Identifying the Elasticity of Taxable Income

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Introduction

- Well known that policymakers face important tradeoffs between equity and efficiency in the design of the tax system.

- The issue we address in this paper informs discussions of what the marginal tax rate should be in the top income bracket if the goal of the government is to maximize revenue.

- Especially salient in this era of rising inequality and fiscal shortfalls.
Trends in Household Quintile Shares

- Lowest fifth
- Second fifth
- Third fifth
- Fourth fifth
- Highest fifth

Year:
- 1967
- 1969
- 1971
- 1973
- 1975
- 1977
- 1979
- 1981
- 1983
- 1985
- 1987
- 1989
- 1991
- 1993
- 1995
- 1997
- 1999
- 2001
- 2003
- 2005
- 2007
- 2009
- 2011

Percent:
- 0.0
- 10.0
- 20.0
- 30.0
- 40.0
- 50.0
- 60.0
FIGURE 1
The Top Decile Income Share, 1917-2012

Source: Table A1 and Table A3, col. P90-100.
Income is defined as market income (and excludes government transfers).
In 2012, top decile includes all families with annual income above $114,000.
2012 data based on preliminary statistics.
FIGURE 2
Decomposing the Top Decile US Income Share into 3 Groups, 1913-2012

Source: Table A3, cols. P90-95, P95-99, P99-100.
Income is defined as market income including capital gains.
Top 1% denotes the top percentile (families with annual income above $394,000 in 2012)
Top 5-1% denotes the next 4% (families with annual income between $161,000 and $394,000 in 2012)
Top 10-5% denotes the next 5% (bottom half of the top decile, families with annual income
between $114,000 and $161,000 in 2012).
2012 data based on preliminary statistics
FIGURE 3
The Top 0.01% Income Share, 1913-2012

Source: Table A1 and Table A3, col. P99.99-100.
Income is defined as market income including (or excluding) capital gains.
In 2012, top .01% includes the 16,068 top families with annual income above $10,250,000.
2012 data based on preliminary statistics
Alvaredo, Atkinson, Piketty, and Saez (JEP, 2013) highlight four main factors underlying growth in top income shares:

- tax cuts at the top of the distribution
- greater bargaining on the part of top executives
- return of inheritance
- positive covariance between labor and capital income

Focus of this paper is tax policy
the twentieth century. The most obvious policy difference—between countries and over time—regards taxation, and it is here that we begin.

**Taxes and Top Shares**

During the twentieth century, top income tax rates have followed an inverse U-shaped time-path in many countries, as illustrated in [Figure 3](#). In the United States, top income tax rates were consistently above 60 percent from 1932 to 1981, and at the start of the 1920s, they were above 70 percent (of course, varying proportions of taxpayers were subject to the top rate). High income tax rates are not just a feature of the post-World War II period, and their cumulative effect contributed to the earlier decline in top income shares. While many countries have cut top tax rates in recent decades, the depth of these cuts has varied considerably. For example, the top tax rate in France in 2010 was only 10 percentage points lower than in 1950, whereas the top tax rate in the US was less than half its 1950 value.

[Figure 4](#) plots the changes in top marginal income tax rates (combining both central and local government income taxes) since the early 1960s against the changes over that period in top 1 percent income shares for 18 high-income countries in the World Top Incomes Database. It shows that there is a strong correlation between the reductions in top tax rates and the increases in top 1 percent income shares.
In 2013 there are 7 marginal tax brackets

<table>
<thead>
<tr>
<th>Taxable Income</th>
<th>Marginal Tax Rate for Married Couple filing Jointly</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0–$17,850</td>
<td>10%</td>
</tr>
<tr>
<td>$17,851–$72,500</td>
<td>15%</td>
</tr>
<tr>
<td>$72,501–$146,400</td>
<td>25%</td>
</tr>
<tr>
<td>$146,401–$223,050</td>
<td>28%</td>
</tr>
<tr>
<td>$223,051–$398,350</td>
<td>33%</td>
</tr>
<tr>
<td>$398,350–$450,000</td>
<td>35%</td>
</tr>
<tr>
<td>$450,001–</td>
<td>39.6%</td>
</tr>
</tbody>
</table>
Trends in Tax Receipts as a Share of GDP by Source, 1940-2012

