Reforming the Social Security Earnings Cap: The Role of Endogenous Human Capital

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Motivation

- Social Security payroll tax "capped" at $\$118,500$
- Policy makers have proposed eliminating cap
  - US Congress (six bills 2013-14)
  - 2016 presidential candidates
- Main goals
  - Extend solvency
  - Fund benefit increases
- Likely to be quantitatively important
  - 7% of workers earn above cap, 16% of earnings above cap
  - These workers have high hourly wages, tend to save a lot
  - Decrease in marginal after-tax wages would be large

Question

What would be the long run impact of eliminating the cap?

- Aggregate output
  - Savings
  - Labor supply
  - **Human capital investment**
- Government revenue
- Distribution of consumption, welfare

What I do

- Construct OLG model with endogenous human capital
- Calibrate model to
  - Life-cycle earnings and hours data for US
  - US federal income tax and Social Security program
- Analyze steady state impact of three reforms:
  1. Eliminate cap. Government eats extra revenue.
  2. Eliminate cap. Lower payroll tax rate.
  3. Eliminate cap. Raise benefits lump sum.

Key results

- Aggregate impact is large
- Increase in government revenues is small
- Welfare effects are heterogenous

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  - Output, consumption fall $2.1 - 3.1\%$
  - **Depressed human capital investment** accounts for half
  - **Non-convexity** from cap magnifies effect
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- Welfare effects are heterogenous
  - $\approx 70\%$ of newborns gain, gains small
  - $\approx 30\%$ of newborns lose, losses large

Outline

1. Simple illustration: impact of eliminating cap
2. The full model
3. Calibrate the benchmark economy to the US
4. Analyze three reforms

Simple illustration:
Impact of eliminating cap

Model setup

- **2-period model** with a single worker
- **Endowments**
  - At birth, initial human capital h_1
  - Each period, one unit of time
- **Decisions**
  - Human capital investment, s
  - Production, $1 - s$
  - Consumption, c
- **Human capital technology**: $h_{t+1} = h_t + s_t^{\theta}$

Worker's problem

- **Preferences**: $u(c_1) + \beta u(c_2)$

- **Taxes**: Earnings below $\hat{e}$ taxed at rate τ

- **Budget constraint**:

$$\begin{aligned} c_1 + c_2 \;\leq\; & (1-\tau)\min\{h_1(1-s_1), \hat{e}\} + \max\{h_1(1-s_1) - \hat{e}, 0\} \\ & +(1-\tau)\min\{h_2 \qquad\quad, \hat{e}\} + \max\{h_2 - \hat{e} \qquad\quad, 0\} \end{aligned}$$

- **Solution**: Choose s_1 to maximize RHS of budget constraint

What would be the impact of setting $\hat{e} = \infty$?

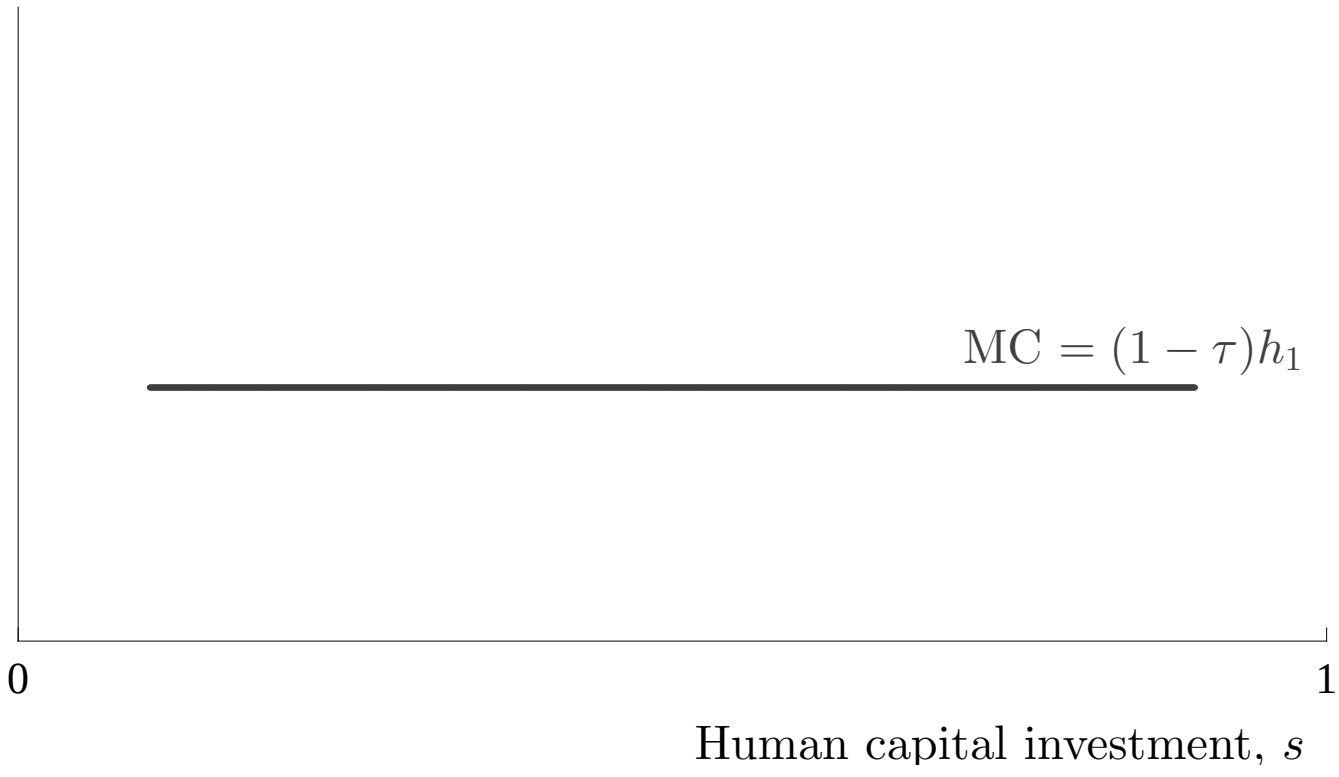
Budget constraint:

$$\begin{aligned}&(1-\tau)\min\{h_1(1-s_1),\hat{e}\} + (1-\tau)\max\{h_1(1-s_1)-\hat{e},0\}\\ +&(1-\tau)\min\{h_2\qquad\qquad,\hat{e}\} + (1-\tau)\max\{h_2-\hat{e}\qquad\qquad,0\}\end{aligned}$$

Three cases:

