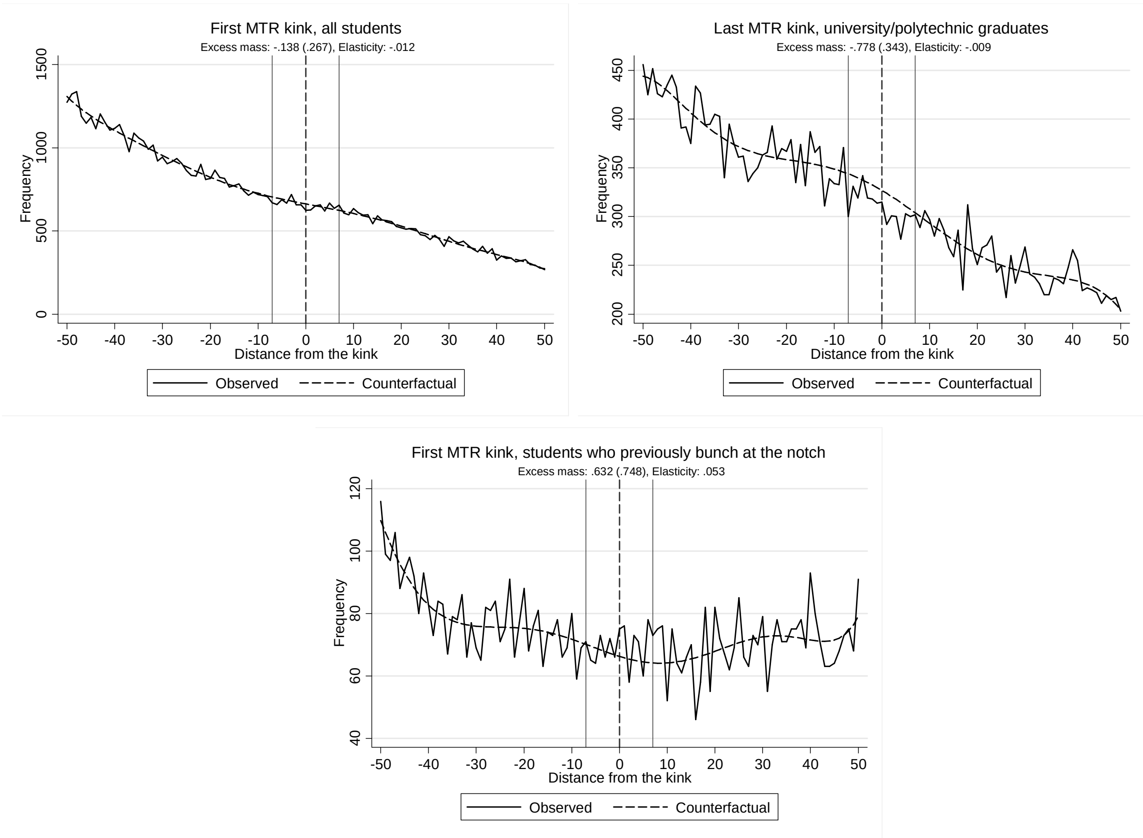
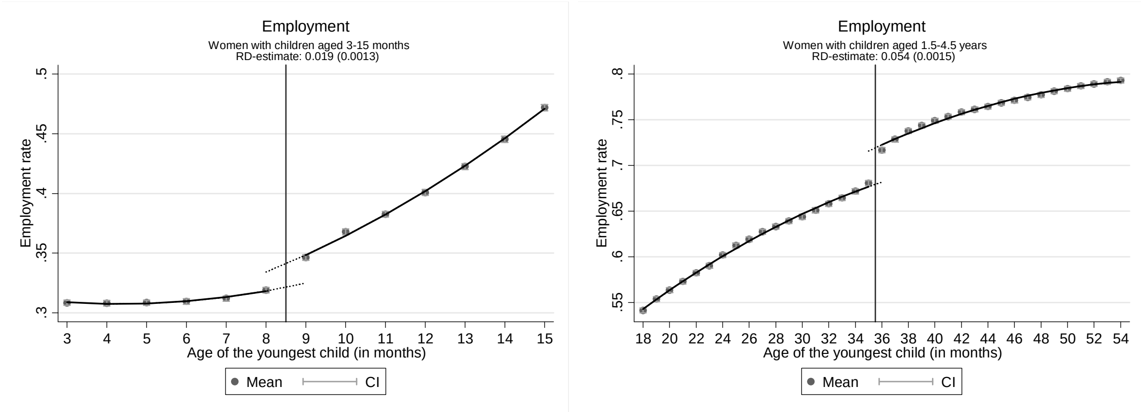


