Estimating the taxable income elasticity at kink points of the Swedish tax system

Spencer Bastani*

and

Håkan Selin*

Preliminary Draft

2011-06-14

Abstract. If taxes distort individuals' taxable income supply we should observe an excess mass (bunching) of taxpayers at convex kink points of the budget constraint. Following Saez (2010), a growing literature in empirical public finance estimates behavioural elasticities by studying empirical taxable income densities at kink points. Using high-quality Swedish register data spanning 1991-2002 the present paper adopts this methodology to estimate the compensated taxable labor income elasticity. During the time period of study the Swedish tax system featured a large, salient and fairly stable kink, where the marginal tax rate increases by 20-25 percentage points. Interestingly, we find no statistically significant excess mass at the kink point among wage earners. In the absence of optimization frictions and adjustment costs, this finding is consistent with a compensated taxable labor income elasticity of zero. In contrast, there is clear evidence of bunching at this large kink for the self-employed. Nonetheless, the implied elasticities are small generating estimates in the range 0.04-0.06 for the benchmark model.

Key words: The elasticity of taxable income, labor supply, bunching.

JEL-codes: H24; J22.

***Uppsala Center for Fiscal Studies at the Department of Economics, Uppsala University, SE-751 20 Uppsala, Sweden. Email: spencer.bastani@nek.uu.se and hakan.selin@nek.uu.se.**

1. Introduction

The elasticity of taxable labor income with respect to the net-of-tax rate ('the taxable income elasticity') is under some conditions a sufficient statistic for the deadweight loss generated by the income tax system (Feldstein 1999, Chetty 2009) and a key parameter for assessing the optimality of the income tax system (Saez 2001). Seminal contributions by Lindsey (1987) and Feldstein (1995) paved the way for a large amount of subsequent research on the estimation of the taxable income elasticity, a literature that recently has been surveyed by Saez et al (2010). The most common approach in the literature is to exploit income tax reforms that treat different income groups differently and to recover the taxable income elasticity by relating changes in marginal tax rates to changes in income growth for different categories of taxpayers (typically by using individual level panel data). This approach requires that the econometrician is able to control for the differential trends in income growth that would appear regardless of the income tax reform.

Saez (1999, 2010) develops a new and interesting method for estimating the taxable income elasticity. Saez departs from a clear prediction from the standard labor supply model[1]: Given that preferences are convex and smoothly distributed in the population, we should observe an excess mass (bunching) of taxpayers at convex kink points, i.e. points at the income tax schedule where the marginal tax rate increases. Saez demonstrates that the compensated taxable income elasticity at a given income level, $z*$, is proportional to the number of individuals who bunch at the kink point. Therefore, if one is able to credibly estimate the excess mass at $z*$ (which, of course, involves estimating the density at $z*$ in the absence of a kink) one should also be able to recover the compensated taxable income elasticity. Here, the

[1] The standard static labor supply model can be generalized to a model for taxable income. In the labor supply model the individual equates the marginal disutility of work and the marginal net-of-tax hourly wage rate in optimum. In the taxable income model the individual instead supplies taxable income until the marginal disutility of supplying taxable income is equal to the marginal net-of-tax rate (1-marginal tax rate). The taxable income elasticity captures more margins than hours of work (e.g. effort per hour, tax avoidance and tax evasion).

methodological challenge is to estimate the counterfactual income distribution locally around $z*$.

The purpose of this paper is to estimate the taxable income elasticity on individual level tax register data for the total Swedish population 1998-2005 in the spirit of the 'bunching methodology'. We believe that the Swedish system exhibits features that are particularly interesting from the perspective of bunching estimation. *First, the Swedish tax system has been quite stable through a large number of years.* With some modifications, the basic structure of the income tax system has been the same since 1991, when dual income taxation (i.e. separate taxation of earned income and capital income) was introduced and the number of brackets of the central government tax schedule was reduced in 'the tax reform of the century' (see below). At the same time inflation has been low. As one can expect knowledge about the tax system to diffuse slowly in the population, we should be more likely to find bunching at kink points if the design of the tax system has been similar for a long period of time – a point made by Saez (2010). *Second, ever since 1991 there is a large and salient convex kink at the income level where the central government tax kicks in.* At this kink the marginal tax rate increases by 20-25 percentage points during the period of study[2]. We concentrate on this large and salient kink of the central government tax schedule. At this income level we obtain an estimate of the compensated taxable labor income elasticity of zero for wage earners and a significant but small elasticity in the range 0.04-0.06 for the self-employed. The results are similar for the periods 1991-1994, 1995-1998 and 1999-2002.

A novel feature of our paper, as compared to the previous literature, is that we investigate the predicted behavioral responses by simulating earnings distributions under different assumptions about the magnitude of the taxable income elasticity. In this way, we obtain a tool to make visual comparisons of the excess mass implied by

---

[2] Third, this kink of the central government tax schedule has been fairly isolated within the income distribution (adjacent kink points lie far away to the left and right) which is helpful in the estimation process.

certain value of the taxable income elasticity and the actual amount of bunching. When simulating the earnings distribution, for each value of the elasticity parameter, we calibrate a skill parameter so that the simulated earnings distribution resembles the actual earnings distribution.

By virtue of its transparency and its reliance on within-year variation (variation in marginal tax rates at a given earnings level is of often low between years whereas differences in marginal tax rates across two segments is sometimes high in progressive tax systems), the bunching method has recently gained popularity in the empirical public finance literature.

