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# Discrepancy in the Elasticity of Taxable Income

## A litterature survey

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**Abstract**

The elasticity of taxable income captures most responses to the marginal tax rate including labour supply responses as well as career choices, avoidance, and evasion. By surveying 5 studies in the U.S. and Denmark a sizable discrepancy is found between the elasticity estimates. While improvements in data availability and estimation methods can explain a lot, there also seem to be some institutional differences that cause higher frictions and less options for avoidance in Denmark relative to the U.S.

In general Danish studies find the elasticity of taxable income to be close to zero except for the groups that have the best access to intertemporal income-shifting and deductions.

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# 1 Introduction

An extensive litterature has been conducted on the elasticity of labour supply with respect to the marginal tax rate (MTR) (see Chetty, 2012) as labour supply is regarded a crucial component for growth in the long run and to avoid bottlenecks in the short run. Unfortunately, effects on the extensive margin and especially on the intensive margin is prone to misreporting and other measurement errors as well as frictions (Chetty et al., 2011). The Elasticity of Taxable Income (ETI) not only is an attractive measure due to better availability and precision in register data but it also captures both the real responses of labour supply as well as the tax avoidance and tax evasion that affects tax revenue. While it can still be relevant to decompose the different effects, the ETI is a better measure of overall efficiency (Feldstein, 1999). However, for efficiency analysis it is also necessary to take the effect on the total tax revenue into account as tax avoidance can lead to fiscal externalities that increase other tax bases due to income shifting towards capital or corporate income or simply inter-temporal substitution within the personal income base (Goolsbee, 2000; Kreiner et al., 2014).

The natural experiments created by tax reforms serve as obvious subjects for investigation. Indeed, four of the five studies being reviewed in this survey pivots on three major tax reforms. Feldstein's (1995) seminal paper and Gruber and Saez (2002) use panel data to examine the U.S. Tax Reform Act '86 (TRA86); the Danish 1987 Tax Reform (Kleven and Schultz, 2014); as well as the Danish 2010 Tax Reform. (Kreiner et al., 2014).

We find that estimates of the ETI are vulnerable to identification problems related to endogeneity, mean reversion and non-tax-related changes in equality. Furthermore when controlling for most of theese effects Danish studies only find a small ETI and most, if not all, of it can be assigned to income-shifting rather than real responses.

In the following section the general theoretical model is layed out before the different empirical implementations are disentangled in section (3). The results of the different papers are presented and discussed in section (4) before the concluding remarks (5).

# 2 Theoretical model

The standard definition of the ETI $\varepsilon$ is

$$\varepsilon = \frac{\delta z}{\delta(1-\tau)} \frac{(1-\tau)}{z} \tag{2.1}$$

Where $z$ is the taxable income and $\tau$ is the MTR.

The reported taxable income $z_{it}$ of individual $i$ at time $t$ can be expressed as a function

(2.2) of potential income $z_{it}^0$ if the MTR $\tau_{it}$ was 0 (Gruber and Saez, 2002) such that

$$\begin{aligned} z_{it} &= z_{it}^0 \cdot (1 - \tau_{it})^{\varepsilon} \\ \Rightarrow \log z_{it} &= \log z_{it}^0 + \varepsilon \cdot \log(1 - \tau_{it}) \end{aligned} \tag{2.2}$$

This log transformation is used for empirical estimation as it conveniently allows for the direct interpretation of $\varepsilon$ as the elasticity of taxable income with respect to the MTR, though in most cases ignoring the mostly theoretical potential income term.

# 3 Empirical implementation

## 3.1 Difference-in-differences

In the seminal paper of Feldstein (1995) three income groups (medium, high, and highest) are analyzed during the implementation of the TRA86. For the high-earners the tax rate was reduced from 50 pct. to 28 pct. Using the differences-in-differences (DD) estimation the ETI is estimated as the treatment effect. The evolution of income for the high-earners $z^H$ is evaluated against the income of the control group of medium-earners $z^M$ relative to the the evolution of MTR $\tau$ for each group from 1985 to 1988:

$$\hat{\varepsilon} = \frac{\Delta \log(z^H) - \Delta \log(z^M)}{\Delta \log(1 - \tau^H) - \Delta \log(1 - \tau^M)} \tag{3.1}$$

While the medium income group is constituted by 3.538 individuals, robustness of the results is weakened by the fact that the high income group only contains 197 individuals and the highest income group only has 57 due to the sample being a non-stratified random draw.

