Taxing Top Incomes in a World of Ideas

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The Saez (2001) Calculation

- Income: \( z \sim \text{Pareto}(\alpha) \)

- Tax revenue: 
  \[
  T = \tau_0 \bar{z} + \tau(z_m - \bar{z})
  \]
  where \( z_m \) is average income above cutoff \( \bar{z} \)

- Revenue-maximizing top tax rate: 
  \[
  z_m - \bar{z} + \tau z'_m(\tau) = 0
  \]
  mechanical gain + behavioral loss

- Divide by \( z_m \) ⇒ elasticity form and rearrange: 
  \[
  \tau^* = \frac{1}{1 + \alpha \cdot \eta_{z_m,1-\tau}}
  \]
  where \( \alpha = \frac{z_m}{z_m - \bar{z}} \).
\[ \tau^* = \frac{1}{1 + \alpha \cdot \eta_{z_m,1-\tau}} \]

- **Intuition**
  - Decreasing in \( \eta_{z_m,1-\tau} \): elasticity of top income wrt \( 1 - \tau \)
  - Increasing in \( \frac{1}{\alpha} = \frac{z_m - \bar{z}}{z_m} \): change in revenue as a percent of income = Pareto inequality

- **Diamond and Saez (2011) Calibration**
  - \( \alpha = 1.5 \) from Pareto income distribution
  - \( \eta = 0.2 \) from literature

\[ \Rightarrow \quad \tau_{d-s} \approx 77\% \]
Overview

• Saez (2001) and following literature
  
  “Macro”-style calibration of optimal top income taxation

• How does this calculation change when:
  
  o New ideas drive economic growth
  
  o The reward for a new idea is a top income
  
  o Creation of ideas is broad
    – A formal “research subsidy” is imperfect (Walmart, Amazon)

  o A small number of entrepreneurs $\Rightarrow$ the bulk of economy-wide growth

• $\uparrow \tau$ lowers consumption throughout the economy via nonrivalry
Literature

- **Human capital**: Badel and Huggett, Kindermann and Krueger
- **Superstars/inventors**: Scheuer and Werning, Chetty et al
- **Spillovers**: Rothschild and Sheuer, Lockwood-Nathanson-Weyl
- **Mirrlees w/ Imperfect Substitution**: Sachs-Tsyvinski-Werquin
- **Inventors and taxes**: Akcigit-Baslandze-Stantcheva, Moretti and Wilson, Akcigit-Grigsby-Nicholas-Stantcheva
- **Growth and taxes**: Stokey and Rebelo, Jaimovich and Rebelo
This paper does not calculate “the” optimal top tax rate

- Many other considerations:
  - Political economy of inequality
  - Occupational choice (other brackets, concavity)
  - Top tax diverts people away from finance to ideas?
  - Social safety net, lenient bankruptcy insure the downside
  - How sensitive are entrepreneurs to top tax rates?
  - Empirical evidence on growth and taxes
  - Rent seeking, human capital

- Still, including economic growth and ideas seems important
Basic Setup
Overview

• BGP of an idea-based growth model. Romer 1990, Jones 1995
  o Semi-endogenous growth
  o Basic R&D (subsidized directly), Applied R&D (top tax rate)
  o BGP simplifies: static comparison vs transition dynamics

• Three alternative approaches to the top tax rate:
  o Revenue maximization
  o Maximize welfare of “workers”
  o Maximize utilitarian social welfare
Environment for Full Growth Model

Final output
\[ Y_t = \int_0^{A_t} x_{it}^{1-\psi} di \left( \mathbb{E}(e\theta)M_t \right)^\psi \]

Production of variety \( i \)
\[ x_{it} = \ell_{it} \]

Resource constraint (\( \ell \))
\[ \int \ell_{it} di = L_t \]

Resource constraint (\( N \))
\[ L_t + S_{bt} = N_t \]

Population growth
\[ N_t = \bar{N} \exp(nt) \]

Entrepreneurs
\[ S_{at} = \bar{S}_a \exp(nt) \]

Managers
\[ M_t = \bar{M} \exp(nt) \]