In an attempt to reconcile the discrepancy between 'micro' and 'macro' labor supply elasticities, Chetty et al (2010) set up a model with endogenous hours constraints and search costs. While the 'micro' and 'macro' elasticities are similar in the absence of search costs, they can differ quite substantially in the presence of search costs. Chetty et al (2010) test the predictions of the model on Danish individual level tax register data 1994-2001 by using the bunching method. In particular, they exploit the kink where the 'top tax' kicks in and the net-of-tax rate falls by 30 percent. Chetty et al also refines the estimation framework proposed by Saez (2010): While Saez made the approximation that the contra factual income distribution is uniform locally around the kink Chetty et al estimates the curvature of the income distribution locally around the kink. Chetty et. al. find very small taxable income elasticites (albeit statistically distinct from 0) . For the whole population of wage earners they estimate an elasticity of around 0.01. Interestingly, the elasticity for married women is estimated to be larger, approximately 0.02. The authors reason along the lines that elasticity estimates for wage earners are attenuated downwards owing to optimization frictions. The elasticity for the self-employed, on the other hand, is estimated to be 0.24 (at the largest kink). An important lesson from Chetty et al is that even individuals who are unaffected by a kink bunch there in Denmark. The reason is that the employers cater the wage-hours packages to satisfy the tax preferences of the majority of wage-earners in a certain occupation, a phenomenon they call 'aggregate bunching'.

The bunching method has recently also been used by Kleven et al (2010) who analyze a tax enforcement field experiment in Denmark. The experiment both involved randomized audits and randomly assigned threat-of-audit letters. While the authors find no effect on income reporting among employees (whose incomes are subject to third party reporting) they find substantial effects on self-reported income (i.e. income reported by self-employed individuals). In similarity with Chetty et al (2010), Kleven et al exploit the kink in the Danish income tax schedule where the 'top tax' kicks in.[3] They compare the excess mass at the kink before and after the treatment, a procedure that allows them to estimate the evasion elasticity, where the evasion elasticity is defined as the difference between the pre-audit taxable income elasticity and the post-audit taxable income elasticity.[4] For taxable income Kleven et al obtain a pre-audit elasticity of 0.16 and a post-audit elasticity of 0.085. In a similar vein, Chetty and Saez (2010) compares bunching at the first EITC kink before and after an experiment (providing taxpayers with information about the EITC).

2. Derivation of Bunching Formula

Consider a situation where each individual maximizes the quasi-linear utility function $U(c,z)=c-g(z)$ subject to the budget constraint $c=z-T(z)+m$, where c is consumption, z is taxable income, $T(z)$ is the income tax function and m is non-labor income. To illustrate the predicted behavior at kink points in the simplest way, suppose a pre-reform situation where individuals' taxable income are distributed according to a smooth density function $h_0(z)$ and all individuals face a proportional tax schedule with a single marginal tax rate, $T(z)=\tau_1 z$. Suppose now that a kink is introduced at an earnings level z^*, so that for income $z \geq z^*$ the tax rate $\tau_2 > \tau_1$

[3] They also exploit a kink point in the tax schedule for dividend income.

[4] Unlike Chetty et al (2010), Kleven et al do not appear to estimate the curvature of the contrafactual density.

applies. Denote the density function for the post-reform earnings distribution by $h(z)$. The hypothetical reform will have the following consequences:

(1) The earnings distribution to the left of z^* is unaffected, $h(z) = h_0(z)$.

(2) Individuals who before the reform reported taxable incomes with $z > z^*$ will reduce their earnings in response to the tax increase.

(3) We will observe a spike in the income distribution. A certain number of individuals, $B = \int_{z^*}^{z^*+\Delta z^*} h_0(z)dz$, will move to z^* where $[z^*, z^* + \Delta z^*]$ is the interval of taxpayers who choose to locate at the kink after the reform.

In the tradition of Feldstein (1995) we define the compensated taxable labor income elasticity, *locally at* z^*, as

$$\tilde{e}(z^*) = \frac{\textit{percentage change in } z^*}{\textit{percentage change in } (1-\tau)} = \frac{\Delta z^*}{z^*} \bigg/ \frac{\Delta(1-\tau)}{(1-\tau_1)} \quad (1)$$

Unless one is willing to impose further assumptions on the structure of preferences and abilities $\tilde{e}(z^*)$ cannot be given a structural interpretation. The number of individuals who bunch at the kink point is

$$B(\Delta z^*) = \int_{z^*}^{z^*+\Delta z^*} h_0(z)dz = \Delta z^* h_0(\xi) \quad (2)$$

for some $\xi \in \left[z^*, z^* + \Delta z^*\right]$ by the mean value theorem of integration calculus. Plugging (2) into (1) and rearranging gives

$$\tilde{e}(z^*) = \frac{B(\Delta z^*)}{z^* \times h_0(\xi) \times \frac{\Delta(1-\tau)}{(1-\tau_1)}} \quad (3)$$

For small tax changes ($\Delta\tau = d\tau$ and $\Delta z^* = dz^*$) the number of individuals who bunch is $B(dz^*) = dz^* h_0(z^*)$. Thus, we have that

$$\lim_{\Delta\tau,\Delta z^* \to 0} \tilde{e}(z^*) = e(z^*) = \frac{dz^*}{d(1-\tau)} \frac{(1-\tau)}{z^*} = \frac{B(dz^*)}{z^* \times h_0(z^*) \times \log\left(\frac{1-\tau_1}{1-\tau_2}\right)} \tag{4}$$

where e is the 'structural' compensated elasticity of taxable income. In (4) z^* and $\log\left(\frac{1-\tau_1}{1-\tau_2}\right)$ are directly observable, while B and $h_0(z^*)$ need to be estimated. Hence, given that B and $h_0(z^*)$ can be identified, the above method non-parametrically identifies e when the kink point is small. Note that the number of individuals who bunch at the kink is proportional to the compensated elasticity locally at z^*.[5]

The key methodological challenge involved in estimating B is to estimate a contra-factual income density at z^*. In this version of the paper we follow the procedure in Saez (2010) and simply use the actual income distribution to the left and to the right of z^* to infer the counterfactual distribution $h_0(z^*)$ locally around z^* (where it is not observed). This procedure has some disadvantages. One such disadvantage is that the density to the right to the kink is transformed by the reform so that $h(z^*)_+ \neq h_0(z)$. Those who bunch move from the right of z^* to the kink, and there has been an inflow of individuals from the right of $z^* + \Delta z^*$. Another potential problem is that the above procedure assumes that the underlying distribution has a trapezoid shape, which might cause bias if in fact the distribution is curved, something which is more likely to happen for large tax reforms, or equivalently if Δz^* is large. Therefore, in future versions of the paper we plan to use alternative

[5] As shown by Saez (2010) this also holds true when elasticities differ between individuals at a given income level. Then (4) identifies the average elasticity at z^*.

procedures, including the iterative estimation procedure proposed by Chetty et al (2010).