Figure 12: Bunching at MTR kink points: Current students, graduates and students who bunched at the study subsidy notch, 1998-2007

6.3 Child care benefit eligibility

Figure 13 presents the average employment of women with a young child in 2001-2009 and the RD-estimates at the 9-month and 36-month age limits. The vertical lines mark the eligibility limits of parental leave and home care allowance, i.e. when the youngest child turns 9 months and 36 months. The plot presents the average employment for each age month of the youngest child with 95% confidence intervals.



Notes:

CI = 95 % confidence interval. Fitted lines on both sides of the thresholds are estimated using a 2nd-order polynomial function.

Figure 13: The effect of parental leave and home care allowance eligibility on employment: Married women with young children

There is a visible jump in the average employment at the age thresholds when participation tax rates decrease on average. For the parental leave threshold, the estimated size of the jump in employment is around 2 percentage points and statistically significant. The right-hand side of the figure shows a clear jump in the average employment also at the age threshold of the home care allowance. The size of the jump is around 5 percentage points, although from a larger mean than in the case of parental leave.

We approximate the average participation elasticity (ε_P) of mothers with young children by relating the average RD-estimate on labor participation to changes in participation incentives at the age thresholds.[17] For all mothers in Figure 13, the point estimate for the average participation elasticity is 0.065 at the 9-month threshold, and 0.286 at the 36-month threshold. These local estimates imply non-trivial participation elasticities, which are, however, smaller than in many previous studies (see e.g. Meghir and Phillips 2010 and Kosonen 2013).

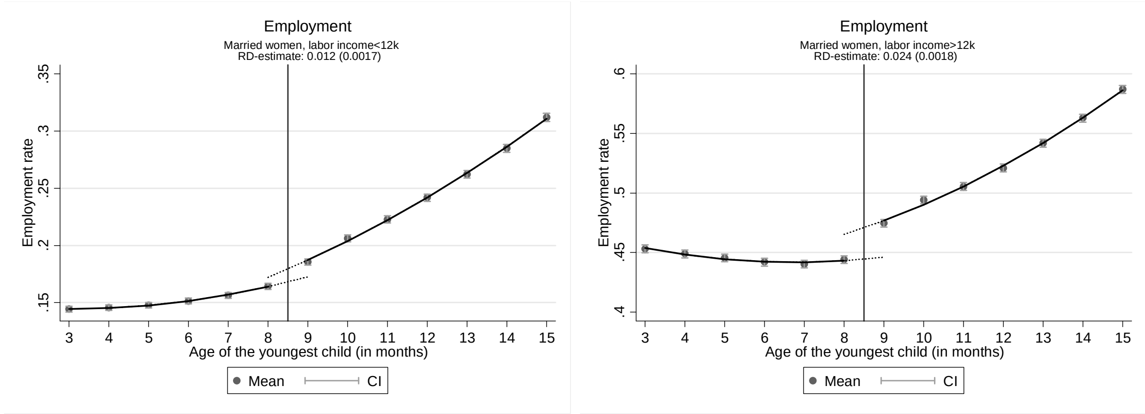
[17]The participation elasticity is $\varepsilon_P = (\partial E/E)/(\partial(w - T(w) - T(0))/(w - T(w) - T(0))$ where E is the employment rate, $T(w)$ is taxes on gross wage income w when participating in labor force, and $T(0)$ denotes the net of social benefits available when not participating in labor force. Thus $(w - T(w) - T(0))$ denotes the difference in consumption between working $(w - T(w))$ and not working $(T(0))$. The participation elasticity is calculated using imputed values for w, $T(w)$ and $T(0)$. We predict annual wages for mothers of children aged 0-4 by regressing wages with exogenous characteristics (age, county of residence and education) for mothers of children aged 4-7 years, and who are employed for 12 months in a year. We predict the home care allowance for each mother by regressing the annual home care allowance with age, county of residence, education, other household income in the year before having the child and the number of children under 7 years of age for mothers with a youngest child aged 1-3, and who are not employed during the whole year. The amount of the parental leave benefit is calculated for each mother using income information in the year before giving birth. In addition, we assume for simplicity that married women are not entitled to any social benefits after the 36-month threshold when not participating in labor force. In general, this approach is likely to generate a lower bound for ε_P at the 36-month threshold. The participation tax rates are calculated using the SISU-microsimulation model and the tax law of the year 2005.