Applied ideas
\[ \dot{A}_t = \bar{a}(\mathbb{E}(e\theta)S_{at})^\lambda A_t^{\phi_a} B_t^{\alpha} \]

Basic ideas
\[ \dot{B}_t = \bar{b}S_{bt}^{\lambda} B_t^{\phi_b} \]

Talent heterogeneity
\[ \theta_i \sim F(\theta) \]

Utility \((S_{a}, M)\)
\[ u(c, e) = \varphi \log c - \frac{e}{1+\varepsilon} e^{\frac{1+\varepsilon}{\varepsilon}} \]
The Economic Environment

- Consumption goods produced by managers $\tilde{M}$, labor $L$, and nonrival “applied” ideas $A$:
  
  $$ \dot{Y} = A^\gamma \tilde{M}^\psi L^{1-\psi} $$

- Applied ideas produced from entrepreneurs, effort $e$, talent $\theta$, and basic research ideas $B$:
  
  $$ \dot{A}_t = \bar{a}(\mathbb{E}(e\theta)S_{at})^\lambda A_t^{\phi_a} B_t^{\alpha} $$

- Fundamental ideas produced from basic research:
  
  $$ \dot{B}_t = \bar{b}S_{bt}^{\lambda} B_t^{\phi_b} $$

- $\tilde{M}, L, S_a, S_b$ exogenous. $e$ endogenous (unspecified for now)
Nonrivalry of Ideas (Romer): $Y = A^{\gamma} \tilde{M}^\psi L^{1-\psi}$

- Constant returns to rival inputs $\tilde{M}, L$
  - Given a stock of nonrival blueprints/ideas $A$
  - Standard replication argument

- $\Rightarrow$ Increasing returns to ideas and rival inputs together
  - $\gamma > 0$ measures the degree of IRS

- Hints at why effects can be large
  - One computer or year of school $\Rightarrow$ 1 worker more productive
  - One new idea $\Rightarrow$ any number of people more productive

*Distortions of the computer/schooling have small effects.*

*Distorting the creation of the idea*...
BGP from a Dynamic Growth Model

- BGP implies that stocks are proportional to flows:
  - $A$ and $B$ are proportional to $S_a$ and $S_b$ (to some powers)
  - $S_a$, $S_b$, $L$ all grow at the same exogenous population growth rate.

- Stock of applied ideas (being careless with exponents wlog)
  \[ A = \nu_a \mathbb{E}[e^\theta] S_a B^\beta \] (2)

- Stock of basic ideas
  \[ B = \nu_b S_b \] (3)
Output = Consumption:

- Combining (1) - (3) with $\tilde{M} = \mathbb{E}[e\theta]M$:

$$Y = \left( \nu \mathbb{E}[e\theta] S_a S_b^\beta \right)^\gamma (\mathbb{E}[e\theta]M)^\psi L^{1-\psi}$$

  - Output per person $y \propto (S_a S_b^\beta)^\gamma$
  - Intuition: $y$ depends on stock of ideas, not ideas per person
  - LR growth $= \gamma(1 + \beta)n$ where $n$ is population growth

- Taxes distort $\mathbb{E}(e\theta)$:
  - $\psi$ effect is traditional, but $\psi$ small?
  - $\gamma$ effect via nonrivalry of ideas, can be large!
Nonlinear Income Tax Revenue

\[ T = \tau_0 [wL + wS_b + w_a \mathbb{E}(e\theta)S_a + w_m \mathbb{E}(e\theta)M] \]

all income pays \( \tau_0 \)

\[ + (\tau - \tau_0) [(w_a \mathbb{E}(e\theta) - \bar{w})S_a + (w_m \mathbb{E}(e\theta) - \bar{w})M] \]

income above \( \bar{w} \) pays an additional \( \tau - \tau_0 \)