A separate issue is that with optimization frictions, excess mass will be spread throughout an interval centered around the kink. Based on visual inspection of the income distribution, Saez (2010) chooses a bandwidth δ and then compares the mass of $h(z)$ over an income band of width 2δ centered at the kink, with the mass in the two surrounding income bands of width δ. In general, it is hard to quantify an appropriate value of δ without specifying how individuals deviate from their optimal income choices. The parameter δ must be chosen to capture exactly those individuals representing a true behavioral response to the tax system. Picking δ too small will underestimate bunching and the corresponding elasticity, whereas picking it too large will overestimate bunching[6].

3. Kinks of the Swedish income tax schedule 1991-2010

The basic structure of the Swedish statutory income tax system, which to a large extent is a result of the comprehensive 1991 reform, is simple. A proportional local tax rate applies to all earned income and taxable transfers. The mean local income tax rate in 2010 is 31.56 %, with a minimum rate of 28.89 (Vellinge), and a maximum rate of 34.17 (Ragunda). The proportional local tax rate has been fairly constant during the period of study. Since the 1991 dual tax reform capital income is taxed separately from total labor income according to a proportional tax rate of 30 %. For total labor incomes above a certain threshold (SEK 384,200 in 2010), the taxpayer also has to pay a central government income tax. This creates a large and salient convex kink in the individual's budget constraint, where the marginal tax rate increases by 20 percentage points. Technically, the location of the kink is

---

[6] A drawback of this approach is that it is valid only if $h_0(z)$ is flat around the kink point (e.g. uniformly distributed). Chetty et al (2010) control for curvature by fitting a polynomial of order q to the earnings distribution but the issue of choosing an appropriate bandwidth remains an open question also in their work.

affected by the size of the “basic allowance” (the income level at which individuals start paying taxes) and the employee’s social security contributions.

As a general rule, the kink points of the central government are ‘protected’ against general real wage growth through indexation.[7] Each year, the kink points are adjusted upwards by the inflation rate plus 2 percentage points. However, in practice legislators have made small year-to-year deviations from this rule during the period of study. The kinks, expressed in nominal values of SEK, of the central government tax schedule of year *t* are legislated by the parliament by the end of year *t-1*. [8] Thus, information on the segment limits is publicly available to taxpayers before the start of the tax year.

Figure 1 provides information on the evolution of the central government tax schedule 1991-2010. In 1991-1998 the central government marginal tax schedule only contained two brackets, which implies that there was only one kink point, where the marginal tax rose from 0 to 20 %. From 1999 and onwards this schedule brings about two kink points; the marginal tax rates in each bracket are 0, 20% and 25%. When only considering the personal income tax the top marginal tax rate on earned income is 56.56 % (in the year 2010).

In 2007, 20 % of the population aged over 20 were liable to the central government income tax, whereas six per cent of the population faced the top marginal tax rate. The thresholds for the central government income tax have increased in real terms during the last couple of years (Table 2.3). In particular, the kink points in central government taxation were increased in 2009.

---

[7] See Skattestastisk årsbok 2010, p. 72 and the table at p. 92.

[8] The kink points are assessed in terms of price base amounts (PBA). The PBA for year *t* is set based on the price level of June of year *t-1*.

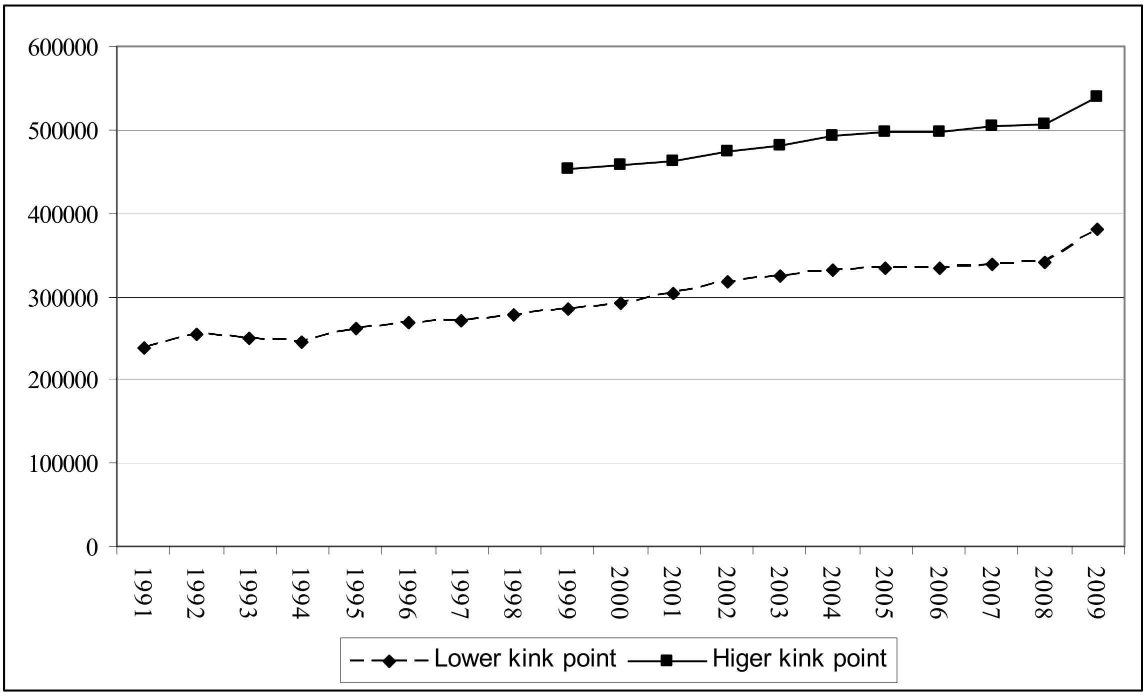

Figure 1. The lower central government kink point and the higher central government kink point 1991-2009, expressed in assessed earned income, inflated by the consumer price index. (2009 prices). The central government tax rate that applies to incomes over the lower kink (and below the higher kink) was 20 percent 1991-1994, 25 percent 1995-1998 and 20 percent 1999-. The tax rate that applies to incomes over the higher kink was 25 percent 1999-.