Child care benefit institutions are very salient in Finland. Both the parental leave benefit and home care allowance need to be applied for, and mothers can observe the amount of the subsidy paid every month. In addition, the Social Insurance Institution sends a pre-notification to mothers indicating the ending date of the child care benefit period. Thus unawareness is generally not an issue with child care benefits, and married women appear to respond to these salient local changes in incentives.

We characterize the significance of the ability to respond and the size of the incentive by dividing mothers into subsamples. First, we divide mothers into two groups based on labor income they earn before the birth of the child. We hypothesize that women who were employed before in a regular job are more able to respond to participation incentives, as they can simply return to their previous employment when there is a sharp change in incentives. Finnish labor regulation guarantees that employers cannot discharge a mother with a permanent employment contract who takes care of her child at home, provided that the youngest child is under 3 years old.

Figure 14 shows the employment rates for mothers with more or less than 12,000€ of labor income in the year before the birth of the child. We focus on the 9-month threshold because both groups have similar possibilities to apply for the home care allowance and stay at home after the parental leave ends. Thus we can focus more sharply on the combined effect of the ability to respond and the change in participation incentives, compared to the 3-year threshold where all eligibility to child care benefits end, and many married mothers are not eligible for *any* social benefits when unemployed.

Figure 14 shows that for both groups there is a jump in the employment rate at the threshold, but the jump is more distinctive for women with previously higher labor income. This indicates that the ability to respond affects the participation effect. It is also important to note that the level of average employment is lower for women with lower income before having the child. The high average employment rates in the data for women with very small children (e.g. 3 months) and who were previously employed are due to the fact that a pension insurance spell is still continuing for some mothers even if they are on parental leave.



Notes:

CI = 95 % confidence interval. Fitted lines on both sides of the threshold are estimated using a 2nd-order polynomial function.

Figure 14: The effect of parental leave eligibility on employment: lower labor income (left), higher labor income (right)

In general, having higher income or a permanent job also translates into a larger jump in the participation tax rate when the eligibility for child care benefits ends. The difference between parental leave benefits and home care allowance is smaller for low-income women, which causes a smaller change in participation incentives at the 9-month threshold, compared to high-income women (see Figure 3 in Section 2). This is mainly caused by the parental leave benefit being based on past earnings. Thus this might also partly explain the difference in responses in Figure 14 above.