- Individual Income Taxes
- Corporation Income Taxes
- Social Insurance and Retirement Receipts
- Excise Taxes
- Other
- Total Receipts
The elasticity of taxable income (ETI) measures how taxable income responds to changes in the after-tax share \((1 - \text{mtr})\).

Identifying the magnitude of this elasticity has become a focal outcome of interest in optimal tax policy.

Under certain assumptions the ETI is a sufficient statistic for the optimal revenue-maximizing rate of taxation.
ETI and the Revenue-Maximizing Top Rate

From Saez (2001)

\[ \tau^* = \frac{1}{1 + a \cdot e} \]

- \( a \) = Pareto parameter \((a \geq 1)\); \( e \) = ETI
- Holding \( e \) fixed, as \( a \rightarrow 1 \), inequality ↑

<table>
<thead>
<tr>
<th>( e )</th>
<th>( a = 1 )</th>
<th>( a = 1.5 )</th>
<th>( a = 2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>0.25</td>
<td>80%</td>
<td>73%</td>
<td>67%</td>
</tr>
<tr>
<td>0.5</td>
<td>67%</td>
<td>57%</td>
<td>50%</td>
</tr>
<tr>
<td>1.0</td>
<td>50%</td>
<td>40%</td>
<td>33%</td>
</tr>
</tbody>
</table>
There now exists a fairly substantial literature estimating the ETI

- Auten and Carroll 1999; Gruber and Saez 2002; Kopczuc 2005; Heim 2009; Blomquist and Selin 2010; Giertz 2010; Weber 2011
- Modal estimate is 0.25 (Saez, Slemrod, and Giertz 2011)

Concern is that the standard identification scheme is biased
The canonical approach to identification of the ETI

- To address endogeneity concerns, a synthetic or predicted tax rate is used to construct an instrument for the actual net-of-tax rate change

- This method is most often attributed to Gruber and Saez (2002)

- This instrument, however, is likely correlated with the error, and this is our main focus
The majority of the literature (except Moffitt and Wilhelm 2000) has used taxpayer panel data

Advantages
- Quality of data measuring income and tax liability
- Follow same person over time

Disadvantages
- Not often publically available
- Limited demographic information
- Do not necessarily capture low end of distribution
We utilize two-year panels of data from the Current Population Survey (CPS) to provide new estimates of the ETI.

CPS has advantage of long time series, lots of demographics, and captures low incomes.

With matched two-year panels from the CPS we develop a grouping instrumental variables estimator to estimate the ETI.

- Heckman and Robb (1985); Angrist (1991); Blundell, et al. (1998)
We also examine how important the issue of ‘selection on observables’ is to estimates of the ETI
- For example, what happens if we also control education and race, which we do not measure in U.S. taxpayer data

And we test for truncation bias
- Most authors drop families with incomes < $20,000 or $10,000. Does this matter?
Basic setup is a static model of consumer behavior:

$$\text{Max}_{c,y} U(c,y) \text{ s.t. } c = y - T(y)$$

where

- $c = \text{consumption}$
- $y = \text{income}$
- $T(y) = \text{tax payments}$

Solving for $y$ yields an income supply function (Feldstein 1995), $y = f(1-t,N)$. 
This income supply function is a discrete approximation to the Slutsky eq (Gruber and Saez 2002)

- $\beta$ is the ETI, $\geq 0$ as it is a compensated elasticity
- $\gamma = 0$ in most studies, so we drop it.
In addition, we need to add controls for aggregate trends (time effects), demographics, and heterogeneous income trends.