Before computing the individual's tax liability, a basic deduction is made mechanically by the tax authorities against the individual's assessed total labor income (the sum of earned income and social transfers). Since 1991 the basic deduction has been phased in at lower income levels and phased out at higher income levels with consequences for the marginal tax rate facing the individual in these income intervals. The basic deduction is phased in between SEK 42,000 and SEK 115,300 and phased out between SEK 131,000 to SEK 334,200 in 2010. The Swedish earned income tax credit, which applies solely to earned income, and not to taxable transfers, was introduced in 2007. The EITC reform marks a break with the longstanding Swedish tradition of taxing several types of social transfers together with earned income. In 2010 the EITC lowers marginal tax rates up to a level of earned income of SEK 334,200.The effective marginal tax rates facing the individual are also affected by means-tested transfer systems. The main bulk of the social security contributions are made by the employer through payroll taxes.

4. Simulating bunching for the 2002 tax system

To illustrate the magnitude of the bunching response predicted by the "standard model" we turn to a set of simulation exercises. To perform simulation we need an individual decision rule determining taxable income. Here we assume the individual decision rule $z = z_0(1-\tau)^e$ which follows from utility maximization of an iso-elastic utility function without income effects subject to a linear budget segment. For any distribution of potential earnings $f(z_0)$ we can use detailed knowledge of the Swedish tax system and a hypothesized elasticity e to simulate the distribution of taxable income $h(z)$. To specify $f(z_0)$ we adopt a procedure similar to what has been used in the optimal tax literature. Mirrlees (1971) interprets z as labor earnings and z_0 as a primitive parameter such as ability level or "skill" and then assumes a specific parametric distribution for $f(z_0)$. The empirical analogue, and the natural proxy for $f(z_0)$, is then the distribution of wage rates which is assumed to be fixed. Interpreting z more broadly as taxable income, the exogeneity assumption on $f(z_0)$ is no longer plausible. Recognizing this, to simulate optimal income taxes in the context of taxable income, Saez (2001) calibrates $f(z_0)$ so that utility maximization results in a distribution $h(z)$ which matches the empirical income distribution under the actual tax system. The difference between the two approaches is that in the former case there is a single elasticity consistent with the observed income distribution. To perform simulations we adopt the latter approach because we want to allow for different elasticities to be consistent with the observed income distribution. This requires us to be agnostic about the shape of the underlying distribution of potential income and adopt the aforementioned calibration procedure.

The purpose of the figures below is to illustrate the kind of behavioral response we should expect to find in the data for various values of the elasticity. The potential income distribution is represented by 100,000 samples from a lognormal distribution with a mean and variance consistent with the (inverted) empirical earnings distribution[9]. The simulated income distribution is found to fit the actual income distribution very well. In Figure 2-3 we report histograms for the elasticities e equal to 0.1 and 0.01 using a bin width of 1000 SEK.

As evident from the figure 2, even with an elasticity as low as 0.01, the model predicts sharp bunching at the large and salient convex kink point where the federal income tax is introduced but it is difficult to visually detect bunching at any other kink point. Hence, the simulations suggest that if the underlying elasticity is indeed as small as 0.01, large reforms are needed to detect bunching behavioral responses in the income distribution.

[9] The empirical earnings distributions is inverted to remove the effects of the current tax system. In the benchmark case with an elasticity of 0.1, the mean and variance are 218 000 SEK and 108 000 SEK respectively. It is often argued that the tail of the income distribution is more accurately captured by a Pareto distribution. However our focus here is not on that part of the income distribution.

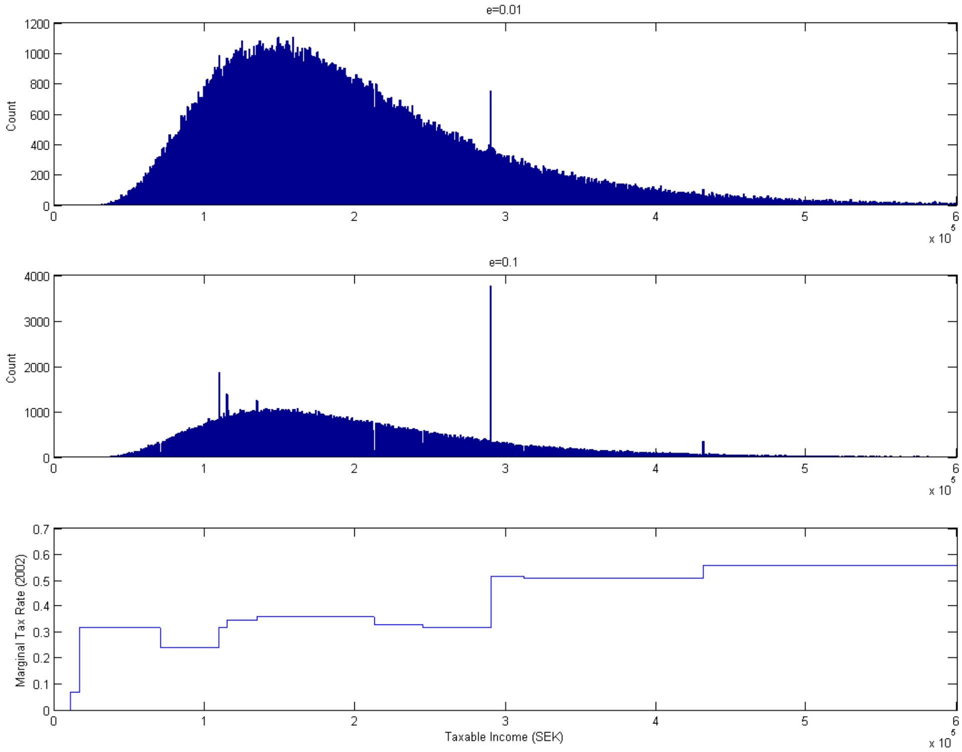

Figure 2. Simulated income distributions for an elasticity of e=0.01 (top panel) and e=0.1 (middle panel) under the Swedish income tax in 2002 (bottom panel). The large and salient federal income tax kink appears at an earnings level of 290,100 SEK generates a sharp prediction for the expected bunching response.