1. Very low h_1 (no impact)
2. Very high h_1 (no impact)
3. Intermediate h_1

Eliminating the cap depresses human capital investment



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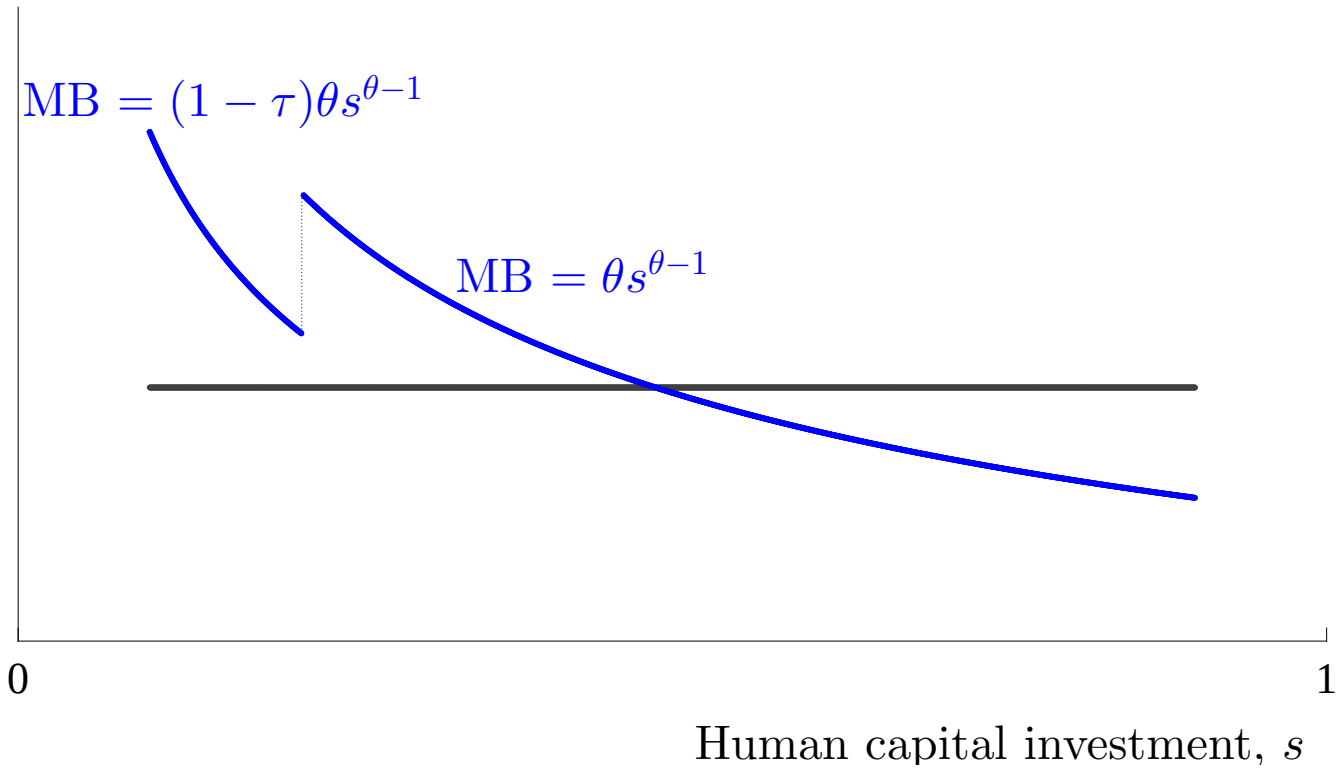
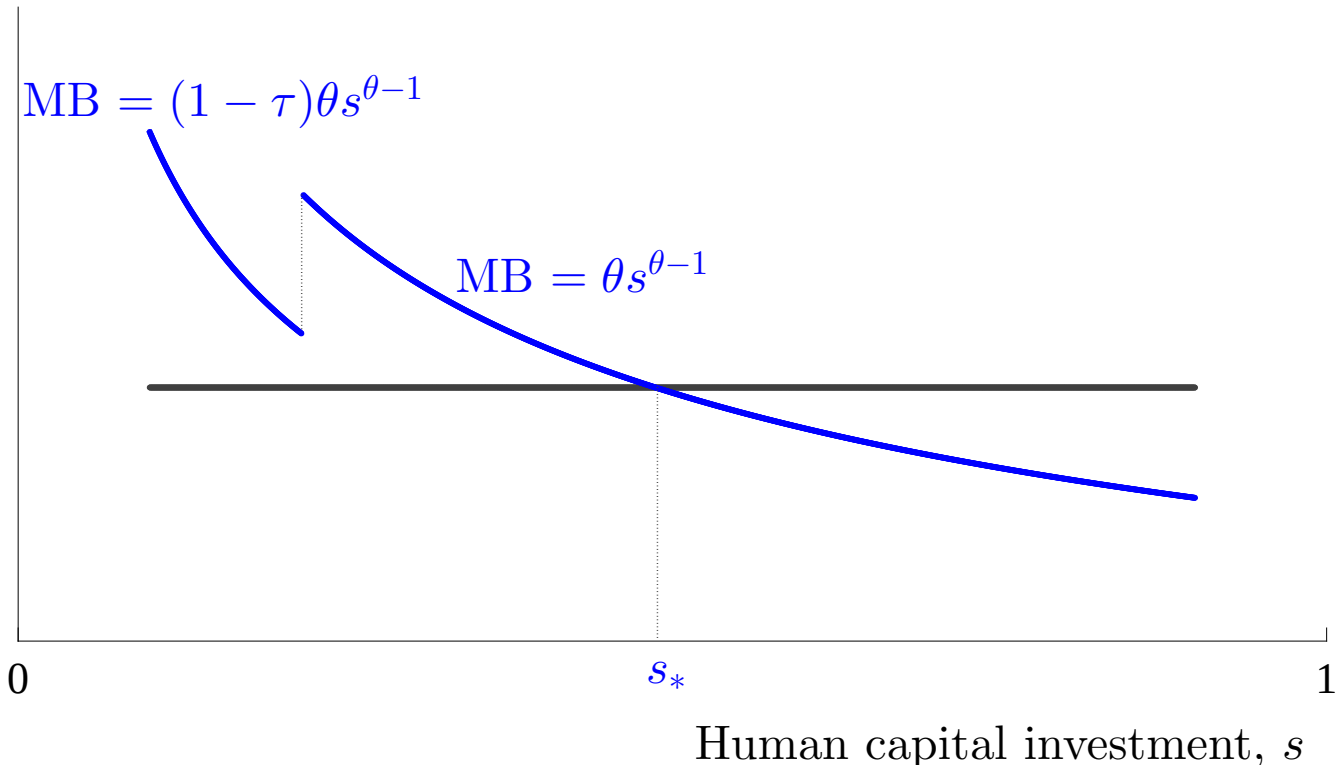


Eliminating the cap depresses human capital investment



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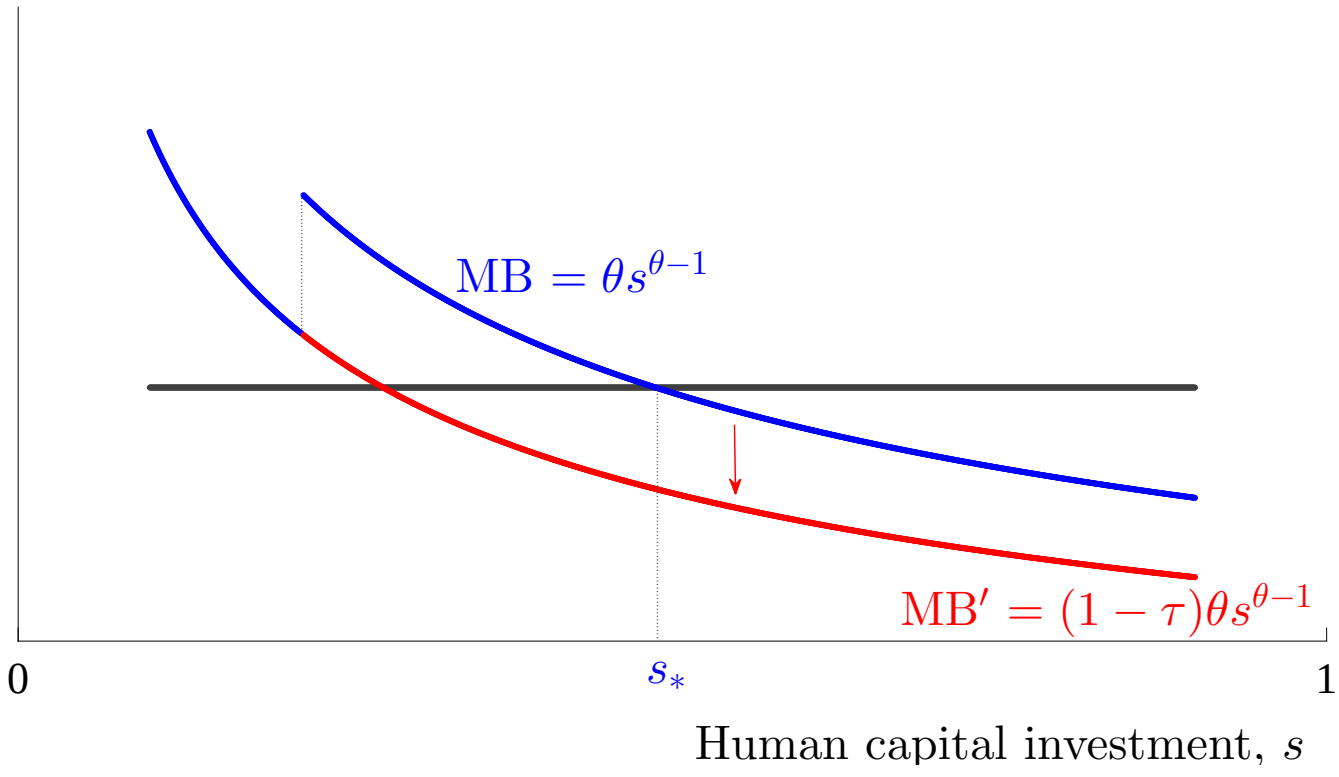