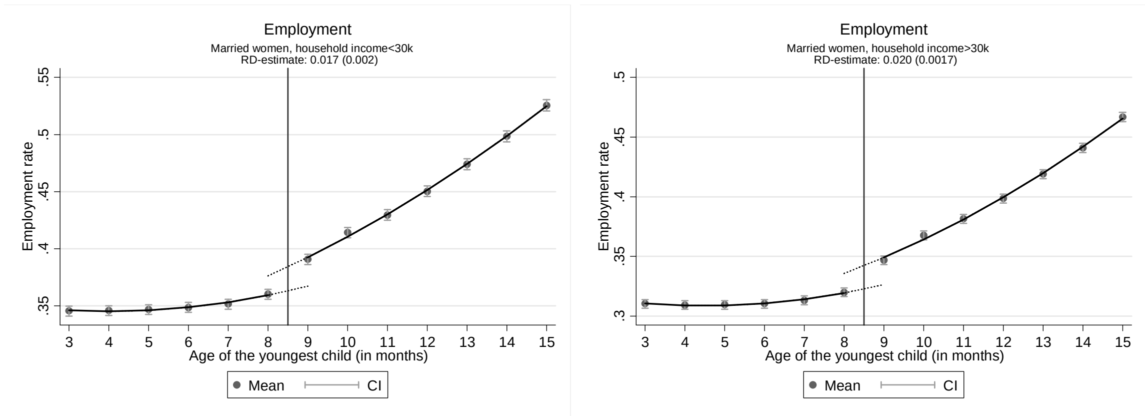
This is also supported by the implied participation elasticities. The participation elasticity for women with low labor income is 0.125 at the 9-month threshold, and 0.029 for women with high labor income before having the child. This means that the relatively small jump in average employment translates to larger ε_P for lower income women because of the smaller jump in participation incentives. In contrast, larger jump in employment results a smaller ε_P for high-income women because of larger change in participation incentives. However, we are not able to unambiguously infer that high-income women have smaller elasticities, as the estimated employment effect only measures the lower bound response especially for women who were previously employed in a permanent job.

To further study the effect of the size of the incentive at the 9-month threshold, we look at the employment of mothers with different levels of other household income (other disposable income of the household). Household income affects the means-tested part of the home care allowance. In general, families with high household income are not entitled to the means-tested part of the home care allowance, while families with lower household income can get an addition to the home care allowance of over 180€ per month.[18] Thus with other things being equal, mothers with low household income receive, on average,

[18] In addition to household income, the means-tested part depends on the number of children who are taken care of at home.

larger home care allowance compared to women with high household income.

Figure 15 shows the employment rates of mothers with more or less than 30,000€ of other household income before the birth of the child. There is only a small difference in the response for these groups. Furthermore, there is only a relatively small difference in the participation elasticities. The implied participation elasticity is 0.044 for low household income women, and 0.076 for high household income women. These imply that the pure size of the incentive is not fully driving the results before, and that the inability to respond to sharp changes in incentives might be an important behavioral friction. Nevertheless, our analysis shows that the overall size of the incentive does matter, as women in all groups respond to sharp changes in labor participation incentives.



Notes:

CI = 95 % confidence interval. Fitted lines are estimated using a 2nd-order polynomial function.

Figure 15: The effect of parental leave eligibility on employment: lower household income (left), higher household income (right)

Figures 18 and 19 in the Appendix show the same divided sample analysis at the 36-month threshold where eligibility to home care allowance ends. The results are similar as above. Firstly, women with higher labor income in the year before giving birth react a bit more distinctively at the margin, which indicates that individuals respond when frictions (inability to respond) are smaller. The participation elasticities are 0.278 and 0.287 for these groups at the 36-month limit, respectively. Secondly, there is only a small difference in the employment response between women with higher or lower other household income, which suggests that the pure size of the home care allowance is not fully explaining the ability outcomes before. The participation elasticities are 0.272 for the low household income group, and 0.316 for the high household income women.

