Taxing Top Incomes
in a World of Ideas

Chad Jones

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Overview

• Saez (2001) and following literature
  “Macro”-style calibration of optimal top income taxation
  Many extensions to $K$, $H$, dynamics — but not ideas!

• How does this calculation change when:
  ◦ New ideas drive economic growth
  ◦ The reward for a new idea is a top income
  ◦ Creation of ideas is broad
    – A formal “research subsidy” is imperfect (Walmart, Amazon)
  ◦ 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**: 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
  - Semi-endogenous growth
  - Basic R&D (subsidized directly), Applied R&D (top tax rate)
  - BGP simplifies: static comparison vs transition dynamics

- Three alternative approaches to the top tax rate:
  - Revenue maximization
  - Maximize welfare of “workers”
  - Maximize utilitarian social welfare
The Economic Environment

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

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

- 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. \( e, z \) endogenous (unspecified for now)
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)
  - $S_a, S_b, L, M$: exogenous population growth

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

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

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

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

  ○ 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 $\mathbb{E}(ez)$:

  ○ $\psi$ effect is traditional, but $\psi$ small?

  ○ $\gamma$ effect via nonrivalry of ideas, can be large!
Nonlinear Income Tax Revenue

\[ T = \tau_0 [w_L + w_S b + w_a \mathbb{E}(ez) S_a + w_m \mathbb{E}(ez) M] \]

---

**all income pays** \( \tau_0 \)

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

---

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

---

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

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

---

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

---

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

• Entrepreneurs/managers paid a constant share of GDP

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

• Production: \[ Y = \left( \nu \mathbb{E}[e_z] S_a S^\beta \right)^\gamma (\mathbb{E}[e_z] M)^\psi L^{1-\psi} \]

• Efficiency: Pay \sim\text{ 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 \( \gamma \)

\( \rho_s (1 - \tau) \) versus \( \gamma \) 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.

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

- 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

\[ \tau^*_r = \frac{1 - \tau_0 \cdot \frac{1 - \rho}{\Delta \rho} \cdot \eta_{Y,1-\tau}}{1 + \frac{\rho}{\Delta \rho} \eta_{Y,1-\tau}} \quad \text{vs} \quad \tau^*_d = \frac{1}{1 + \alpha \cdot \eta_{z_m,1-\tau}} \]

- 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

\[ \eta_{Y,1-\tau} \quad \text{The economic model} \]

\[ \rho \eta_{Y,1-\tau} \quad \text{Behavioral effect via top earners} \]

\[ (1 - \rho) \eta_{Y,1-\tau} \quad \text{Behavioral effect via workers} \]

\[ \Delta \rho \equiv \rho - \bar{\rho} \quad \text{Tax base for } \tau, \text{ mechanical effect} \]

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

$$Y = \left(\nu \mathbb{E}[ez]S_aS_b^\beta\right)^\gamma (\mathbb{E}[ez]M)^\psi L^{1-\psi} \implies \eta_{Y,1-\tau} = (\gamma + \psi)\zeta$$

- $\gamma$ = degree of IRS via ideas
- $\psi$ = manager’s share = 0.15 (not important)
- $\zeta$ is the elasticity of $\mathbb{E}[ez]$ 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

\[ \frac{\zeta}{1-\zeta} \in \{0.2, 0.5\} \]  
Behavioral elasticity. Saez values

\[ \gamma \in [1/8, 1] \] 
\[ g_{tfp} = \gamma(1 + \beta) \cdot g_S \approx 1\% . \]

\[ \tau_0 = 0.2 \]  
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, $\tau^*_r$  

<table>
<thead>
<tr>
<th>Case</th>
<th>Behavioral Elasticity</th>
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<tbody>
<tr>
<td></td>
<td>0.20</td>
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Intuition: Double the “keep rate” $1 - \tau$ (e.g. $\tau = 75\%$ to $\tau = 50\%$).

- What is the long-run effect on GDP?
  
  - Answer: $2^{\eta_y (1-\tau)} = 2^{\gamma \zeta}$
  
  - Baseline: $\gamma = 1/2$ and $\zeta = 1/6 \Rightarrow 2^{1/12} \approx 1.06$
    
    Raises GDP by just 6%!

- With $\Delta \rho = 10\%$, the revenue cost is 2.5% of GDP
  
  6% gain to everyone...
  
  > redistributing 2.5% to the bottom half!

- 6% seems small, but achieved by a small group of researchers working 15% harder...
Maximizing Worker Welfare

- Revenue-max ignores effect on consumption
- Worker welfare yields a clean closed-form solution
Choose $\tau$ and $\tau_0$ to Maximize Worker Welfare

- Workers:  
  $$c^{\bar{w}} = w(1 - \tau_0)$$  
  $$\nu_w(c) = \theta \log c$$

- 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 \( c^w \):

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

- Baseline parameters: \( \eta_{Y,1-\tau} = \frac{1}{6}(\gamma + \psi) \) and \( \frac{\Delta \rho}{1 - \Delta \rho} = \frac{1}{9} \).

\[ \gamma + \psi > \frac{2}{3} \Rightarrow \tau < \tau_0. \]
## Tax Rates that Maximize Worker Welfare