- $f(y_{it-1})$ is function of lag income (e.g. log level or spline function)
Empirically the standard assumption for OLS is violated, even controlling for regression to the mean via lagged income.

This means we need an instrument for the change in net-of-tax share.
Gruber and Saez (2002) implement an exactly identified model based on the instrument

\[ \Delta \ln y_{it} = \beta \Delta \ln (1 - \tau_{it}) + \delta f(y_{it-1}) + x_{it} \theta + \varepsilon_{it} \]

\[ \Delta \ln (1 - \tau_{it}) = \ln (1 - \hat{\tau}_{it}) - \ln (1 - \tau_{it-1}) \]
Well recognized that synthetic tax rate instrument employed in canonical model may be correlated with error term
  ◦ (Moffitt and Wilhelm 2000; Blomquist and Selin 2010; Weber 2011)

We implement more exogenous instrument based on a grouping instrumental variables strategy
Unobservable differences in changes in average taxable income across cohorts can be summarized by a permanent state effect, a permanent cohort effect, and an additive time effect.

A.1 implies the exclusion restrictions for identification
Combining Panel with Cohort Identification

A.2 \( (E[\Delta \ln(1 - \tau_{ijct})|j,c,t] - E[\Delta \ln(1 - \tau_{ijct})|j] - E[\Delta \ln(1 - \tau_{ijct})|c] - E[\Delta \ln (1 - \tau_{ijct})|t])^2 \neq 0 \)

A.2 is a rank condition that requires variation in changes in log net-of-tax shares remains after controlling for fixed state, cohort, and time effects.
Combining Panel with Cohort Identification

\[
\Delta \ln y_{ijct} = \beta \Delta \ln (1 - \tau_{ijct}) + \delta f(y_{ijct-1}) + x_{ijct} \theta \\
+ \pi_j + \gamma_c + \mu_t + e_{ijct}
\]

- We append to the model state fixed effects ($\pi_j$) and cohort fixed effects ($\gamma_c$) and time effects ($\mu_t$)
A.1 says we can use a full interaction of state-cohort-year effects in the reduced-form equation for the change in net-of-tax share

- Too many instruments!

Instead, we use the state-cohort-year mean change in the log net-of-tax share

\[
\ln\left\{ \frac{(1 - \hat{\tau}_{it})}{(1 - \tau_{it-1})} \right\}_{sct}
\]

Takes advantage of the fact that the 50 states adopt different tax policy too
Combining Panel with Cohort Identification

- First-difference ETI model nets out person-specific and time invariant heterogeneity in log levels of income

- Our model also admits heterogeneity in income growth across states and birth cohorts

- Thus, ours is a significant extension of the Wald estimator of Blundell, et al. (1998)
Most taxpayer panel datasets have limited information on demographics, e.g. they do not record education attainment or race, and sometimes not gender.

Large literature in labor economics says these demographics are important determinants of earnings.

We test whether the ETI is affected once we control for these additional factors.
Issue 2: Truncation Bias

- The typical ETI paper truncates data below some threshold
  - $20,000 in Auten and Carroll (1999); $10,000 in Gruber Saez (2002)
  - Does not control for possible (unobserved) changes in labor force composition in response to tax reforms
  - Zero conditional mean assumption violated
  - Under normality

\[
E[\Delta \ln y_{ijct} | y_{ijct-1} > \varphi] = \beta \Delta \ln (1 - \tau_{ijct}) + \delta f(y_{ijct-1}) + x_{ijct} \theta + \pi_j + \gamma_c + \mu_t + \sigma \lambda_{ijct}
\]
Issue 2: Truncation Bias