Using Danish montly administrative data Kreiner et al. (2016) is able to estimate the short-run ETI as $\hat{\beta}_3$ using panel regression:

$$\underbrace{w_{y,m,i}}_{\text{wage income}} = \beta_0 + \underbrace{\beta_1 d_{y,i}^{2010}}_{\text{2010 dummy}} + \underbrace{\beta_2 d_i^T}_{\text{treatment dummy}} + \underbrace{\beta_3 \frac{1 - \tau_{y,i}}{1 - \tau_{2009,i}}}_{\text{ETI}} + u_{y,m,i} \tag{3.2}$$

The treatment group of 219,179 individuals is evaluated against a control group of 109,500 individuals with weak or no incentives to shift their income due to the tax reform.

As the marginal tax rate reductions in the Danish 2010 Tax Reform was agreed upon as early as March 1 2009 it allowed for intertemporal tax shifting where self-employed were able to plan and employers to negotiate with there employees. Kreiner et al. (2016) find a substantial shifting from november and december 2009 to january 2010 such that omitting theese three months from the estimation (3.2) leads to a short-run ETI estimate of 0.00, showing that the ETI estimate was solely due to shifting and not real responses.

### 3.2 IV panel data regression

Gruber and Saez (2002) set out to use a panel with 60,000 individuals from 1979-1990 to estimate the ETI $\varepsilon$ as occuring in equation (2.2). As opposed to Feldstein (1995) they do not use simple DD to analyze the absolute change in income relative to the absolute change in MTR between a single set of two years. On the contrary, they take advantage of the different increases and decreases in the MTR durings the 11 year period to calculate the percentage change in deflated income $z_i$ relative to the percentage change in MTR $\tau_i$ for periods of varying length in years $k$ with the regression equation:

$$\log\left(\frac{z_{it+k}}{z_{it}}\right) = \alpha + \varepsilon \cdot \log\left(\frac{1-\tau_{it+k}}{1-\tau_{it}}\right) + u_{it}, \qquad k = 1,2,3 \tag{3.3}$$

This equation though gives rise to an endogeneity problem, as an income shock $u_{it} > 0$ due to the progressiveness of the tax system would lead to a mechanical rise in the MTR, causing a downward biased OLS estimate as $\text{corr}(\tau_{it}, u_{it}) > 0$. To solve the endogeneity issue Gruber and Saez (2002) use Instrumental Variable (IV) panel regression by introducing $\tau^h$ as an instrument for $\tau_{it+k}$, which is the MTR that individual $i$ would have paid in period $t+k$ due to changes in the tax system if her income would not have changed since period $t$. For this the NBER TAXSIM model is used.

In general panel data is prone to potential mean reversion that would lead to a downward bias in the ETI if some individuals were only in the high-income group initially as a results of an income shock. On the other hand, divergence in the income distribution as observed in the U.S. (Gruber and Saez, 2002) would lead to an upward bias if the changes are non-tax-related such as impacts of skill-biased technological change and globalization. Gruber and Saez (2002) attempt to take care of these two issues by controlling for initial log-income of the individual as well as including a 10 piece spline in lagged income controlling for initial decile of the income distribution. The following 2$^{\text{nd}}$ stage IV equation is given by letting these controls be captured by $f(z_{it})$ and also adding a control for initial mariatal status $x_{it}$:

$$\log\left(\frac{z_{it+k}}{z_{it}}\right) = \alpha_0 + \varepsilon \cdot \log\left(\frac{1-\hat{\tau_{it+k}}}{1-\tau_{it}}\right) + \alpha_0 x_{it} + f(z_{it}) + u_{it}, \qquad k = 1,2,3 \tag{3.4}$$

The estimation results show to be sensitive to controls for mean reversion and non-tax changes to inequality. Estimation using equation (3.4) still relies on a several assumptions: 1) that the size of the response is constant over the time period and is identical in the short and the long run; 2) that all individuals have perfect knowledge and an identical elasticity. However, the results are also sensitive to exclusion of low-income earners.