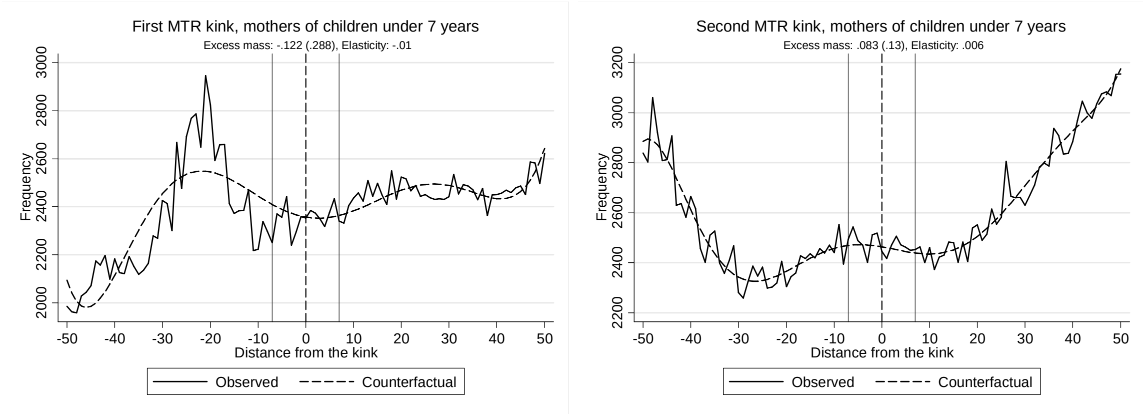


Figure 16: Bunching at MTR kink points: Mothers of young children

Finally, there is a clear difference between the responses to marginal tax rate kinks and the participation tax rates. Figure 16 shows that women with small children do not respond to local changes in marginal tax rates. The Figure shows the income distributions around the first and second MTR kink for mothers with children under 7 years. The same result holds for all the kinks, and also for married or single mothers with older or younger children and married or single women with no children at all. This evidence implies that married women with small children are more responsive at the extensive margin of labor supply. This result is widely acknowledged in previous labor supply literature (Meghir and Phillips 2010). However, this response might be driven by the higher awareness of incentives related to extensive margin decisions, and also by the higher ability to respond to extensive margin incentives compared to intensive margin working hours decisions.

7 Discussion

We study the role of different optimization frictions which prevent some taxpayers from reacting to tax incentives in a manner implied by the underlying structural elasticity. We utilize different institutional features when studying the anatomy of optimization frictions. We compare the behavioral effects induced by different incentives within the same institutions and subpopulations. We use bunching and regression discontinuity methods in order to produce clear and visually convincing evidence.

We find no bunching at kink points of the marginal income tax schedule. This result holds for any subgroup we study, and for kink points of any size in any year. Our results point to the direction that inability to respond is not fully driving the negligible bunching at kink points. Based on the evidence from entrepreneurs and university students, kink points do not induce responses even though these groups are clearly able to affect their reported income or labor supply in other similar situations (round numbers and study subsidy notches). This suggests that either unawareness or low elasticity explains the no bunching at kink points, at least for entrepreneurs and students.

The evidence from the study subsidy notch implies that individuals react to strong enough tax incentives even when the ability to respond is attenuated. We also see an increase in bunching behavior over time, which implies that some (but not all) individuals overcome the inability to respond. We also find a clear response to the salient and sharp changes in labor participation incentives for women with young children. Analysis with our current data also tentatively suggests that higher ability to respond increases behavioral responses, which denotes that absent frictions, we observe a clear response to large incentives.

Our results point to the following implications: First, if frictions related to unawareness do not decrease over time, the structural elasticity is close to the observed behavioral responses at kink points. This would indicate low or even zero elasticity of taxable income, at least locally around kinks. Second, when individuals are aware of incentives that are strong enough, we observe clear behavioral responses. However, our empirical evidence suggests that these responses are attenuated by the inability to respond, and that the underlying structural elasticity might be somewhat larger than the observed one. In future work, we aim at a more careful distinction between different frictions by using a population-wide and even more detailed register data.

Finally, our analysis implies that not all tax incentives are similar because of different institutional characteristics. For example, income transfers and tax credits paid out in cash differ from withholding income taxes, as transfers and cash credits give arguably a more clear picture of financial incentives. Thus there might be a relevant behavioral asymmetry between theoretically symmetric tax instruments, which is important to take into account in welfare and optimal income tax analysis.