- Full growth model: entrepreneurs paid a constant share of GDP

\[ \frac{w_a \mathbb{E}(e\theta)S_a}{Y} = \rho_s \quad \text{and} \quad \frac{w_m \mathbb{E}(e\theta)M}{Y} = \rho_m. \]

and \( Y = wL + w_b S_b + w_a \mathbb{E}(e\theta)S_a + w_m \mathbb{E}(e\theta)M, \quad \rho \equiv \rho_s + \rho_m \)

\[ \Rightarrow T = \tau_0 Y + (\tau - \tau_0) [\rho Y - \bar{w}(S_a + M)] \]
Some Intuition

- Entrepreneurs/managers paid a constant share of GDP

\[
\frac{w_a \mathbb{E}(e\theta)S_a}{Y} = \rho_s \quad \text{and} \quad \frac{w_m \mathbb{E}(e\theta)M}{Y} = \rho_m.
\]

- Production:

\[
Y = \left(\nu \mathbb{E}[e\theta]S_a S_b^\beta\right) \gamma \left(\mathbb{E}[e\theta]M\right)^\psi L^{1-\psi}
\]

- Efficiency: Pay \(\sim\) Cobb-Douglas exponents. IRS means cannot!

- Jones and Williams (1998) social rate of return calculation:

\[
\tilde{r} = g_Y + \lambda g_y \left(\frac{1}{\rho_s(1 - \tau)} - \frac{1}{\gamma}\right)
\]

⇒ After tax share of payments to entrepreneurs should equal \(\gamma\)

\[
\rho_s(1 - \tau) \quad \text{versus} \quad \gamma \quad \text{is one way of viewing the tradeoff}
\]
The Top Tax Rate that Maximizes Revenue
Revenue-Maximizing Top Tax Rate

- Key policy problem:

$$\max_{\tau} T = \tau_0 Y + (\tau - \tau_0) [\rho Y - \bar{w}(S_a + M)]$$

s.t.

$$Y = \left( \nu \mathbb{E}[e\theta]S_a S_b^\beta \right)^\gamma (\mathbb{E}[e\theta]M)^\psi L^{1-\psi}$$

- A higher $\tau$ reduces the effort of entrepreneurs/managers
  - Leads to less innovation
  - which reduces everyone’s income ($Y$)
  - which lowers tax revenue received via $\tau_0$
Solution

\[
\max_{\tau} T = \tau_0 Y(\tau) + (\tau - \tau_0) \left[ \rho Y(\tau) - \bar{\omega} S_a \right]
\]

- **FOC:**
  
  \[
  \underbrace{(\rho - \bar{\rho}) Y}_{\text{mechanical gain}} + \underbrace{\frac{\partial Y}{\partial \tau} \cdot [(1 - \rho)\tau_0 + \rho \tau]}_{\text{behavioral loss}} = 0
  \]

  where \( \bar{\rho} \equiv \frac{\bar{\omega}(S_a+M)}{Y} \)

- **Rearranging with** \( \Delta \rho \equiv \rho - \bar{\rho} \)

  \[
  \tau^*_{rm} = \frac{1 - \tau_0 \cdot \frac{1-\rho}{\Delta \rho} \cdot \eta_{Y,1-\tau}}{1 + \frac{\rho}{\Delta \rho} \eta_{Y,1-\tau}}
  \]
\begin{align*}
\tau_{rm}^* &= \frac{1 - \tau_0 \cdot \frac{1 - \rho}{\Delta \rho} \cdot \eta_{Y,1-\tau}}{1 + \frac{\rho}{\Delta \rho} \eta_{Y,1-\tau}} \\
\text{vs} \\
\tau_{ds}^* &= \frac{1}{1 + \alpha \cdot \eta_{z_m,1-\tau}}
\end{align*}

• Remarks: Two key differences

○ $\eta_{Y,1-\tau}$ versus $\eta_{z_m,1-\tau}$

$\eta_{Y,1-\tau} \Rightarrow$ How GDP changes if researchers keep more

$\eta_{z_m,1-\tau} \Rightarrow$ How average top incomes change

○ If $\tau_0 > 0$, then $\tau^*$ is lower

Distorting research lowers GDP

$\Rightarrow$ lowers revenue from other taxes!
Guide to Intuition

$\eta_{Y,1-\tau}$ The economic model

$\rho \eta_{Y,1-\tau}$ Behavioral effect via top earners

$(1 - \rho) \eta_{Y,1-\tau}$ Behavioral effect via workers

$\Delta \rho \equiv \rho - \bar{\rho}$ Tax base for $\tau$, mechanical effect

$1 - \Delta \rho$ Tax base for $\tau_0$
What is $\eta_{Y,1-\tau}$?