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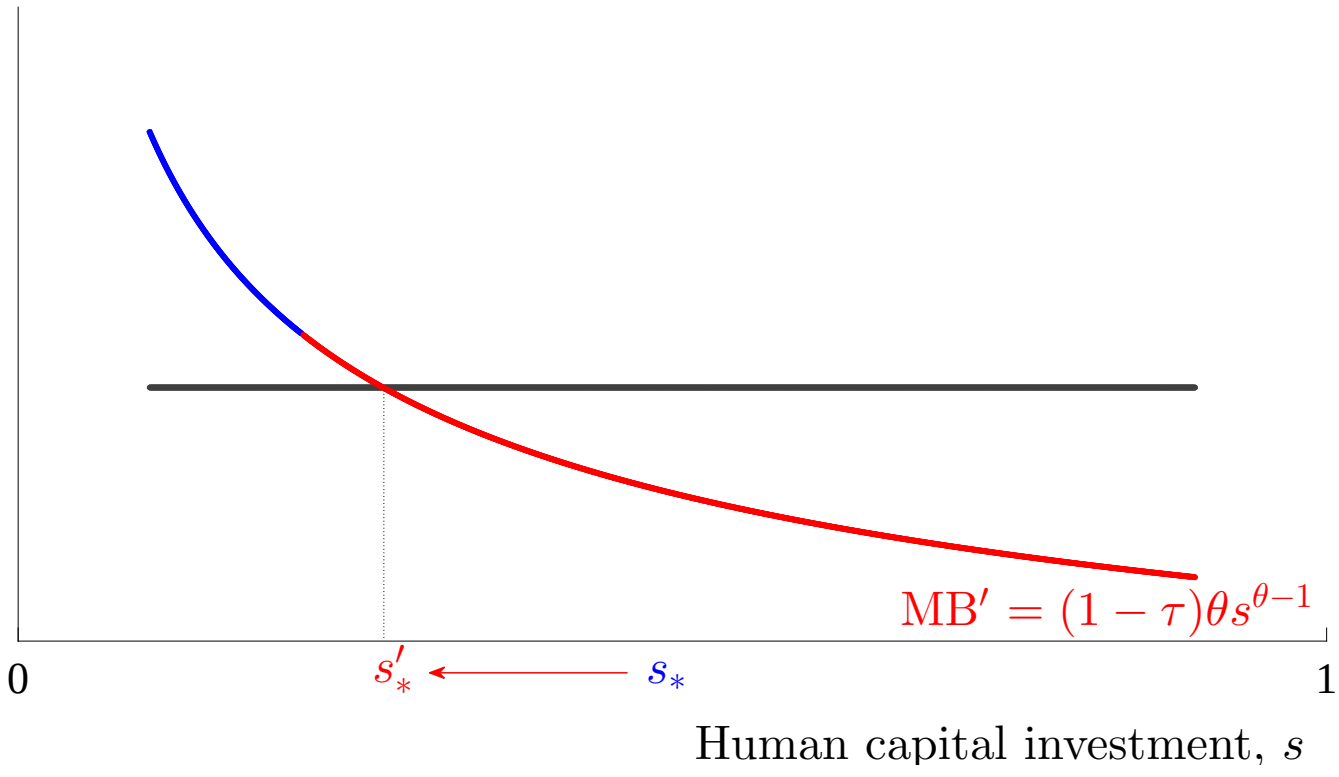
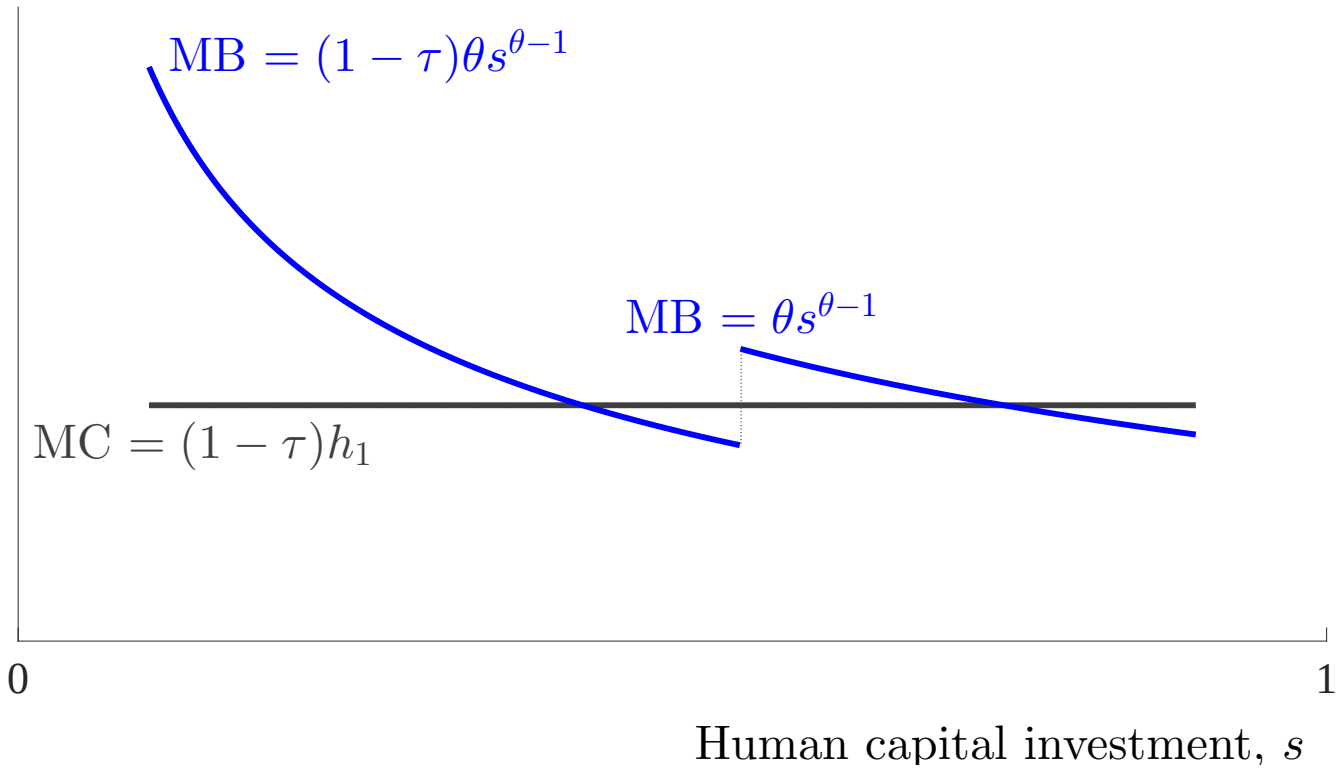


Earnings can fall BELOW cap



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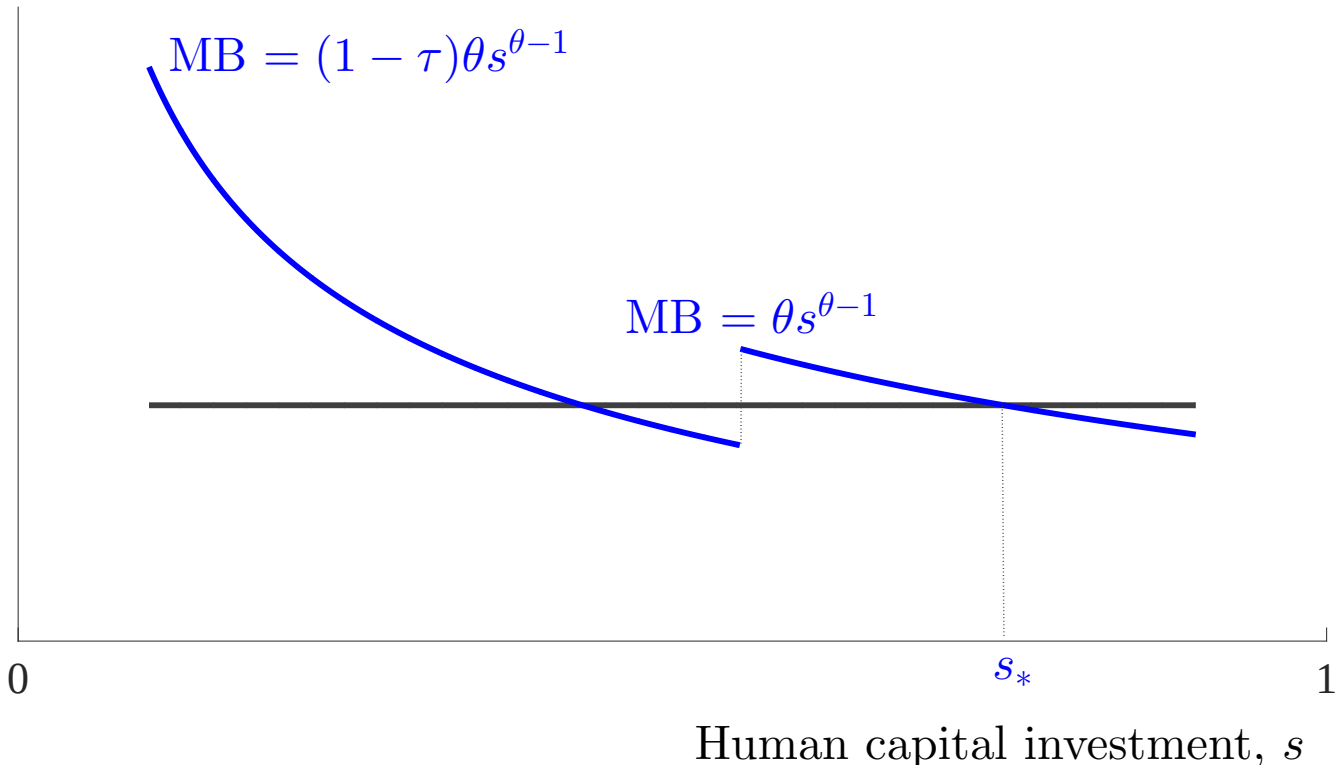