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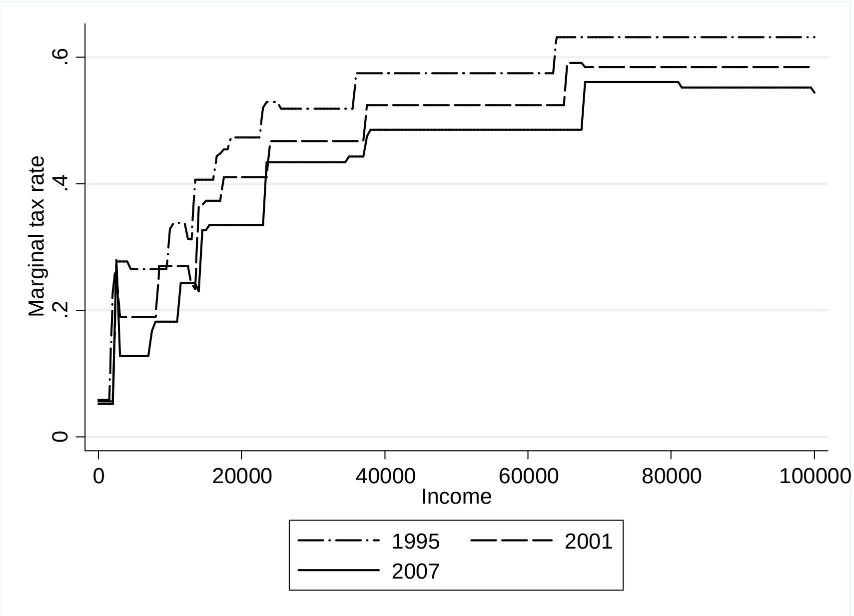
Appendix

Year	Taxable income	Marginal tax rate	Year	Taxable income	Marginal tax rate
1995	7 063-9 754	7	*2001*	11 100-14 296	14
	9 754-12 110	17		14 296-19 678	18
	12 110-17 155	21		19 678-30 947	24
	17 155-26 910	27		30 947-54 661	30
	26 910-47 934	33		54 661-	37
	47 934-	39	*2002*	11 500-14 300	13
1996	7 232-9 923	7		14 300-19 700	17
	9 923-12 278	17		19 700-30 900	23
	12 278-17 492	21		30 900-54 700	29
	17 492-27 415	27		54 700-	36
	27 415-48 774	33	*2003*	11 600-14 400	12
	48 774-	39		14 400-20 000	16
1997	7 568-10 259	6		20 000-31 200	22
	10 259-12 782	16		31 200-55 200	28
	12 782-18 164	20		55 200-	35
	18 164-28 592	26	*2004*	11 700-14 500	11
	28 592-50 456	32		14 500-20 200	15
	50 456-	38		20 200-31 500	21
1998	7 737-10 428	6		31 500-55 800	27
	10 428-13 119	16		55 800-	34
	13 119-18 500	20	*2005*	12 000-15 400	10,5
	18 500-29 096	26		15 400-20 500	15
	29 096-51 466	32		20 500-32 100	20,5
	51 466-	38		32 100-56 900	26,5
1999	7 905-10 596	5,5		56 900-	33,5
	10 596-13 455	15,5	*2006*	12 200-17 000	9
	13 455-18 837	19,5		17 000-20 000	14
	18 837-29 601	25,5		20 000-32 800	19,5
	29 601-52 466	31,5		32 800-58 200	25
	52 461-	38		58 200-	32,5
2000	8006-10 697	5	*2007*	12 400-20 400	9
	10 697-13 623	15		20 400-33 400	19,5
	13 623-19 005	19		33 400-60 800	24
	19 005-29 937	25		60 800 -	32
	29 937-52 979	31			
	52 979-	37,5			

Table 1: Central government marginal income tax rates, 1995-2007



Note: Marginal tax rate includes central government income taxation, average municipal income tax rates and social security contributions. Marginal tax rates include the effects of automatic deductions and tax credits on the marginal tax rates.

Figure 17: Average marginal tax rates (MTR) for earned income, years 1995, 2001 and 2007

Study subsidy months	Income limit	Relative income loss at the margin if income limit is exceeded
1	17,340	3.1%
2	16,330	3.2%
3	15,320	3.5%
4	14,310	3.7%
5	13,300	4.0%
6	12,290	4.3%
7	11,280	4.7%
8	10,270	5.2%
9	9,260	5.7%

Note: The relative loss from marginally exceeding the income limit is calculated using the full study subsidy (461 euros) plus 15% interest.