\[ Y = \left( \nu \mathbb{E}[e\theta] S_a S_b^\beta \right)^\gamma (\mathbb{E}[e\theta] M)^{\psi L^{1-\psi}} \Rightarrow \eta_{Y,1-\tau} = (\gamma + \psi)\zeta \]

- $\gamma = \text{degree of IRS via ideas}$
- $\psi = \text{manager’s share} = 0.15$ (not important)
- $\zeta = \text{the elasticity of } \mathbb{E}[e\theta] \text{ with respect to } 1 - \tau$.
  - Standard Diamond-Saez elasticity: $\zeta = \eta_{zm,1-\tau}$
  - How individual behavior changes when the tax rate changes
  - Cool insight from PublicEcon: all that matters is the value of this elasticity, not the mechanism!
  - So for now, just treat as a parameter (endogenized later)
Calibration

- Parameter values for numerical examples

$$\gamma \in \left[\frac{1}{8}, 1\right]$$

$$g_{\text{tp}} = \gamma(1 + \beta) \cdot g_S \approx 1\%.$$  

$$\zeta \in \{0.1, 0.2, 0.3\}$$

Uncompensated elasticity < Chetty, Saez

$$\tau_0 = 0.2$$

Average tax rate outside the top.

$$\Delta \rho = 0.10$$

Share of income taxed at the top rate; top returns account for 20% of taxable income.

$$\rho = 0.15$$

So \(\frac{\rho}{\Delta \rho} = 1.5\) as in Saez pareto parameter, \(\alpha\).
## Revenue-Maximizing Top Tax Rate, $\tau_{r*}$

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Revenue-Maximizing Top Tax Rate, $\tau_{rm}^*$

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Intuition: Double the “keep rate” $1 - \tau$

- What is the long-run effect on GDP?
  - Answer: $2^{\eta y, 1-\tau} = 2^{\gamma \zeta}$
  - Baseline: $\gamma = 1/2$ and $\zeta = 0.2 \Rightarrow 2^{1/10} \approx 1.07$

Going from $\tau = 75\%$ to $\tau = 50\%$ raises GDP by just 7%!

- With $\Delta \rho = 10\%$, the revenue cost is 2.5% of GDP
  - 7% gain to everyone...
    > redistributing 2.5% to the bottom half!

- 7% seems small, but achieved by a small group of researchers working 15% harder...
Maximizing Worker Welfare

– In Saez (2001), revenue max = max worker welfare
– Not here! Ignores effect on consumption
– Worker welfare yields a clean closed-form solution
Choose $\tau$ and $\tau_0$ to Maximize Worker Welfare

- **Workers:**

  \[ c^{w} = w(1 - \tau_0) \]

  \[ u_w(c) = \theta \log c \]

- **Government budget constraint**

  \[ \tau_0 Y + (\tau - \tau_0)[\rho Y - \bar{w}(S_a + M)] = \Omega Y \]

  Exogenous government spending share of GDP = $\Omega$
  (to pay for basic research, legal system, etc.)