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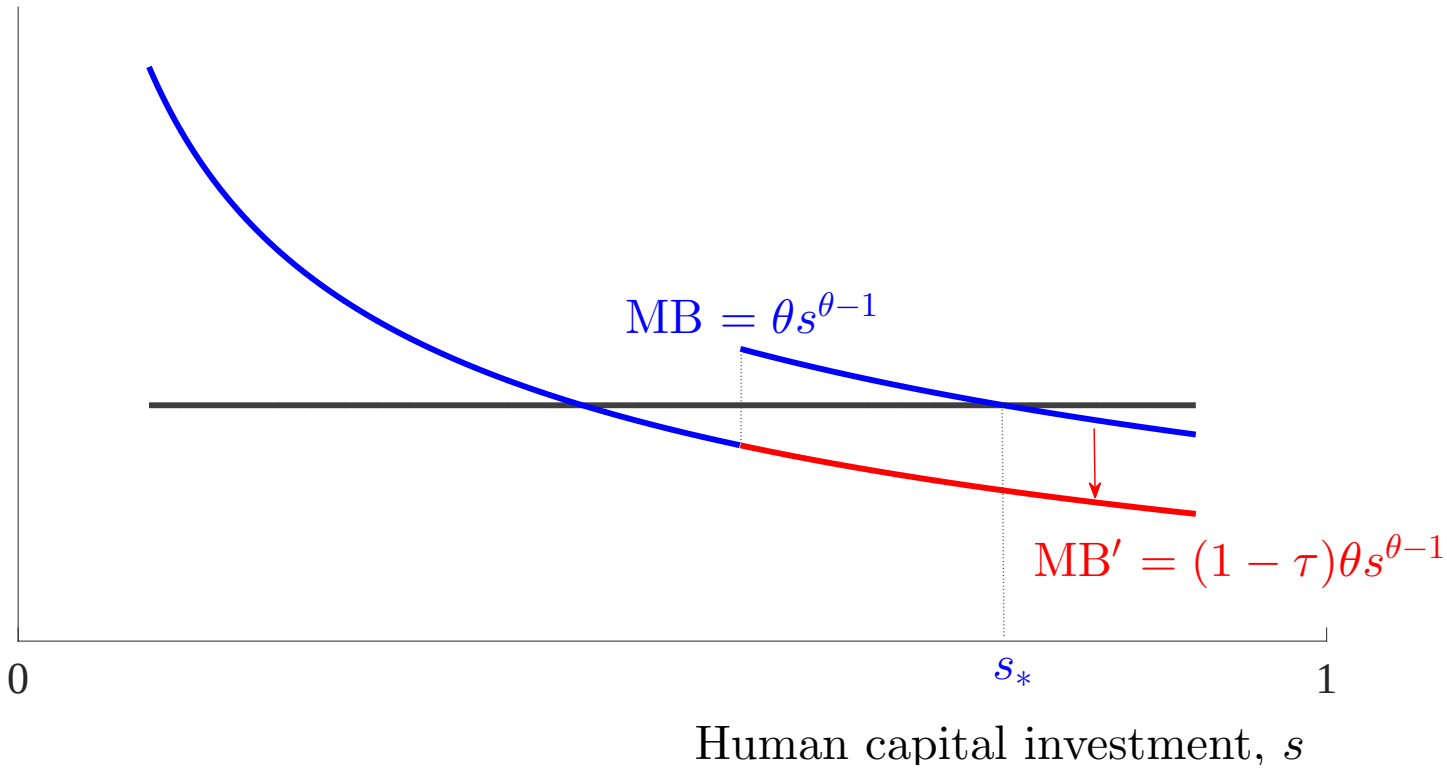

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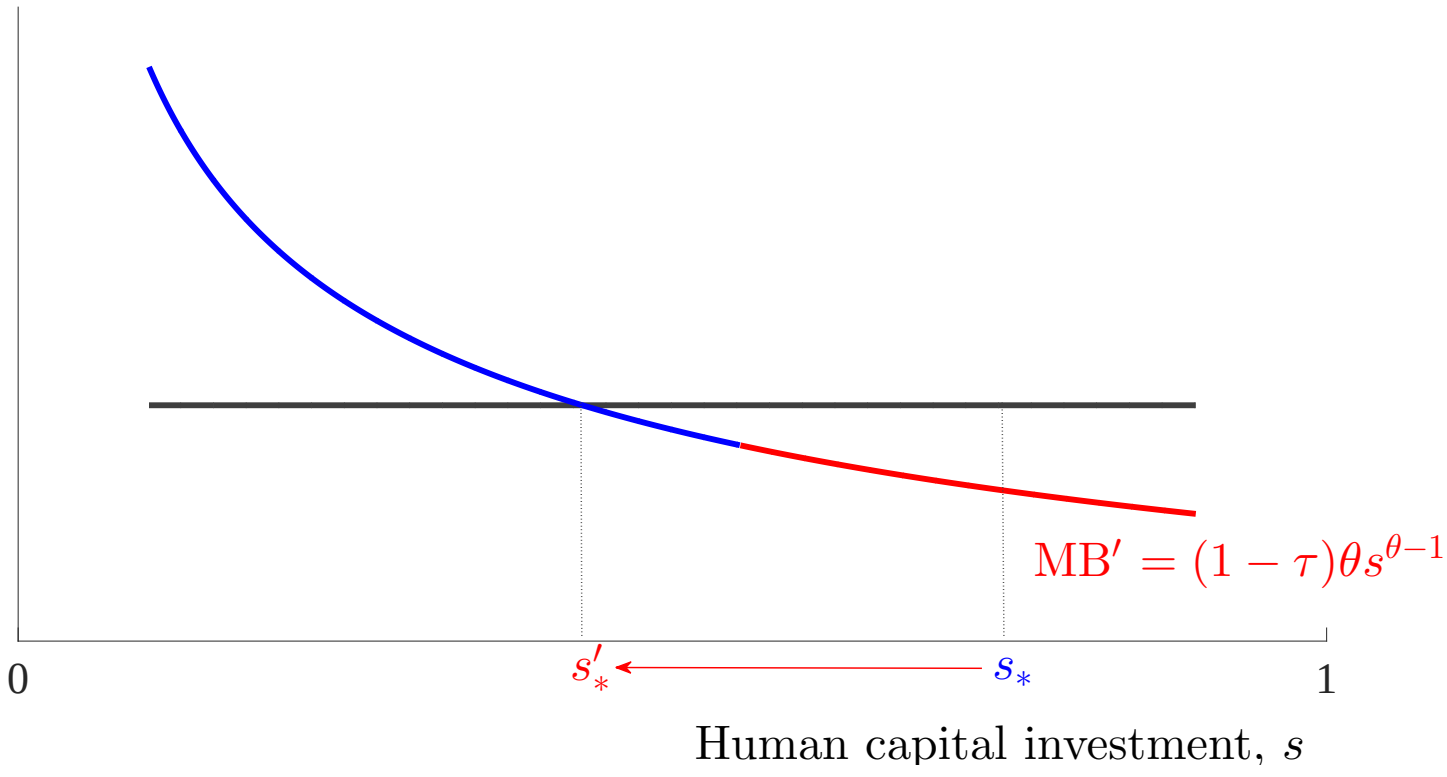


The upshot

Eliminating the tax cap...