- We test whether or not the ETI is affected by truncation bias using a method similar to correcting for sample selection bias.
  - Step 1: Estimate a probit model of the probability income > $10,000
  - Step 2: Construct the inverse Mills ratio (assuming normally distributed errors) as
    \[
    \lambda_{ijct} = \frac{\phi\left(\frac{\varphi - Z'_{ijct}\Gamma}{\sigma}\right)}{\Phi\left(\frac{\varphi - Z'_{ijct}\Gamma}{\sigma}\right)}
    \]
    - add this variable to the regression model and test whether it is significant and whether the ETI changes
Data

  - Calendar years 1979-2008
  - Family heads (male or female) ages 25-60
  - Delete observations with imputed income (Bollinger and Hirsch 2006)
  - Use consistent top codes of Larrimore, et al. (2009)
Create a series of 2-year panels

CPS rotation sequence: In 4 months, out 8 months, in 4 months—Max match rate is 50%

- Match on month in sample; gender, person ID; household ID; household number; race; state; age
- Missing matches: 1985, 1995
- Impose constant marital status over 2 waves
- 198,285 matched pairs over sample period
Create 39 separate cohorts
  ◦ defined by 5-year date of birth and three education groups (less than high school, high school, more than high school)

Tradeoff between more heterogeneity and more measurement error (Deaton 1985)

Creates an unbalanced panel in cohorts
Key Variables

Dependent Variables:

- Change in Log of Broad Income
  - Total family income less social security and capital gains (Gruber and Saez 2002)

- Change in Log of Taxable Income
  - Broad Income less estimated deductions and exemptions

Independent Variable:

- Change in Log of Net-of-Tax Share
Tax rates, tax payments, and deductions for taxable income are estimated using the NBER \textit{TAXSIM} program.

Marginal tax rate is Federal + State (includes EITC).

Instrument: Found by inflating income in (t-1) to time t and calculating a “synthetic” tax rate (Gruber-Saez).

Our instrument takes the latter and computes the mean at the state-cohort-year level.
Figure 1: Life-Cycle Net of Tax Rates for the 5-year birth-year Cohorts by Level of Education
## Baseline Estimates

<table>
<thead>
<tr>
<th>1979-2008</th>
<th>Broad Income</th>
<th>Taxable Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gruber-Saez Synthetic Instrument</td>
<td>Gruber-Saez Synthetic Instrument</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(3)</td>
</tr>
<tr>
<td>spline of ln (income)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>0.119**</td>
<td>0.291***</td>
</tr>
<tr>
<td></td>
<td>(0.046)</td>
<td>(0.097)</td>
</tr>
<tr>
<td>observations</td>
<td>198285</td>
<td>198285</td>
</tr>
</tbody>
</table>
# Initial Sensitivity Checks: Demographics and Truncation Bias

<table>
<thead>
<tr>
<th></th>
<th>Broad Income</th>
<th>Taxable Income</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Additional Demographics:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>0.234***</td>
<td>0.358**</td>
</tr>
<tr>
<td></td>
<td>(0.082)</td>
<td>(0.112)</td>
</tr>
<tr>
<td><strong>Truncation Bias:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>0.263***</td>
<td>0.407***</td>
</tr>
<tr>
<td></td>
<td>(0.095)</td>
<td>(0.125)</td>
</tr>
<tr>
<td><strong>With Demographics and Truncation:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>0.234***</td>
<td>0.357***</td>
</tr>
<tr>
<td></td>
<td>(0.082)</td>
<td>(0.112)</td>
</tr>
</tbody>
</table>
## Which Demographics Matter?

<table>
<thead>
<tr>
<th></th>
<th>Broad Income</th>
<th>Taxable Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital Status</td>
<td>0.291***</td>
<td>0.431***</td>
</tr>
<tr>
<td></td>
<td>(0.097)</td>
<td>(0.126)</td>
</tr>
<tr>
<td>Add Age, Gender, Children</td>
<td>0.239***</td>
<td>0.364***</td>
</tr>
<tr>
<td></td>
<td>(0.087)</td>
<td>(0.117)</td>
</tr>
<tr>
<td>Add Education and Race</td>
<td>0.234***</td>
<td>0.358***</td>
</tr>
<tr>
<td></td>
<td>(0.082)</td>
<td>(0.112)</td>
</tr>
</tbody>
</table>

Good news for taxpayer panels? Not so fast
Our Preferred Estimates: Demographics and Cohort Income

Concern that person–specific lagged income is correlated is error. We thus replace it with cohort–mean income.