- **Problem:**

  \[ \max_{\tau, \tau_0} \log(1 - \tau_0) + \log Y(\tau) \quad \text{s.t.} \]

  \[ \tau_0 Y + (\tau - \tau_0)[\rho Y - \bar{w}(S_a + M)] = \Omega Y. \]
First Order Conditions

• The top rate that maximizes worker welfare satisfies

\[ \tau_{ww}^* = \frac{1 - \eta_{Y,1-\tau} \left( \frac{1-\rho}{\Delta \rho} \cdot \tau_0^* + \frac{1-\Delta \rho}{\Delta \rho} \cdot (1 - \tau_0^*) - \frac{\Omega}{\Delta \rho} \right)}{1 + \frac{\rho}{\Delta \rho} \eta_{Y,1-\tau}}. \]

• Three new terms relative to Saez:

\[ \eta \frac{1-\rho}{\Delta \rho} \cdot \tau_0^* \quad \text{Original term from RevMax} \]

\[ \eta \frac{1-\Delta \rho}{\Delta \rho} \cdot (1 - \tau_0^*) \quad \text{Direct effect of a higher tax rate reducing GDP} \]
\[ \Rightarrow \text{reduce workers consumption} \]

\[ \eta \frac{\Omega}{\Delta \rho} \quad \text{Need to raise } \Omega \text{ in revenue} \]
**Intuition**

- When is a “flat tax” optimal?

\[ \tau \leq \tau_0 \iff \eta_{Y,1-\tau} \geq \frac{\Delta \rho}{1 - \Delta \rho}. \]

Two ways to increase $\bar{c}^\psi$:

- $\downarrow \tau \Rightarrow$ raises GDP by $\eta_{Y,1-\tau}$
- Redistribute $\Rightarrow$ take from $\Delta \rho$ people, give to $1 - \Delta \rho$

- Baseline parameters: $\eta_{Y,1-\tau} = \frac{1}{5}(\gamma + \psi)$ and $\frac{\Delta \rho}{1-\Delta \rho} = \frac{1}{9}$.

\[ \gamma + \psi > \frac{5}{9} \approx 0.56 \Rightarrow \tau < \tau_0. \]
The top rate that maximizes worker welfare can be negative!
Maximizing Utilitarian Social Welfare
Entrepreneurs and Managers

- Utility function depends on consumption and effort:

\[ u(c, e) = \varphi \log c - \frac{\varepsilon}{1 + \varepsilon} e^{\frac{1+\varepsilon}{\varepsilon}} \]

- Researcher with talent \( \theta \) solves

\[
\max_{c, e} u(c, e) \quad \text{s.t.} \\
\begin{align*}
    c &= \bar{w}(1 - \tau_0) + [w_s e \theta - \bar{w}] (1 - \tau) + R \\
    &= \bar{w}(1 - \tau_0) - \bar{w}(1 - \tau) + w_s e \theta (1 - \tau) + R \\
    &= \bar{w}(\tau - \tau_0) + w_s e \theta (1 - \tau) + R
\end{align*}
\]

where \( R \) is a lump sum rebate.

- FOC:

\[ e = \left( \frac{\varphi w_s \theta (1 - \tau)}{c} \right)^\varepsilon \]
SE/IE and Rebates

- Log preferences imply that SE and IE cancel: \( \frac{\partial e}{\partial \tau} = 0 \)

- Standard approach is to rebate tax revenue to neutralize the IE.
  - Tricky here because IE’s are heterogeneous!

- Shortcut: heterogeneous rebates that vary with \( \theta \) to deliver

\[
c_\theta = w_s e\theta (1 - \tau)^{1 - \alpha}
\]

\[
e_\theta = e^* = [\varphi (1 - \tau)^{\alpha}]^{\frac{\epsilon}{1+\epsilon}} \equiv [\varphi^{1/\alpha} (1 - \tau)]^{\zeta_u}
\]

where \( \zeta_u \) is the uncompensated elasticity of effort wrt \( 1 - \tau \)

- \( \eta_{Y,1-\tau} = (\gamma + \psi) \zeta_u \) and \( \zeta_u \equiv \alpha^{\frac{\epsilon}{1+\epsilon}} \)

- \( \alpha \) governs tradeoff with redistribution
Utilitarian Social Welfare

• Social Welfare:

\[ \text{SWF} \equiv L u(c^w) + S_b u(c^b) + S_a \int u(c_z^s, e_z^s) dF(z) + M \int u(c_z^m, e_z^m) dF(z) \]

• Substitution of equilibrium conditions gives

\[ \text{SWF} \propto \log Y + \ell \log(1 - \tau_0) + s[(1 - \alpha) \log(1 - \tau) - \frac{\zeta u}{\alpha}(1 - \tau)^\alpha] \]

where \( s \equiv \frac{S_a + M}{L + S_b + S_a + M}, \ \ell \equiv 1 - s, \)
Proposition 2 gives the tax rates, written in terms of the “keep rates” \( \kappa \equiv 1 - \tau \) and \( \kappa_0 \equiv 1 - \tau_0 \).