- Depresses labor supply and savings of high earners
  - Standard
- Depresses human capital investment of future high earners
  - Badel,Huggett('14); Guvenen,Kuruscu,Ozkan('14); Krueger,Ludwig('16) make similar points related to progressive taxes
- May push earnings discretely below $\hat{e}$
  - Seems new

The Full Model

Demographics and Endowments

- Unit measure of individuals born each period
  - Individuals live for J periods and work for $J_{SS} - 1$ periods

- **Endowments**
  - Initial human capital, h_1
  - Learning ability, a
  - Unit of time in each period

- **Decisions**
  - Production, n
  - On the job human capital investment, s
  - Leisure, $1 - n - s$
  - Consumption, c
  - Saving, $k' \geq \underline{k}$

Preferences and Human Capital Accumulation

- **Preferences** over consumption and leisure:

$$\sum_{j=1}^{J} \beta^{j-1} u_j(c_j, 1 - n_j - s_j)$$

- **Human capital** evolves via a Ben-Porath technology:

$$h_{j+1} = (1 - \delta^h) h_j + a h_j^{\phi} s_j^{\theta}$$

Technology

- **Output** produced by stand-in firm operating CRS technology:

$$Y = F(K, H) = K^{\alpha} H^{1-\alpha}$$

- Note: H is aggregate supply of human capital
  - "efficiency units"

- Physical capital depreciates at rate δ^k

Government Policies (1/2)

Government runs a pay-as-you-go **pension system**:

- **Payroll tax**
  - Proportional rate τ^{SS} up to a taxable earnings cap $\hat{e}$
- **Old age benefit rule**
  - Retirees are paid a benefit each period which is a function of their average lifetime earnings at the year they retire:

$$b(\bar{e}_{J_{SS}})$$

  - Average earnings of workers evolve according to:

$$\bar{e}' = \frac{j\bar{e} + \min\{e, \hat{e}\}}{j+1}$$

Government Policies $(2/2)$

- **Federal income tax**
  - Average tax rate: $t(y/\bar{y}) = \eta_0 + \eta_1 \log(y/\bar{y})$
    - Estimated by Guner, Kaygusuz, Ventura ('14)

- **Government consumption** balances government budget

Decision problem of a worker, $j < J_{SS}$

State of a worker given by $z = (k, h, \bar{e}, a)$.

$$V_j(z) = \max_{c,k',n,s} \quad u_j(c\ ,\ 1-n-s)\ +\ \beta V_{j+1}(z')$$

$$s.t. \qquad c + k' = (1 - t(y/\bar{y}))y - \tau^{SS} \min\{\omega h n, \hat{e}\}\ ;$$

$$y = k(1+r) + \omega h n\ ;$$

$$h' = (1-\delta^h)h + a h^{\phi} s^{\theta}\ ;$$

$$\bar{e}' = \frac{j\bar{e} + \min\{\omega h n, \hat{e}\}}{j+1}\ ;$$

$$k' \geq \underline{k}\ ;$$

$$n, s \geq 0; \qquad n + s \leq 1.$$

Retiree problem

Stationary Equilibrium

A **Stationary Equilibrium** for the closed economy is a collection of individual decisions, aggregate variables, factor prices, government policy variables, and a measure of individuals $\Lambda(x) = (\Lambda_j(x))$ that satisfy the following conditions:

1. Individual decisions solve their corresponding decision problems given factor prices

2. Factor prices are determined competitively

3. Labor and capital markets clear

4. The output market clears

5. The government's budget is balanced

6. The age vector of distributions is stationary

Calibrating Benchmark Economy to US

Calibration strategy

- **Technology parameters**
  - Standard

- **Federal income tax**
  - $t(y/\bar{y}) = \eta_0 + \eta_1 \log(y/\bar{y})$
  - $\eta_0 = .099$, and $\eta_1 = .035$

- **Household parameters**
  - Jointly target to life-cycle profiles for the mean and variance of annual earnings, hourly wages, and hours worked
  - Sample: Employed heads of household in PSID $(1990 - 2013)$

Benchmark government policy

- **Payroll tax**, $\tau^{SS} = .106$
- **Old age benefit rule**, $b(\bar{e})$
  - 90% of the first BP_1 average earnings,
  - 32% of the next $BP_2 - BP_1$ average earnings,
  - 15% of the remaining $\hat{e} - BP_2$ average earnings
- $BP_1 = 0.18 \times Mean\ Earnings$
- $BP_2 = 1.09 \times Mean\ Earnings$
- $\hat{e} = 2.21 \times Mean\ Earnings$

Fit of the benchmark economy

- Life-cycle mean earnings and wages

- Life-cycle variance of log earnings

- **Fraction of earners above earnings cap**:
  - Model: 9%
  - Sample: 11%

- **Fraction of earnings above earnings cap**:
  - Model: 12%
  - Sample: 16%

The Impact of Eliminating the Taxable Earnings Cap

Three reforms

1. Eliminate cap. Government consumes additional revenue.

2. Eliminate cap. Lower payroll tax rate.

3. Eliminate cap. Raise benefits lump sum.

Impact of reforms on economic aggregates

	R1 $(\uparrow G)$	**R2** $(\downarrow \tau^{SS})$	**R3** $(\uparrow b)$
Consumption	-2.9%		
Output	-2.1%		
Physical Capital	-1.3%		
Human Capital	-2.5%		
Hours Worked	-1.2%		
H.C. Investment	-5.1%		

All reforms

What drives the change in human capital? $(1/2)$

Impact of Reform 1

	Endog. HC	**Exog. HC**
Consumption	-2.9%	-1.3%
Output	-2.1%	-1.2%
Physical Capital	-1.3%	-0.9%
Human Capital	-2.5%	-1.3%
Hours Worked	-1.2%	-1.0%
H.C. Investment	-5.1%	NA

What drives the change in human capital? $(2/2)$

- Eliminating cap eliminates non-convexity in budget set
- 4% of population earned discretely above $\hat{e}$ in baseline, and discretely below $\hat{e}$ after R1
  - By "discretely", I mean 5%
- How to interpret impact?
  - 1 out of 7 workers earning above cap are affected
  - Ball park impact: lowers aggregate output by 0.5%

Impact of reforms on government budget

	R1 $(\uparrow G)$	**R2** $(\downarrow \tau^{SS})$	**R3** $(\uparrow b)$
Payroll tax revenue	$+11.8\%$	-0.5%	$+11.0\%$
Income tax revenue	-2.9%	-2.5%	-4.5%
Total tax revenue	$+1.2\%$	-2.0%	-0.2%

Impact of reforms on welfare of newborn workers

	R1 $(\uparrow G)$	**R2** $(\downarrow \tau^{SS})$	**R3** $(\uparrow b)$
Share of workers benefiting	$.73$		
Conditional welfare gain (CEV)	$+0.1\%$		
Conditional welfare loss (CEV)	-2.4%		
Average welfare change (CEV)	-0.7%		

Impact of reforms on welfare of newborn workers

	R1 $(\uparrow G)$	**R2** $(\downarrow \tau^{SS})$	**R3** $(\uparrow b)$
Share of workers benefiting	$.73$	$.78$	$.63$
Conditional welfare gain (CEV)	$+0.1\%$	$+1.6\%$	$+0.4\%$
Conditional welfare loss (CEV)	-2.4%	-2.1%	-2.3%
Average welfare change (CEV)	-0.7%	$+0.9\%$	-0.6%

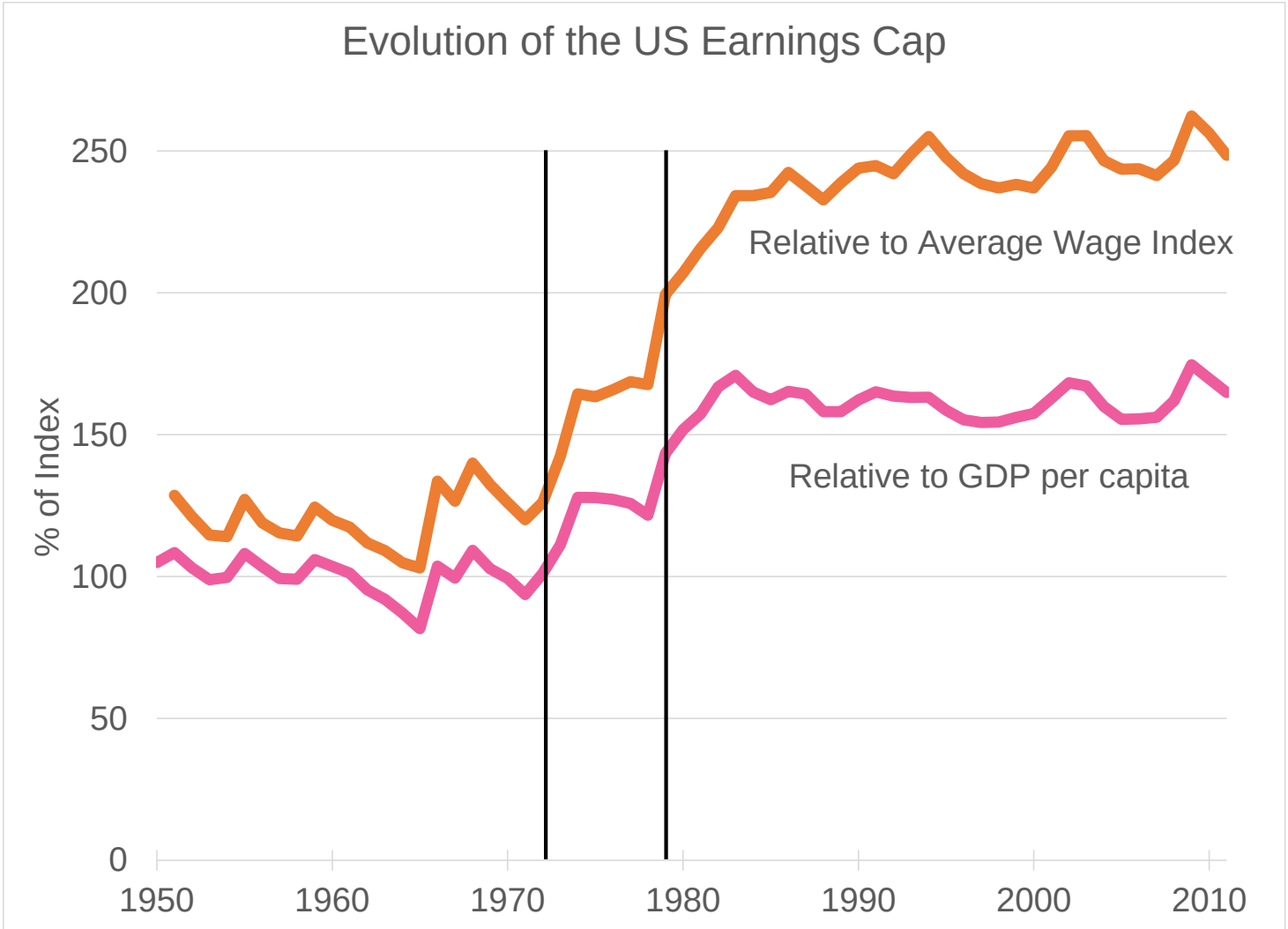
Conclusion

Conclusion

- I study the long run impact of reforming the taxable earnings cap in the context of an endogenous human capital model