<table>
<thead>
<tr>
<th></th>
<th>Broad Income</th>
<th>Taxable Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cohort Income and Additional Demographics</td>
<td>Cohort Income and Additional Demographics</td>
</tr>
<tr>
<td>Elasticity</td>
<td>0.426***</td>
<td>0.410***</td>
</tr>
<tr>
<td></td>
<td>(0.111)</td>
<td>(0.103)</td>
</tr>
</tbody>
</table>
## Additional Robustness Checks on Baseline: Broad Income

<table>
<thead>
<tr>
<th>Broad Income</th>
<th>Birth year only cohort grouping</th>
<th>Drop Top 5%</th>
<th>Keep cohort-year cells with &lt;50 obs</th>
<th>No Cohort Fixed Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticity</td>
<td>0.346</td>
<td>0.156*</td>
<td>0.307***</td>
<td>0.835***</td>
</tr>
<tr>
<td></td>
<td>(0.287)</td>
<td>(0.093)</td>
<td>(0.096)</td>
<td>(0.133)</td>
</tr>
<tr>
<td>Additional Demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>0.224</td>
<td>0.131</td>
<td>0.249***</td>
<td>0.247***</td>
</tr>
<tr>
<td></td>
<td>(0.230)</td>
<td>(0.089)</td>
<td>(0.082)</td>
<td>(0.084)</td>
</tr>
</tbody>
</table>
# Additional Robustness Checks on Baseline: Taxable Income

<table>
<thead>
<tr>
<th></th>
<th>Birth year only cohort grouping</th>
<th>Drop Top 5%</th>
<th>Keep cohort-year cells with &lt;50 obs</th>
<th>No Cohort Fixed Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticity</td>
<td>0.516*</td>
<td>0.289**</td>
<td>0.445***</td>
<td>1.110***</td>
</tr>
<tr>
<td></td>
<td>(0.309)</td>
<td>(0.125)</td>
<td>(0.125)</td>
<td>(0.160)</td>
</tr>
<tr>
<td>Additional Demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>0.370</td>
<td>0.251**</td>
<td>0.372***</td>
<td>0.353***</td>
</tr>
<tr>
<td></td>
<td>(0.244)</td>
<td>(0.120)</td>
<td>(0.110)</td>
<td>(0.109)</td>
</tr>
</tbody>
</table>
Conclusion

- We present new estimates of the ETI using matched-two-year panels from the CPS.

- The grouping instrumental variables estimator utilized variation in tax policy across states, birth and education cohorts, and time to identify the ETI.

- Our preferred estimates suggest that the elasticity with respect to broad income is about 0.4 and with respect to taxable income is about 0.55.
The optimal revenue-maximizing tax rate is 27 pp lower with our estimator than with Gruber-Saez. Current top rate of 39.6% not too far off.

\[ \tau^* = \frac{1}{1 + a \cdot e} \]

<table>
<thead>
<tr>
<th>e</th>
<th>a = 1</th>
<th>a = 1.5</th>
<th>a = 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15</td>
<td>87%</td>
<td>82%</td>
<td>77%</td>
</tr>
<tr>
<td>0.55</td>
<td>65%</td>
<td>55%</td>
<td>48%</td>
</tr>
</tbody>
</table>
Results suggest that our approach could be a fruitful alternative for identification in future research on the elasticity of taxable income.

Controlling for selection on observables is sufficient.

A key issue in tax panels is finding a proxy for permanent income like education.