Two well-behaved nonlinear equations:

\[
\zeta u \kappa^{\alpha} + \frac{\kappa}{\kappa_0} \cdot \frac{\ell}{1 - \Delta \rho} (\Delta \rho + \bar{\rho} \eta) = \eta \left( 1 + \frac{\bar{\rho} \ell}{1 - \Delta \rho} \right) + s(1 - \alpha)
\]

\[
\kappa_0 (1 - \Delta \rho) + \kappa \Delta \rho = 1 - \Omega.
\]
Maximizing Social Welfare: \( \alpha = 1 \)
### Tax Rates that Maximize Social Welfare ($\alpha = 1$)

<table>
<thead>
<tr>
<th>Degree of IRS, $\gamma$</th>
<th>GDP loss if $\tau = 0.75$</th>
<th>$\zeta_u = 0.2$</th>
<th>$\zeta_u = 0.1$</th>
<th>$\zeta_u = 0.3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.77</td>
<td>-0.3%</td>
<td>0.87</td>
<td>0.68</td>
</tr>
<tr>
<td>1/8</td>
<td>0.59</td>
<td>2.6%</td>
<td>0.77</td>
<td>0.44</td>
</tr>
<tr>
<td>1/4</td>
<td>0.42</td>
<td>6.4%</td>
<td>0.68</td>
<td>0.22</td>
</tr>
<tr>
<td>1/2</td>
<td>0.12</td>
<td>15.1%</td>
<td>0.49</td>
<td>-0.17</td>
</tr>
<tr>
<td>1</td>
<td>-0.40</td>
<td>32.7%</td>
<td>0.16</td>
<td>-0.81</td>
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</tbody>
</table>
Tax Rates that Maximize Social Welfare (α = 1/2)

<table>
<thead>
<tr>
<th>Degree of IRS, γ</th>
<th>GDP loss, if τ = 0.75</th>
<th>ζ_u = 0.1</th>
<th>ζ_u = 0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.46 2.3%</td>
<td>0.51</td>
<td>0.40</td>
</tr>
<tr>
<td>1/8</td>
<td>0.28 5.6%</td>
<td>0.42</td>
<td>0.16</td>
</tr>
<tr>
<td>1/4</td>
<td>0.12 9.6%</td>
<td>0.33</td>
<td>-0.06</td>
</tr>
<tr>
<td>1/2</td>
<td>-0.17 18.2%</td>
<td>0.16</td>
<td>-0.45</td>
</tr>
<tr>
<td>1</td>
<td>-0.67 35.4%</td>
<td>-0.15</td>
<td>-1.07</td>
</tr>
</tbody>
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Intuition: First-Best Effort

• What if social planner could choose consumption and effort?

• The tax rate that implements first-best effort satisfies

\[
(1 - \tau)^\alpha = \frac{\gamma}{s_a}
\]

⇒ **Negative** top tax rate if \( s_a < \gamma \).

• Illustrates a key point:

the fact that a **small share of people,** \( s \)
create **nonrival ideas that drive growth via** \( \gamma \)
constrains the **top tax rate,** \( \tau \)
# Summary of Calibration Exercises