As mentioned previously, it is likely that individuals cannot perfectly control their incomes. As a first example, a worker might not be able to control exactly the number of days of work each year. To this end, suppose desired days of work for a given year is N, and the daily wage is w. If there is a probability p each week that the worker will deviate from the desired number of workdays per week by 1 day[10]

[10] A standard workweek in Sweden corresponds to five days, hence one day represents a weekly deviation of 20%.

then, assuming X weeks of work per year, observed days of work during one year will be

$$\widetilde{N} = N + pS$$

where S is a simple random walk defined as $S = \sum_{j=1}^{N/X} Z_j$ and Z_j is a random variable taking values in $\{-1,1\}$ with equal probability. Hence the induced variance of observed annual labor income is

$$Var[w\widetilde{N}] = Var[w(N + pS)] = (wp)^2 (N / X)$$

We use this structure to explain optimization errors in taxable income. Since $\widetilde{N}$ will be approximately normally distributed, if desired annual income is z^*, observed taxable income can be defined as

$$\tilde{z} = z^* + \varepsilon$$

where $\varepsilon \sim \mathrm{N}\left(0, wp\sqrt{N / X}\right)$.

Below we present simulations using $N / X = 40$, $p = 0.15$ and a mean daily wage of $w = 1200$. This translates into a standard deviation of observed annual income of approximately 1000 SEK.

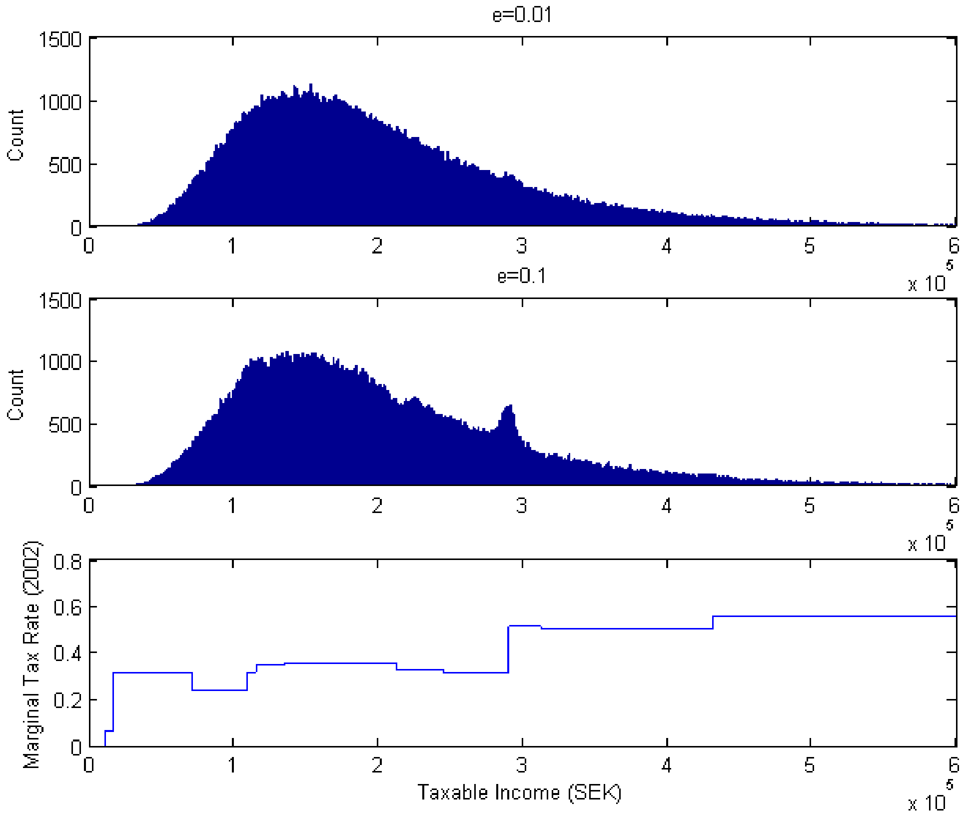

Figure 3 Simulated income distributions for an elasticity of e=0.01 (top panel) and e=0.1 (middle panel) under the Swedish income tax in 2002 (bottom panel) now with a Gaussian optimization error. The large and salient federal income tax kink appears at an earnings level of 290,100 SEK and generates a hump-shaped excess density. For e=0.01, the bunching is no longer distinguishable due to the noise generated by the optimization errors.

As is clear from figure 3, in the presence of optimization errors, it is difficult to visually detect excess mass at the largest kink when the elasticity is 0.01. For an elasticity of 0.1 we see that bunching is clearly visible but is now hump-shaped. Hence excess mass is now spread throughout an interval, depending on the variance of the optimization error.

5. Visual inspection of the real world taxable income distribution

After witnessing the kind of bunching behavioral responses we should expect to see in the data we visually inspect a series of histograms based on detailed tax register data over the period 1991-2002. In figure 4 we show the income distribution in 2002 which is the empirical counterpart of the simulated response presented in figures 2-3 which also used the 2002 tax system. We follow the convention to analyze wage earners and self-employed separately as we believe these groups have fundamentally different degrees of control over their taxable income[11]. Judging from figure 4 we find for wage earners no clear evidence of bunching at any kink point of the tax system. In particular at the first central government kink where the response is expected to be most visible the density looks surprisingly smooth. There are two visible spikes though – one large at SEK 76 896 and one considerably smaller at SEK 70,272 – at the bottom part of the taxable income distribution. To understand these spikes one should note that taxable income includes both taxable transfers and wage income. These two spikes relate to fixed compensation amounts of the public pension system (for singles and married individuals, respectively) and do not reflect a behavioural response of the kind we are interested in here.