- I find:
  - Aggregate impact is large
    - **Depressed human capital investment** accounts for half
    - **Non-convexity** from cap pushes some discretely below cap
  - Increase in government revenues is small
  - Welfare effects heterogeneous

Earnings Cap Over Time



Data source: *SSA: "The Evolution of Social Security's Taxable Maximum"*

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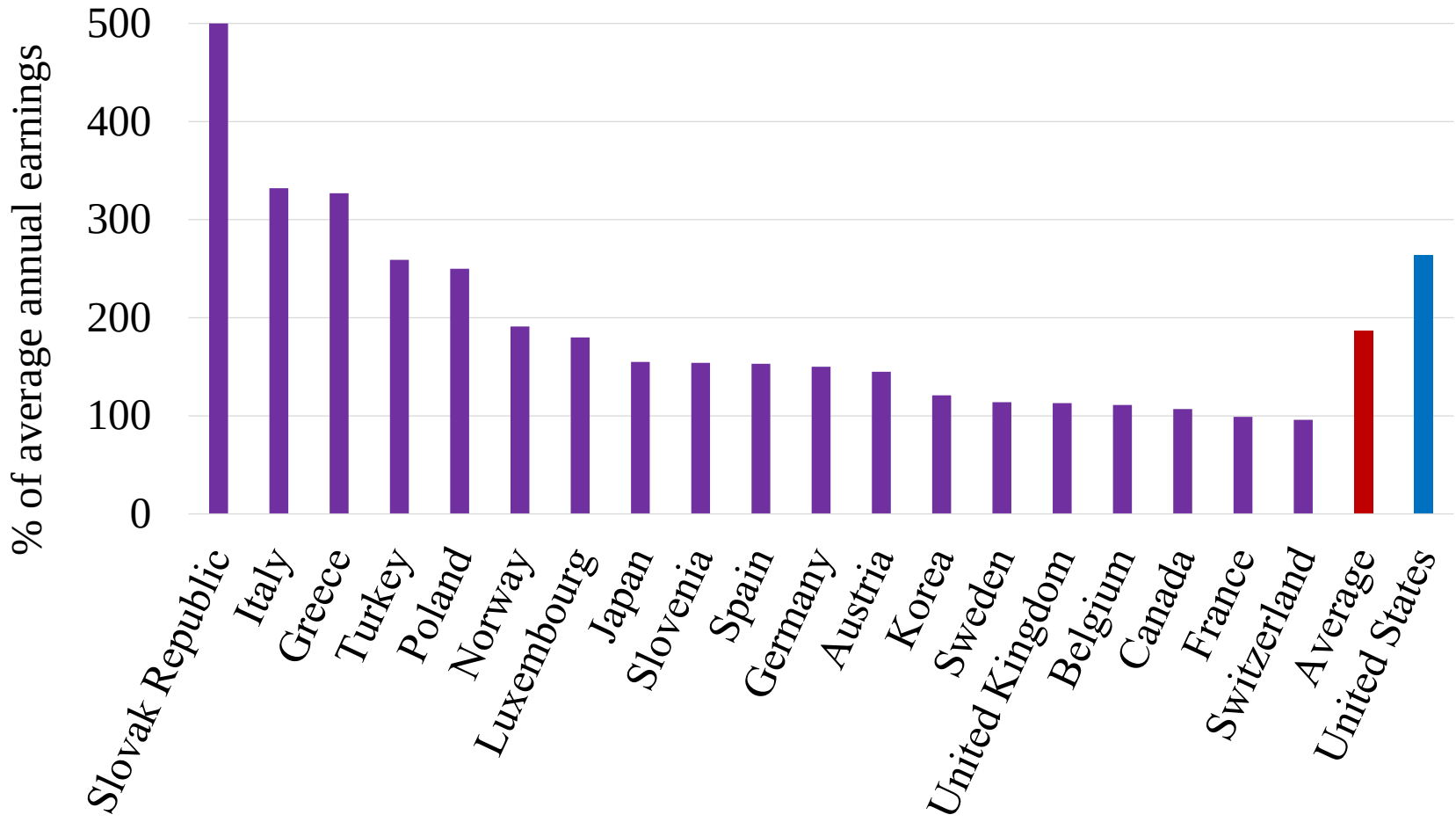
Taxable earnings caps across the OECD



Data source: *OECD: "Pensions at a Glance 2013"*

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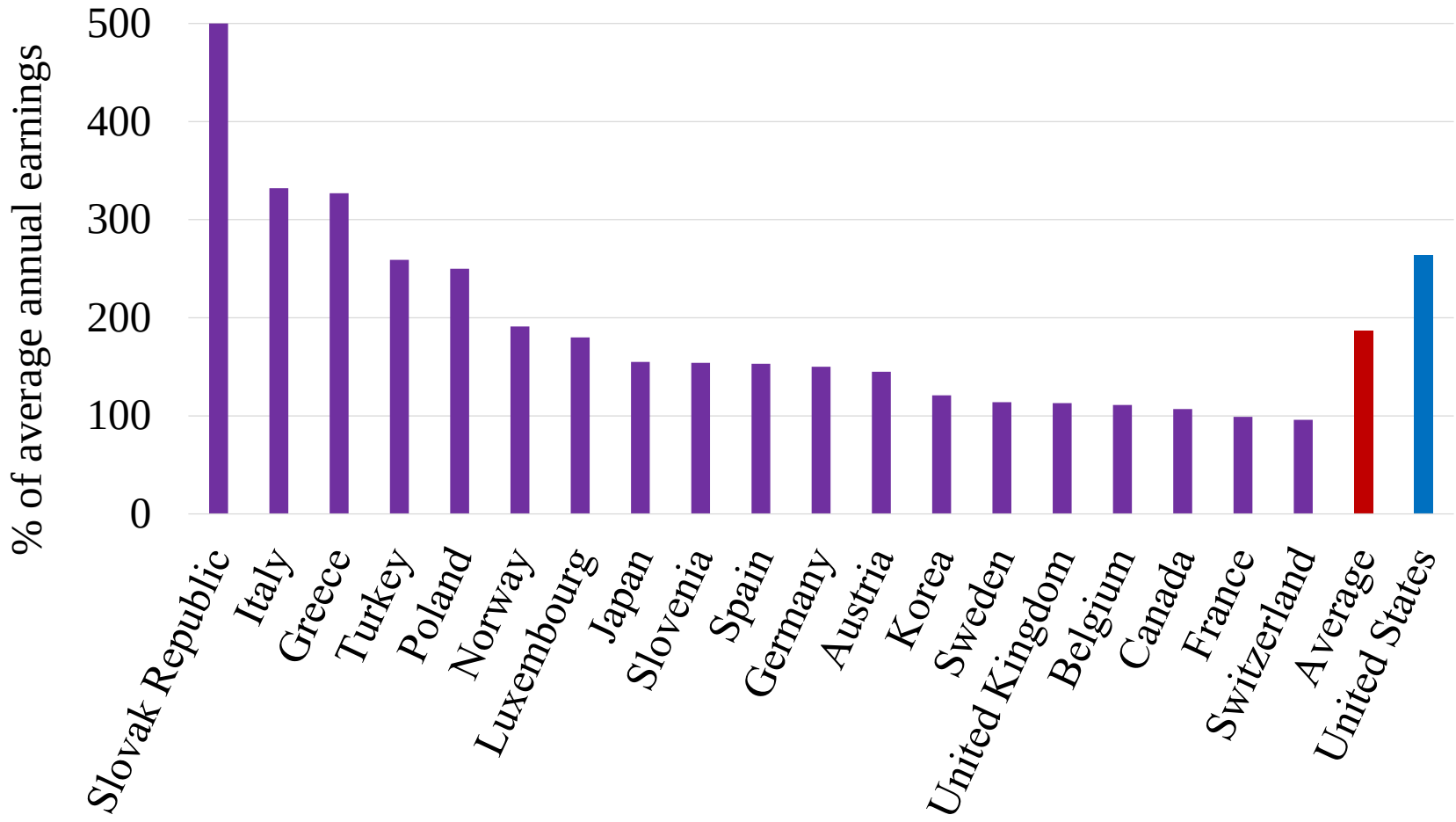
Taxable earnings caps across the OECD