Equation (3.4) is extended to not only allow for substitution effects but also include income effects of changes in tax rate. They are found to be negative but insignificant, though.

### 3.3 Full population data

Kleven and Schultz (2014) combine tax return information with administrative data containing rich information about labour market, education, and sociodemographics for the full Danish population. The availability of detailed controls in theory allows us to regard the average treatment effect of the treated as the average treatment effect according to the conditional independence assumption, though, even with rich controls it is impossible to be certain that potential bias is removed. Bias from non-tax related changes to inequality and mean reversion is though likely to be much less than in prior studies due to the Danish setting where income inequality has been more stable in the period covered by the data from 1984-2005 than even in other Nordic countries. Furthermore, identificaton is also strenghthened as the variation in taxes is not strongly correlated with income level, thus, the different tax reforms over the period provides nonlinear variation in taxes throughout the income distribution and introduces assymetric treatment of different components affecting individuals at the same income level differently due to different compositions of income.

Similarly to equation (3.4) panel regression is used to estimate EIT based on responses to changes in the MTR. Thanks to the administrative data, controls are included for time-invariant individual characteristics $x_i^c$ for which the effect $\gamma_t^c$ is allowed to change over time $t$ and the difference in time-variant individual characteristics $\Delta x_i t^v$ for which the effect it constant over time. For different income types $j$ the log-difference is estimated with the 2nd stage 2SLS equation:

$$\Delta \log z_{it}^j = \varepsilon \cdot \Delta \log\left(1 - \tau_{it}^j\right) + \eta \cdot \Delta \log y_{it} + \Delta \gamma_t^c \boldsymbol{x}_i^c + \gamma^v \cdot \Delta \boldsymbol{x}_{it}^v + \Delta v_{it} \tag{3.5}$$

Where $\Delta \log y_{it}$ is the difference in log virtual income (the sum of non-labour incomes). The endogeneity problem is solved by replacing this and $\Delta \log\left(1 - \tau_{it}^j\right)$ by the the difference in the mechanical tax rate due to changes in tax system only. These intstruments are based on a constructed tax simulator and allows for IV estimation of the panel regression. In the baseline specification differences at time $t$ are the differences between $t$ and $t+3$.

By merging employer and employee data Chetty et al. (2011) are able to extend equation (3.5) with controls for occupation fixed effects and region fixed effects while not having accesss to most other controls. Nonetheless, the biggest impact of the paper is to document the friction due to the Danish labour market being highly unionized.

## 4 Results and discussion

The different estimates of the ETI in table 1 show a huge discrepancy from the seminal studies by Feldstein (1995) over other U.S. studies (Gruber and Saez, 2002) to the later studies for Denmark (Chetty et al., 2011; Kleven and Schultz, 2014; Kreiner et al., 2016).

| | $\hat{\varepsilon}$ | Income group | Method | N | Period | Country |
|---|---|---|---|---|---|---|
| Feldstein (1995) | 1.04 | $\sim$ \$100,000 | OLS DD | 3,792 | 1985-1988 | U.S. |
| Gruber & Saez (2002) | 0.40 | $>$ \$10,000 | IV Panel Regression | ~60,000 | 1979-1990 | U.S. |
| —"— | 0.57 | $>$ \$100,000 | —"— | —"— | —"— | —"— |
| Kleven & Schultz (2014) | 0.05 | wage earners | IV Panel Regression | 29,668,870 | 1984-2005 | DK |
| —"— | 0.09 | self-employed | —"— | 1,646,270 | —"— | —"— |
| —"— | 0.11 | all taxpayers | —"— | 11,799,628 | 1984-1990 | —"— |
| —"— | 0.2-0.3 | —"— | IV DD | ~3,000,000 | 1986-1989 | —"— |
| Kreiner et al (2016) | 0.08 | highest quartile | OLS DD | 328,679 | 2009-2010 | DK |
| —"— | 0.00 | —"— | —"— | —"— | 2009-2010* | —"— |
| Chetty et al (2011) | 0.00 | wage earners | IV Panel Regression | 8,302,905 | 1994-2001 | DK |

**Table 1:** Estimated elasticity of taxable income in different studies. *excl. N09, D09 & J10.

An estimate of $\hat{\varepsilon} > 1$ would refer to U.S. being on the wrong side of the laffer curve prior to 1986 such that reducing the tax rate (for the income group in question) would actually raise collected tax revenue. Besides from working with a very small sample-size Feldstein (1995) does not control for issues with mean reversion and other income distribution changes nor solve endogeneity problems. Controlling for theese issues by using IV panel regression and including controls for baseline income Gruber and Saez (2002) estimate a significantly smaller ETI covering more years around the TRA86 though the result is very fragile to different specifications. Nonetheless, most other reliable estimates also find the ETI to be in the range 0.12-0.40 for the U.S. (Saez et al., 2012).