This is also evident from 5 where we have zoomed in and centered the histogram at this kink point. For self-employed on the other hand there is very sharp bunching at the central government kink suggesting that this group knows the location of the kink point and face small or zero optimization errors. There is also a spike in the taxable income distribution at exactly SEK 180,000. At present, we cannot rule out that this spike reflects a behavioural response. Note however that the absence of any bunching behavioral response for wage earners implies that the underlying elasticity is zero only when the optimization error is zero, as a small

[11] We define self-employed as individuals who reported positive self-employment income or were registered as a partner in a small business.

variance on the optimization error is sufficient to flatten an income distribution, even if the distribution displays bunching in the absence of errors.

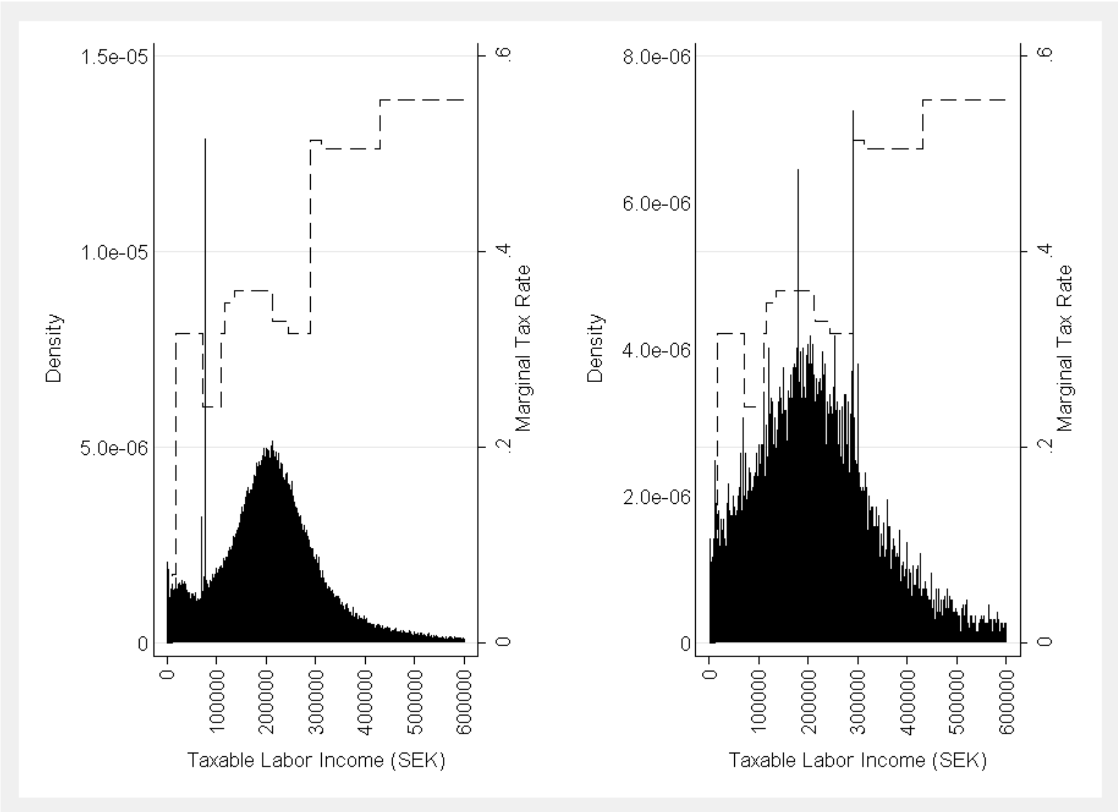

Figure 4 Actual income distribution for wage earners (left graph) and self-employed (right graph) in 2002.

Pooling data over several years allows us to obtain smooth histograms. In Figure 4 we have graphed histograms for wage earners and self-employed, centered at the first central government kink point. We find no bunching for wage earners but a very clear spike for self-employed. This is perhaps not surprising taking into account that the self-employed are likely to have better control over their income.

To the extent a given kink point move over time, with repeated cross sections it is also possible to verify that any bunching found tracks the movement of the kink point over time. This strengthens the argument that bunching represents a true behavioral response and is not due to noisy histograms.

Figure 5 Histograms for wage earners and self-employed over the period 1991-2002 centered around the income level of the first central government kink point. Notably, there is no bunching for wage earners but a very clear spike in the earnings distribution for self-employed.

6. Empirical Strategy

Even though the basic structure of the Swedish tax system has been fairly stable during the period of study, the tax system has still undergone changes. This warrants us to partition the estimation sample into three separate time periods. In 1991-1994 there was only one bracket of the central government tax schedule. At the kink, where the central government tax kicked in, the marginal tax rate rose by 20 percentage points. Since the average local tax rate was around 31 %, the percentage change in the net-of-tax share was approximately 29.0 %.[12] 1995-1998 there was still only one central government tax brackets, but the tax rate increased by 5 percentage points. Accordingly, during this period the percentage reduction in the net-of-tax share was 36.2% at the kink. 1999-2002 the size of the kink was reduced to the 1991-1994 value.

The number of individuals who bunch is estimated by

$$\hat{B} = \hat{H}^* - (\hat{H}^*_+ + \hat{H}^*_-) \qquad (5)$$

where $\hat{H}^*$ is the estimated number of individuals who locate in the band $(z^* - \delta, z^* + \delta)$. The lower surrounding band, $\hat{H}^*_-$, is $(z^* - 2\delta, z^* - \delta)$ and the upper surrounding band, $\hat{H}^*_+$, is $(z^* + \delta, z^* + 2\delta)$. Following Saez (2010) we have estimated the share of individuals in each band (from all individuals belonging to any of these bands) by simultaneously regressing a dummy variable for belonging to each band on a constant in the sample of individuals belonging to any of those bands. We then obtain an estimate of the contrafactual density in the following way

$$\hat{h}_0(z^*) = \frac{\hat{H}^*_+ + \hat{H}^*_-}{2\delta} \qquad (6)$$

[12] Note that the percentage change in the net-of-tax rate is unaffected by pay-roll taxes and consumption taxes in the absence of a kink in the pay-roll tax schedule or consumption taxation exactly at the central government kink.