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Calibration Results: Exogenous Parameters

Parameter	Description	Value
r	Real Interest rate	0.04
δ^k	Depreciation rate of physical capital	0.07
α	Physical capital share in Y	0.33

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Calibration Results: Endogenous Parameters

Parameter	Description	Source	Value
J	Periods in life-cycle	80 years	12
J_{SS}	Retirement period	65 years	9
(μ_{h_1}, μ_a)	Mean of $log(h_1, a)$	Initial, Peak mean earn	$(5.81, 1.55)$
(σ_{h_1}, σ_a)	Variance of $log(h_1, a)$	Initial, Peak var. earn	$(0.56, 0.35)$
$\rho_{h_1 a}$	Correlation of (h_1, a)	Middle age var. earn	0.95
θ	Curvature of H w.r.t. s	Browning et al. ('99)	0.70
ϕ	Curvature of H w.r.t. h	Blandin ('16)	0.60
δ^h	Depreciation rate	Blandin ('16)	0.01
β	Time discount factor	Close model	0.96
γ	Curvature of leisure utility	Blandin ('16)	2
ψ	Leisure utility	Peak mean hours	0.69
$(1 + g_\psi)^{J_{SS}-1}$	Growth in leisure utility	Minimum hours	1.15

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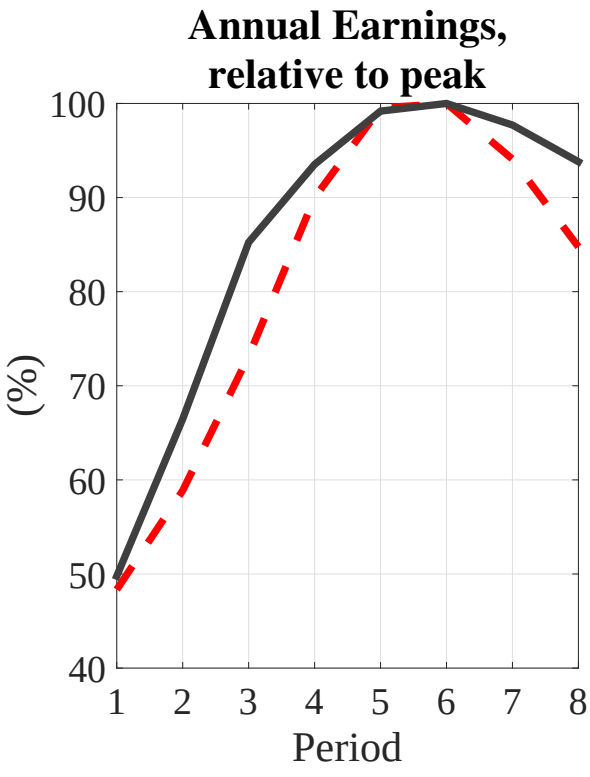
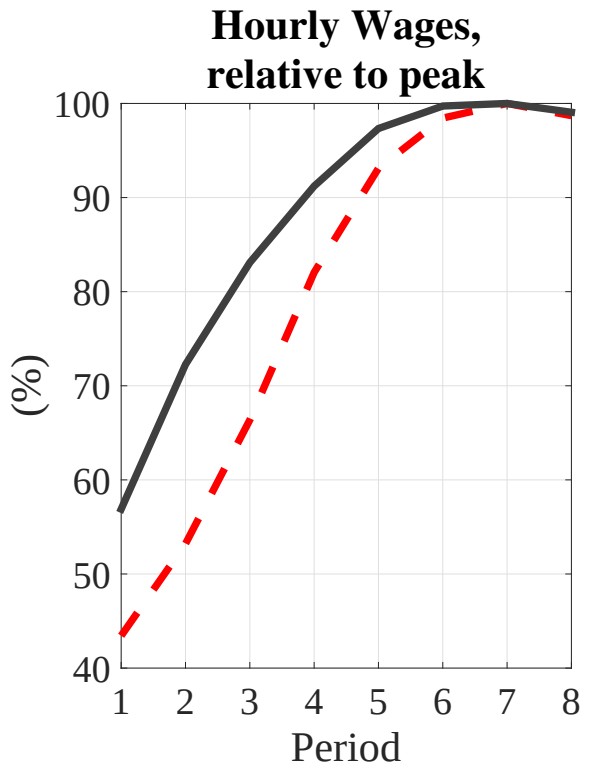
Life-cycle Profile of Earnings and Wages





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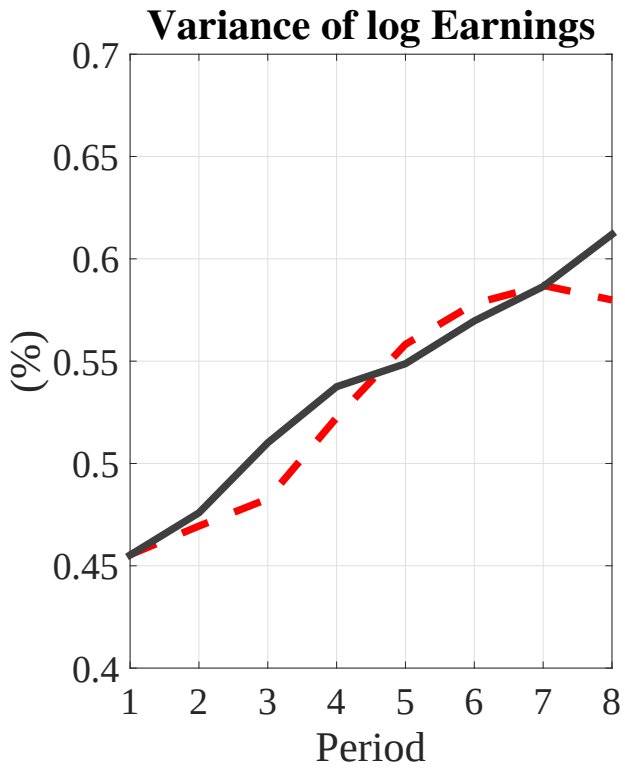
Life-cycle Variance of Earnings



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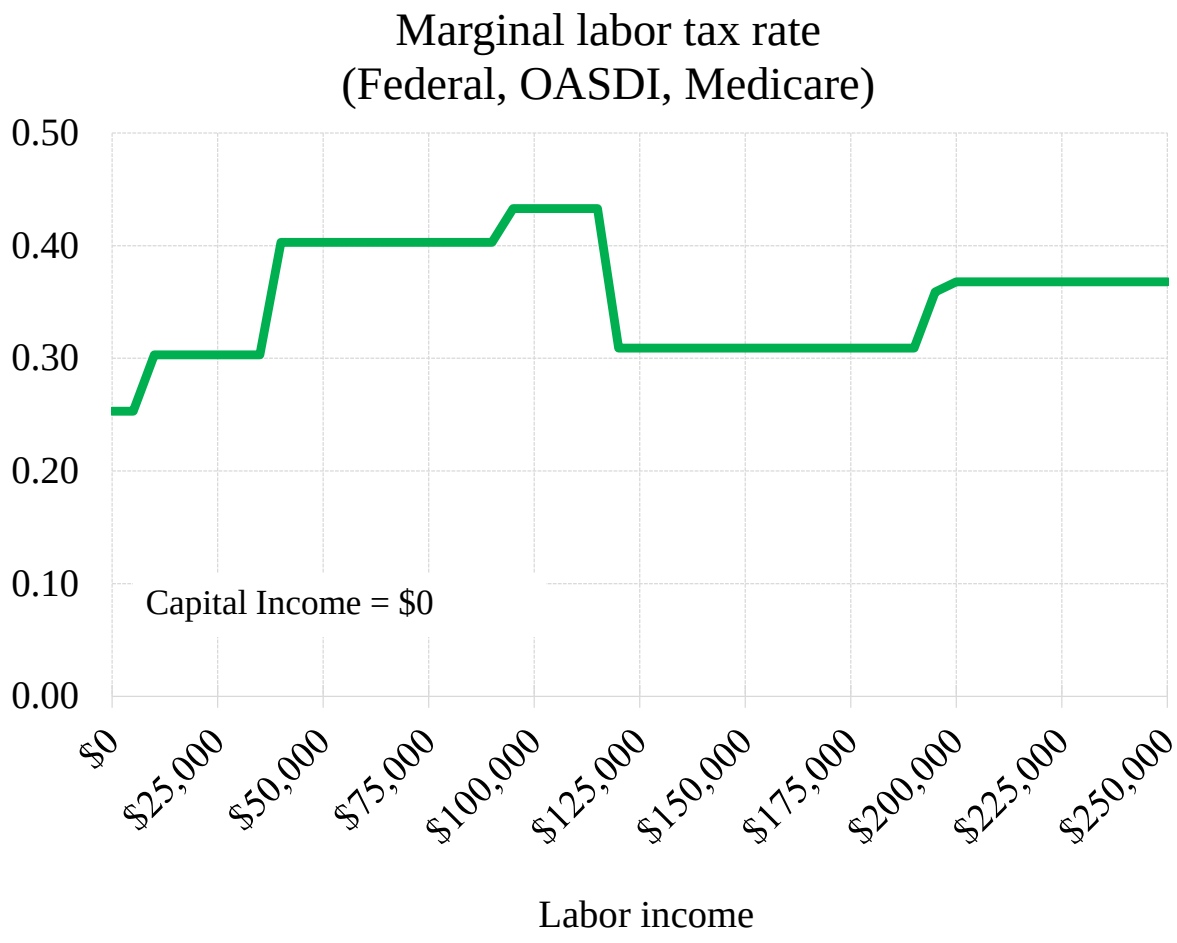
Marginal tax rates and the taxable earnings cap