Table 2: Income limits in the study subsidy system and the relative marginal loss if the limit is exceeded (in proportion to gross income at the limit), academic year 2006/2007

Variable	N	Mean	Std. Dev.	Min	Max
Taxable earned income	3,116,040	20,892.73	28275.61	0	1.88e+07
Gross earned income	3,116,040	24,726.47	29134.99	0	1.89e+07
Total taxable income	3,116,040	22,079.89	48116.18	0	3.35e+07
(earned+capital income)					
Age	3,127,819	42.06	9.4572	25	60
Female	3,127,819	0.50	0.5	0	1
Size of the household	3,105,782	3.56	1.645	1	25
Marginal tax rate	3,127,340	0.393	0.1328	0	0.668

Table 3: Summary statistics, all taxpayers aged 17-70, register data 1995-2007

All students (>20y)	N	Mean	SD	Min	Max
Taxable income	187,351	6,783.4	4616.304	0	85,302.1
Earned income	187,351	7,537.9	5129.77	13	92,017.6
Age	198,683	25.1	6.339387	20	65
Years studied	198,683	3.4	2.212307	0	9
Subsidy months	167,103	7.1	2.833617	1	12
Gross income (subject to income limit)	187,351	6068.937	5449.999	0	99,036
Income limit	198,683	9361.82	4848.61	0	17,340
Students with 9 months of study subsidy (>20y)	N	Mean	SD	Min	Max
Taxable income	54,613	6,069.6	3399.075	0	59,775
Earned income	54,613	6,780.4	3770.996	39	61,036.24
Age	54,619	23.95	4.60524	20	64
Years studied	54,619	4.2	1.974525	0	9
Gross income (subject to income limit)	54,613	4,841.5	3898.573	0	74,608.4

Table 4: Summary statistics, students aged over 20 years, register data 1998-2007

Women (16-55y)	N	Mean	SD	Min	Max
Earned income	3,374,832	20,952	13833	0	200,000
Household disposable income	3,364,249	37,023	22032	0	199,990
Employment (monthly)	41,045,916	.66	.47	0	1
Age	3,420,493	38.8	10.5	16	55
Age of the youngest child	1,837,041	9.0	6.9	0	38
Home care allowance (year-level)	3,420,493	0.10	.3	0	1
Parental leave (year-level)	3,420,493	0.07	.27	0	1

Table 5: Summary statistics, all women aged 16-55, FLEED data 2001-2009

Women (16-55y)					
Year before giving birth	N	Mean	SD	Min	Max
Labor income	128,898	15,510	13,731	0	195,670
Employment (monthly)	740,294	.60	.49	0	1
Age	140,728	29.1	5.4	16	54
Youngest child 0-1 years					
Labor income	147,127	10,400	11,228	0	200,000
Employment (monthly)	1,929,979	.41	.4915691	0	1
Age	164,123	30.0	5.5	16	55
Youngest child 1-3 years					
Labor income	328,620	12,235	13,524	0	199,670
Employment (monthly)	2,926,252	.49	.5	0	1
Age	367,828	32.4	5.7	16	55
Youngest child 4-6 years	N	Mean	SD	Min	Max
Labor income	239,550	20,283	14642.07	0	199,900
Employment (monthly)	3,152,729	.69	.4618708	0	1
Age	25,3674	36.5	5.501021	18	55

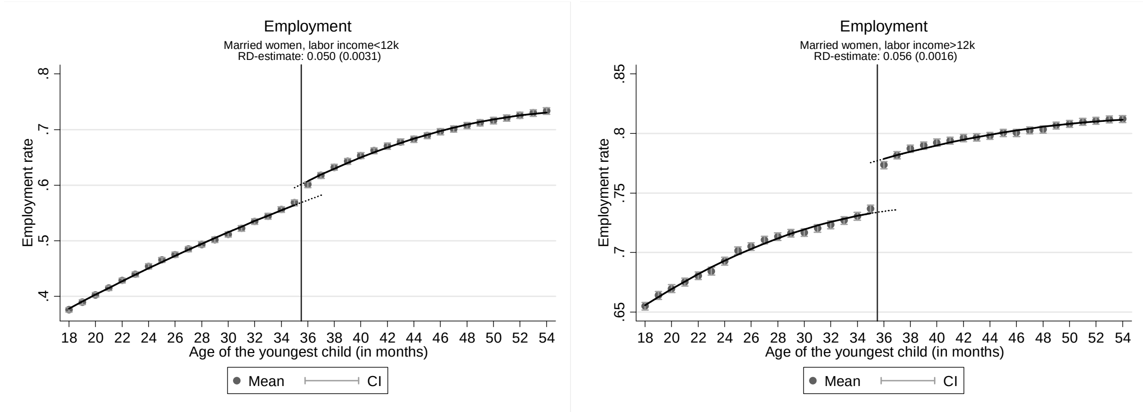
Table 6: Summary statistics, women with different aged youngest child, FLEED data 2001-2009