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<td>$\tau_{ww}^*$</td>
<td>$\tau_0^*$</td>
</tr>
<tr>
<td>1/8</td>
<td>0.64</td>
<td>0.15</td>
</tr>
<tr>
<td>1/4</td>
<td>0.49</td>
<td>0.17</td>
</tr>
<tr>
<td>1/2</td>
<td>0.22</td>
<td>0.20</td>
</tr>
<tr>
<td>1</td>
<td>-0.25</td>
<td>0.25</td>
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The top rate that maximizes worker welfare can be negative!
### Summary of Calibration Exercises

<table>
<thead>
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<th>Exercise</th>
<th>Top rate, $\tau$</th>
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<tr>
<td><strong>No ideas, $\gamma = 0$</strong></td>
<td></td>
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<td>Revenue-maximization, $\tau_0 = 0$</td>
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<tr>
<td><strong>With ideas</strong></td>
<td></td>
</tr>
<tr>
<td></td>
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<td>Maximize utilitarian welfare</td>
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<td>Maximize worker welfare</td>
<td>-0.25</td>
</tr>
<tr>
<td>Maximize utilitarian welfare</td>
<td>-0.05</td>
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*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 $\downarrow \tau$

- 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
Environment for Full Growth Model

Final output

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

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

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

Basic ideas

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

Talent heterogeneity

\[ z_i \sim F(z) \]

Utility \( (S_a, M) \)

\[ u(c, e) = \theta \log c - \zeta e^{1/\zeta} \]
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
Extra Slides
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 \( z_m \Rightarrow \) 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

\[ \Rightarrow \quad \tau_{d-s}^* \approx 77\% \]
Solution

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

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

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

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

  \[ \tau_{r\text{m}}^* = \frac{1 - \tau_0 \cdot \frac{1 - \rho}{\Delta \rho} \cdot \eta_{Y,1-\tau}}{1 + \frac{\rho}{\Delta \rho} \eta_{Y,1-\tau}} \]
Maximizing Utilitarian Social Welfare
Entrepreneurs and Managers

• Utility function depends on consumption and effort:

\[ u(c, e) = \theta \log c - \zeta e^{1/\zeta} \]

• Researcher with talent \( z \) solves

\[
\max_{c, e} u(c, e) \quad \text{s.t.}
\]

\[
c = \bar{w}(1 - \tau_0) + [w_s ez - \bar{w}](1 - \tau) + R
\]

\[
= \bar{w}(1 - \tau_0) - \bar{w}(1 - \tau) + w_s ez(1 - \tau) + R
\]

\[
= \bar{w}(\tau - \tau_0) + w_s ez(1 - \tau) + R
\]

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

• FOC:

\[ e^{\frac{1}{\zeta} - 1} = \frac{\theta w_s ez(1 - \tau)}{c} . \]
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 \( z \) to deliver

\[
c_z = ws e_z (1 - \tau)^{1-\alpha}
\]

\[
e_z = e^* = [\theta (1 - \tau)^\alpha] \zeta,
\]

where \( \alpha \) parameterizes the elasticity of effort wrt \( 1 - \tau \)

- \( \eta_{Y,1-\tau} = \alpha \zeta (\gamma + \psi) \)

- governs tradeoff with redistribution
Utilitarian Social Welfare

- Social Welfare:

\[
SWF \equiv Lu(c^w) + S_b u(c^b) + S_a \int u(c^s_z, e^s_z) dF(z) + M \int u(c^m_z, e^m_z) dF(z)
\]

- Substitution of equilibrium conditions gives

\[
SWF \propto \log Y + \ell \log(1 - \tau_0) + s[(1 - \alpha) \log(1 - \tau) - \zeta(1 - \tau)^\alpha]
\]

where \( s \equiv \frac{S_a + M}{L + S_b + S_a + M} \), \( \ell \equiv 1 - s \),
Tax Rates that Maximize Social Welfare

- 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:

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

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

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<td>GDP loss if $\tau = 0.75$</td>
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<td>1/8</td>
<td>0.649</td>
<td>0.7%</td>
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<tr>
<td>1/4</td>
<td>0.502</td>
<td>2.8%</td>
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<td>0.231</td>
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<tr>
<td>1</td>
<td>-0.238</td>
<td>23.4%</td>
</tr>
</tbody>
</table>
Tax Rates that Maximize Social Welfare ($\alpha = 1/2$)

<table>
<thead>
<tr>
<th>Degree of IRS, $\gamma$</th>
<th>Behavioral elast. = 0.2</th>
<th>Behavioral elast. = 0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\tau^*$ if $\tau = 0.75$</td>
<td>$\tau^*$ if $\tau = 0.75$</td>
</tr>
<tr>
<td>1/8</td>
<td>0.445 0.8%</td>
<td>0.328 2.0%</td>
</tr>
<tr>
<td>1/4</td>
<td>0.369 1.9%</td>
<td>0.189 4.8%</td>
</tr>
<tr>
<td>1/2</td>
<td>0.222 4.6%</td>
<td>-0.070 11.4%</td>
</tr>
<tr>
<td>1</td>
<td>-0.047 11.3%</td>
<td>-0.517 26.0%</td>
</tr>
</tbody>
</table>
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:

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

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

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