Plugging (5) and (6) into (4), gives an expression of an estimate of the taxable income elasticity. Since there are small year-to-year changes in $z*$ we use the mean-value of $z*$ for the relevant time period, e.g. for the period 1991-1994, when evaluating the elasticity. We calculate standard errors by the delta method.[13]

7. Results

Table 1 reports elasticity estimates, standard errors and the number of taxpayers in the bands $\hat{H}^*$, $\hat{H}^*_+$ and $\hat{H}^*_-$. Based on visual inspection of the taxable income distributions for the self-employed we find it natural to use $\delta = SEK10{,}000$ as a benchmark. When pooling all taxpayers, i.e. both wage earners and self-employed, we obtain a very small positive elasticity of 0.0035 for the time period 1991-1994 (reported in the upper panel of Table 1). When we decompose the sample into wage earners and self-employed we note that the response among wage earners is not significantly distinct from zero. Moreover, the zero response is precisely estimated, which is well in line with the graphical evidence presented in Section 5. Self-employed, on the other hand, exhibits a clear and significant response to the change in the marginal tax rate. Still, the implied taxable income elasticity is small: 0.0423. The pattern is pretty similar for 1995-1998 and 1999-2002. It is interesting to note that the elasticity for the self-employed is the highest during 1995-1998, i.e. the time period when the fall in the net-of--tax share at the kink was the largest. Chetty (2009) argues along the lines that a large reform should bring about a larger elasticity in the presence of optimization friction and adjustment costs. [14]

---

[13] Alternatively, one can arrrive at an estimator by solving the second-order equation implied by equation (5) in Saez (2010). This more complicated formula, which is derived by using specific parametric assumptions about the structure of the utility function, yields results that are numerically very similar to those obtained by the method described above. However, there is a very slight difference between the approach described here and the Saez formula. The latter approach takes into account that $h(z^*)_+ \neq h_0(z^*)$ for a given estimate of B. However, when estimating B Saez does not pay attention to the fact that $h(z^*)_+ \neq h_0(z^*)$.

[14] However, at this stage we cannot rule out that the higher elasticity is due to compositional changes of the sample of self-employed. In future versions of the paper we will use better data on the self-employed.

For natural reasons, the elasticity estimates for wage earners are insensitive to choice of bandwidth. For self-employed, who exhibit bunching around the kink, the choice of bandwidth is more interesting. Picking δ too small, excess bunching will be underestimated. Conversely, a large δ will overestimate (underestimate) excess bunching if the pre-reform density is convex (concave) locally around z^*.[15] Table 2 reports the elasticity estimates for self-employed individuals for different values of δ. For an extremely small value of δ, SEK 1,000, the elasticity is also very small, 0.0126. However, then the concern is that the lower and upper bands contain 'bunching observations', which would lead to a downward bias. The elasticity estimates are tolerably stable in the range SEK 10,000 to SEK 20,000. Rounding off the elasticity estimates in a conventional manner, the elasticity estimates range between 0.05-0.06. Focusing on this range is motivated by visual analysis of Figure 5 above. Both $\delta = SEK30{,}000$ and $\delta = SEK50{,}000$ should be regarded as 'extreme' bandwidth choices.

How do the results reported here relate to the earlier literature? Saez (2010) finds clear evidence of bunching around the first kink point of the U.S. Earned Income Tax Credit. However, it turns out that this response is driven by the self-employed. This qualitative pattern is consistent with the results we obtain in this paper. Saez obtains higher elasticity estimates than we do (0.76-1.10 for the self-employed). On Danish data Chetty et al (2010) also find that self-employed are considerably more responsive than wage earners.

It is also illuminating to compare our elasticity estimates with earlier elasticity estimates obtained on Swedish data by the means of other methods. Swedish studies on labor supply and the taxable income elasticity have recently been surveyed by Pirttilä and Selin (2011). A fare amount of structural labor supply studies, e.g. Blomquist (1983), employ non-linear budget set methods and estimate

[15] In a future version of the paper, we intend to correct for the curvature of the pre-reform density along the lines of Chetty et al (2010).

the labor supply elasticity to be around 0.1 for regular wage earners.[16] Another strand of literature, e.g. Blomquist and Selin (2010), Gelber (2010) and Hansson (2007), exploits the 1991 reform to estimate the taxable labor income elasticity. These studies report preferred estimates that hover between 0.2-0.4 for wage earners. The rationale for the higher taxable income elasticities, as compared to the labor supply elasticity, is that the taxable income elasticity presumably captures more margins (e.g. effort, tax avoidance and tax evasion responses). To our knowledge there are no estimates on taxable income estimates for the self-employed on Swedish data. The general belief, however, is that their reporting of incomes is more sensitive to taxation since they, in contrast to wage earners, are not subject to third-party reporting.[17]

It is striking that the amount of excess bunching is well below the predictions from these earlier studies of behavioural elasticities. One explanation could be that the structural elasticity has been overestimated in previous studies. Another explanation to the lack of bunching responses, purported by Chetty (2009b), is that the utility losses from ignoring kinks are very small for most individuals. Chetty claims that introducing small frictions in choosing taxable income can generate income distributions without bunching at kink points. An interesting avenue for future work is to compare the utility loss associated with not bunching at the central government kink point with the utility loss of not re-optimizing in the 1991 reform. In the presence of optimization frictions an observed elasticity of zero might be consistent with a fairly large underlying structural elasticity.

[16] In a linearized model, the hours elasticity with respect to the net-of-tax wage is equivalent to the taxable labor income elasticity with respect to the net-of-tax rate.

[17] Selin (2010) shows that the pension deductions -- an important component of taxable income --, of the self-employd are sensitive to taxation.