Age of the child, months	All women	Labor income before giving birth		Other disposable income of the household	
		Over 12,000	Under 12,000	Over 30,000	Under 30,000
12	53.6	37.3	70.1	54.2	47.5
18	47.2	31.3	63.1	47.7	40.8
24	38.6	22.9	54.0	38.9	32.1
30	32.4	17.8	46.5	32.7	26.3
36	21.0	9.1	32.3	20.9	15.6
n (24 m)	118,607	58,767	59,840	57,449	22,008

Age of the child, months	Education			Workplace	
	Tertiary	Primary or secondary	No educ. or missing	Same job (when child 4y)	Different job (when child 4y)
12	36.0	54.5	72.5	36.0	28.7
18	29.2	47.6	68.0	28.7	24.6
24	20.9	38.4	60.9	18.8	19.0
30	15.9	32.1	54.0	14.9	14.8
36	9.2	19.7	39.1	4.5	10.3
n (24m)	15,428	69,853	8,797	11,012	12,193

Note: Monthly home care allowance is approximated using year-level data. A woman is approximated to receive home care allowance if she does not have a job in the data and if monthly home care allowance is over 100 euros and the youngest child is under three years of age.

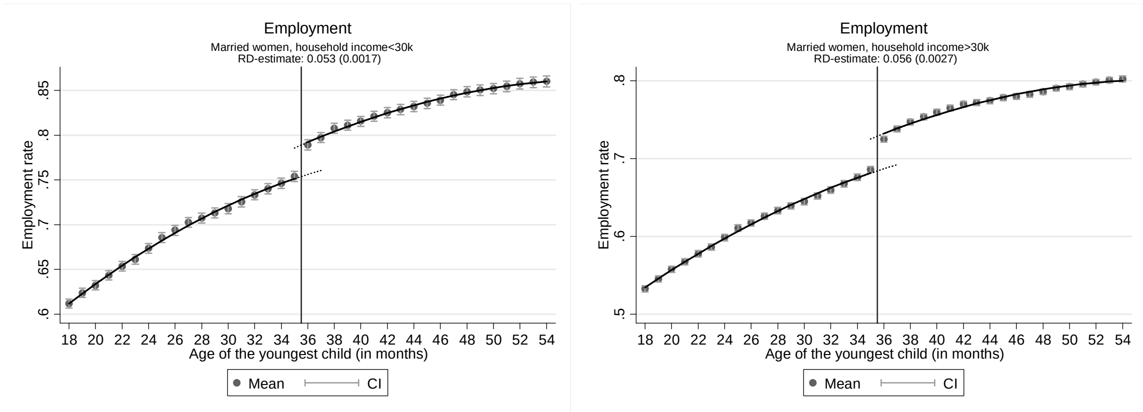
Table 7: Summary statistics, the share of women receiving home care allowance in different subgroups, FLEED data 2001-2009



Notes:

CI = 95 % confidence interval. Fitted lines are estimated using a 2nd-order polynomial function.

Figure 18: The effect of home care allowance eligibility on employment, 2001-2009: lower labor income (left), higher labor income (right)



Notes:

CI = 95 % confidence interval. Fitted lines are estimated using a 2nd-order polynomial function.

Figure 19: The effect of home care allowance eligibility on employment, 2001-2009: lower household income (left), higher household income (right)