<table>
<thead>
<tr>
<th>Exercise</th>
<th>$\zeta_u = .1$</th>
<th>$\zeta_u = .2$</th>
<th>$\zeta_u = .3$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No ideas, $\gamma = 0$</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue-maximization, $\tau_0 = 0$</td>
<td>0.98</td>
<td>0.96</td>
<td>0.94</td>
</tr>
<tr>
<td>Revenue-maximization, $\tau_0 = 0.20$</td>
<td>0.95</td>
<td>0.91</td>
<td>0.87</td>
</tr>
<tr>
<td><strong>With ideas, $\gamma = 1/2$</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue-maximization</td>
<td>0.81</td>
<td>0.65</td>
<td>0.52</td>
</tr>
<tr>
<td>Maximize worker welfare</td>
<td>0.50</td>
<td>0.09</td>
<td>-0.26</td>
</tr>
<tr>
<td>Maximize utilitarian welfare ($\alpha = 1$)</td>
<td>0.49</td>
<td>0.12</td>
<td>-0.17</td>
</tr>
<tr>
<td>Maximize utilitarian welfare ($\alpha = 1/2$)</td>
<td>0.16</td>
<td>-0.17</td>
<td>-0.45</td>
</tr>
</tbody>
</table>

*Incorporating ideas sharply lowers the top tax rate.*
Discussion
Evidence on Growth and Taxes? Important and puzzling!!!

- Stokey and Rebelo (1995)
  - Growth rates flat in the 20th century
  - Taxes changed a lot!

- But the counterfactual is unclear
  - Government investments in basic research after WWII
  - Decline in basic research investment in recent decades?
  - Maybe growth would have slowed sooner w/o ↓ \( \tau \)

- Short-run vs long-run?
  - Shift from goods to ideas may reduce GDP in short run...
Taxes in the United States

Top marginal tax rate (left scale)

Total government revenues as a share of GDP (right scale)
U.S. GDP per person

PER CAPITA GDP (RATIO SCALE, 2017 DOLLARS)

YEAR

2.0% per year
U.S. R&D Spending Share

- **Private R&D**
- **Government R&D**
- **Software and Entertainment**


Share of GDP:
- 0%
- 1%
- 2%
- 3%
- 4%
- 5%
- 6%
The Social Return to Research

• How big is the gap between equilibrium share and optimal share to pay for research?

• Jones and Williams (1998) social rate of return calculation here:

\[ \tilde{r} = g_Y + \lambda g_y \left( \frac{1}{\rho_s (1 - \tau)} - \frac{1}{\gamma} \right) \]

⇒ After tax share of payments to entrepreneurs should equal \( \gamma \)

• Simple calibration: \( \tau = 1/2 \) ⇒ \( \tilde{r} = 39\% \) if \( \rho_s = 10\% \)
  - Consistent with SROR estimates e.g. Bloom et al. (2013)
  - But those are returns to formal R&D...
Environment for Full Growth Model

Final output

\[ Y_t = \int_0^{A_t} x_{it}^{1-\psi} di \left( \mathbb{E}(e\theta)M_t \right)^\psi \]

Production of variety \( i \)

\[ x_{it} = \ell_{it} \]

Resource constraint (\( \ell \))

\[ \int \ell_{it} di = L_t \]

Resource constraint (\( N \))

\[ L_t + S_{bt} = N_t \]

Population growth

\[ N_t = \bar{N} \exp(nt) \]

Entrepreneurs

\[ S_{at} = \bar{S}_a \exp(nt) \]

Managers

\[ M_t = \bar{M} \exp(nt) \]

Applied ideas

\[ \dot{A}_t = \bar{a}(\mathbb{E}(e\theta)S_{at})^\lambda A_t^{\phi_a} B_t^{\alpha} \]

Basic ideas

\[ \dot{B}_t = \bar{b}S_{bt}^\lambda B_t^{\phi_b} \]

Talent heterogeneity

\[ \theta_i \sim F(\theta) \]

Utility \( (S_a, M) \)

\[ u(c, e) = \varphi \log c - \frac{e}{1+\varepsilon} \frac{1+\varepsilon}{e} \]
Conclusion

- Lots of unanswered questions
  - Why is evidence on growth and taxes so murky?
  - What is true effect of taxes on growth and innovation? Akcigit et al (2018) makes progress...
  - At what income does the top rate apply?
  - Capital gains as compensation for innovation
  - Transition dynamics

- Still, innovation is a key force that needs to be incorporated
  - Distorting the behavior of a small group of innovators can affect all our incomes