Self-Employed and Wage Earners

	(1) All taxpayers	(2) Wage earners	(3) Self-employed
1991-1994			
Elasticity (e)	0.0035	0.0014	0.0423
	(0.0017)**	(0.0018)	(0.0086)***
	[90,797]	[85,782]	[5,015]
1995-1998			
Elasticity (e)	0.0020	0.0001	0.0577
	(0.0013)	(0.0013)	(0.0088)***
	[80,431]	[77,448]	[2,983]
1999-2002			
Elasticity (e)	0.0051	0.0007	0 .0480
	(0.0016)***	(0.0017)	(0.0060)***
	[75,379]	[67,580]	[7,799]

The underlying estimation sample includes all Swedish taxpayers aged 20 to 64. Standard errors are obtained by the delta method and reported in parenthesis. The number of taxpayers used in the estimation (i.e. the number of taxpayers in the bands surrounding the kink) are reported in squared brackets. "Delta" is SEK 10,000 in the price level of 2002 in all regressions. *** denotes significance at 1 %, ** at 5 %, and * at 10 %.

Table 1. Estimates of the compensated taxable labor income elasticity at the first kink point of the central government tax schedule, 1991-2002.

Self-Employed

	δ = SEK 1,000	δ = SEK 5,000	δ = SEK 10,000
1999-2002			
Elasticity (e)	0.0126	0.0234	0.0480
	(0.0021)***	(0.0040)***	(0.0060)***
	[1,123]	[4,293]	[7,799]
	δ = SEK 20,000	δ = SEK 30,000	δ = SEK 50,000
1999-2002			
Elasticity (e)	0.0633	0.0769	0.0970
	(0.0081)***	(0.0099)***	(0.0124)***
	[14,593]	[21,225]	[34,171]

The underlying estimation sample includes all self-employed Swedish taxpayers aged 20 to 64. Standard errors are obtained by the delta method and reported in parenthesis. The number of taxpayers used in the estimation (i.e. the number of taxpayers in the bands surrounding the kink) are reported in squared brackets. "Delta" is SEK 10,000 in the price level of 2002 in all regressions. *** denotes significance at 1 %, ** at 5 %, and * at 10 %.

Table 2. Estimates of the compensated taxable labor income elasticity for self-employed individuals for different bandwidths, 1999-2002**.**

8. Conclusions and Future Work

We have analyzed bunching in the Swedish tax system. We believe such an analysis is important for several reasons. First, despite a large number of Swedish studies on labor supply (in a broad sense) and taxation, no systematic descriptive study of the link between personal taxation and the actual taxable income distributions has so far been undertaken on Swedish data. Second, we also contribute to the literature on the taxable income elasticity. We report taxable income elasticity estimates that are well below those reported by earlier studies. This version focuses on the kink point of the central government tax schedule. In future work we plan to systematically describe other kinks of the tax- and transfer system, including pay-roll taxation, housing allowances and student allowances. In addition, we plan to use data on deductions and distinguish between individuals who make few or small deductions and those who make many or large deductions. At present, the bulk of Swedish deductions are made for deferrals to tax-favoured pension savings and work-related travel expenses. It can be argued that those who make a lot of deductions have a better knowledge of the tax system and are more likely to bunch at kink points. Deductions are also, as argued by Chetty et al (2010), key to distinguishing between individual and aggregate (firm) bunching. If it is the case that self employed individuals with small deductions (common tax preferences) bunch as much as those with large deductions (uncommon tax preferences) then aggregate bunching is likely to be small and bunching is indicative of an individual response. We are also in the process of expanding our dataset to more recent years and obtaining detailed data on the whole population.

References

Blomquist, N.S. (1983) 'The Effect of Income Taxation on the Labor Supply of Married Men in Sweden' *Journal of Public Economics* 22, 169-197.

Blomquist, S and H. Selin (2010) 'Hourly Wage Rate and Taxable Labor Income Responsiveness to Changes in Marginal Tax Rates', *Journal of Public Economics* 94, 878-889.

Chetty, R. (2009a) 'Is the taxable income elasticity sufficient to calculate deadweight loss? The implications of evasion and avoidance', *American Economic Journal – Economic Policy 1(2),*31-52.

Chetty, R. (2009b) Bounds on Elasticities with Optimization Frictions: A Synthesis of Micro and Macro Evidence on Labor Supply *NBER Working Paper # 15616*

Chetty, R. , Friedman, J. , Olsen, T. and Pistaferri, L. (2010), Adjustment Costs, Firm Responses, and Micro vs. Macro Labor Supply Elasticities: Evidence from Danish Tax Records, forthcoming *Quarterly Journal of Economics*

Chetty, R. and Saez, E. (2009) Teaching the Tax Code: Earnings Responses to an Experiment with EITC Recipients, *NBER Working Paper No. 14836*

Feldstein, M. (1995) 'The effect of marginal tax rates on taxable income: A panel study of the 1986 tax reform act', *Journal of Political Economy 103*, 551-72.

Feldstein, M. (1999) 'Tax avoidance and the deadweight loss of the income tax', *Review of Economics and Statistics 81(4),* 674-80.

Gelber, A.M. (2010) 'Taxation and the Earnings of Husbands and Wives', Working paper.

Hansson, Å. (2007) 'Taxpayers responsiveness to tax rate changes and implications for the cost of taxation', *International Tax and Public Finance 14(5),* 563-82.

Kleven, H. J. , Knudsen, M. , Kreiner, C. T. , Pedersen, S. , Saez, E. (2010) Unwilling or Unable to Cheat? Evidence from a Tax Audit Experiment in Denmark. Forthcoming *Econometrica*.

Lindsey, L. (1987) 'Individual taxpayer response to tax cuts: 1982-1984: With implications fo the revenue maximizing tax rates', *Journal of Public Economics 33(2),* 173-206.

Pirttilä, J. and H. Selin (2011) 'Tax Policy and Employment. How Does the Swedish System Fare?' Uppsala Center for Fiscal Studies working paper 2011:2.

Saez, E. , Slemrod, J. , Giertz, S. (2010). "The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review" , forthcoming *Journal of Economic Literature*

Saez, E. (1999). "Do Taxpayers Bunch at Kink Points?" *NBER Working Paper No. 7366*

Saez, E. (2010). "Do Taxpayers Bunch at Kink Points?" *American Economic Journal: Economic Policy* 2(3), 0, 180-212

Selin, H. (2010) 'Marginal Tax Rates and Tax-Favoured Pension Savings of the Self-Employed. Evidence from Sweden', forthcoming in *Scandinavian Journal of Economics*.