Throughout the surveyed studies there is a clear indication that the responses to changes in the MTR are more evident for high-income earners as they both might have better knowledge as well as better possibilities to react such as deductibles (Saez et al., 2012). Thus, the overall effect will be lower if estimated for all taxpayers. Furthermore, if looking at responses to a broader tax base in terms of all types of incomes the elasticity of the rate of the personal income tax is down from 0.40 to 0.12 (Gruber and Saez, 2002). While partly mechanical due to the tax base being wider it also shows the presence of fiscal externalities due to avoidance. More so, the discrepancy in the estimate between taxable income and broad income is found to be much smaller in Denmark (Kleven and Schultz, 2014). Besides from the fact that labour income to a greater degreee is the main income component in Denmark, this suggests that options for avoidance or evasion is much smaller than in the U.S. which could help explain the smaller estimates of EIT on Danish data.

Using a similar approach for Denmark but with rich individul background data available, Kleven and Schultz (2014) takes advantag of the nonlinear variations in the various tax reforms in the 80s and 90s as well of the fact that inequality is close to constant over the period. They find quite modest responses to the MTR over the period for wage earners as well as self-employed. The estimate is a little higher for the sub-sample around the thorough 1987 tax reform while at it's highest for the one DD estimation from 1986-1989 that seems to capture most of the effect. This corresponds with the concept that larger changes in incentives are more likely to cause a reaction that reveals the long-

run elasticities by overcoming frictions such as searching and other switching costs but likewise a simple attention cost (Chetty, 2012).

Nonetheless, a sizable decrease in the MTR from 63 pct. to 56 pct. for the highest-earning quartile of the full-time employees was only found to have a minor effect (Kreiner et al., 2016), though estimation on subgroups shows that within the treated group the ETI estimate grows continously from 0 for the lowest incomes to 0.25 for the top one percent incomes. Even more so, all of the effects could be assigned to intertemporal income shifting, leaving no real responses when leaving out the few months around the implementation. Reversely, the estimate is 0.80 when only taking december 2009 and january 2010 into account.

Using bunching methods Chetty et al. (2011) find substantial elasticities in the proximity of the kinks in the MTR as well as for self-employed and secondary earners. Nonetheless, the overall elasticity is insignificant for the smaller tax reforms analyzed.

A lower EIT estimate in Denmark can partly be due to larger frictions on an institutional level such as a labour market dominated by collective agreements. This means adjustments take longer as on the collective level as agreements are only being renegotiated every 2-3 years and well as on the individual level where career changes might be necessary, thus, if effects are spread out over more than a the three years included in the specifications, estimates will be downward biased (Chetty et al., 2011).

## 5 Concluding remarks

The elasticity of taxable income (EIT) with respect to the marginal tax rate (MTR) not only accounts for labour supply but also other behavioral responses such as tax avoidance, tax evasion, collective agreements and career choices.

Though differences-in-differences estimation using OLS can be a simple way to analyze effects in the proximity of a substantial tax reform, it can be difficult to completely exclude effects from non-tax-related changes to inequality and mean reversion. Availability of controls as well as 2SLS panel regression over a period with a variety of tax system changes can reduce these biases.

While most studies for the U.S. estimate a significant ETI, studies for Denmark tend to find modest or zero effects of changes in the MTR for the wage earner when being able to control for intertemporal income-shifting or self-employed. On one hand the discrepancy between the ETI in the U.S. and Denmark can partly be explained by higher frictions and less options for tax avoidance, on the other hand estimates have also decreased with richer better data availability allowing for more controls. This suggests that future studies in the U.S. might also find estimates closer to zero come richer data availability, but also that there might be a revenue and efficiency loss from gaps in the U.S. tax law.

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