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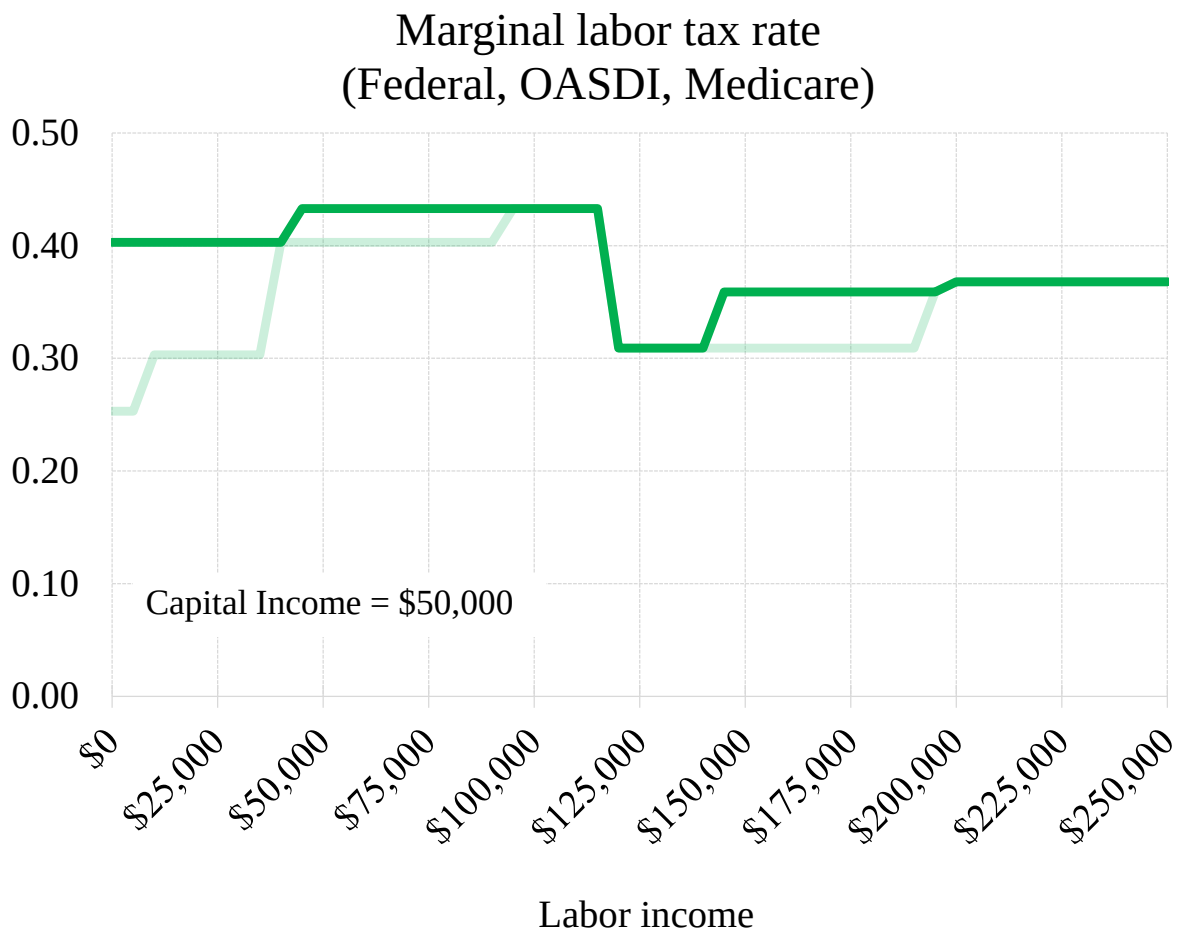

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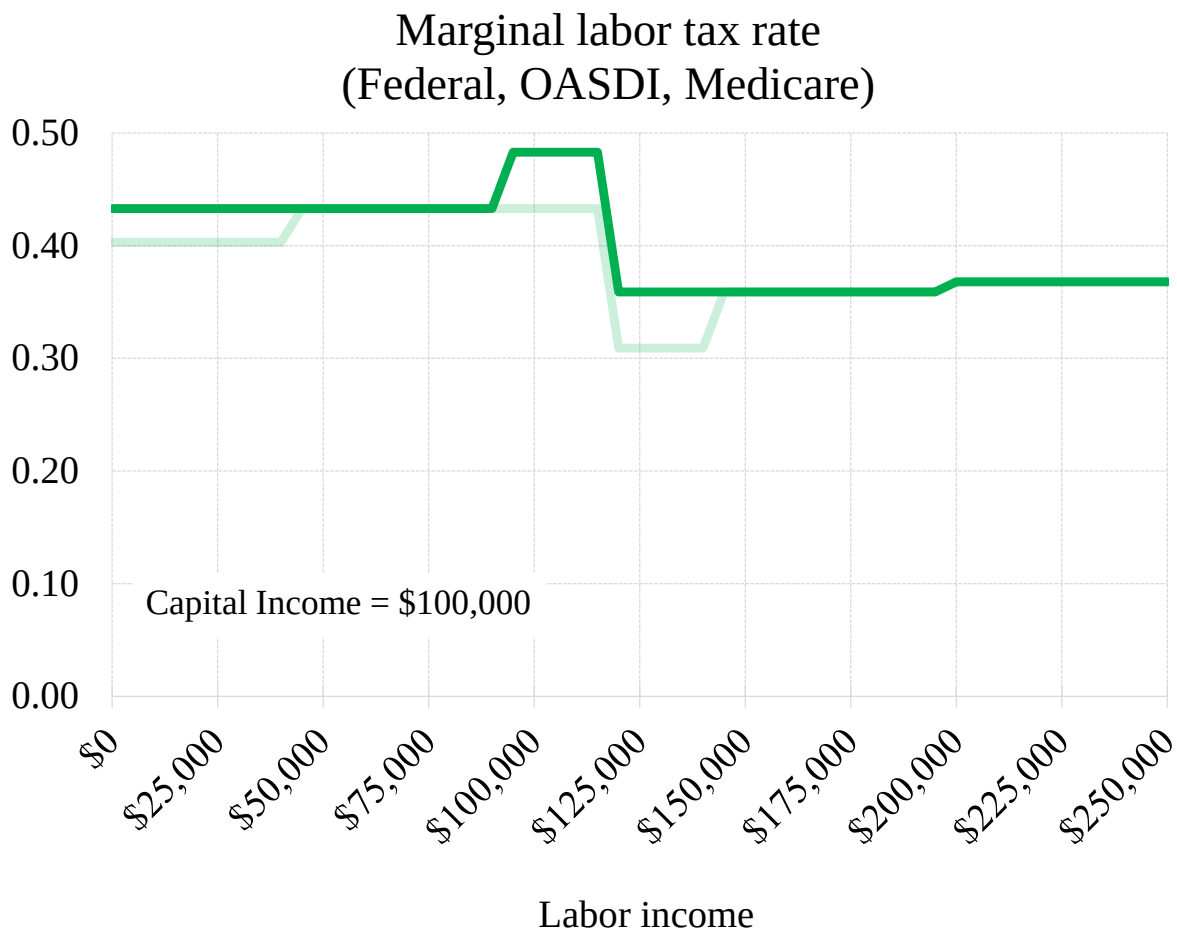
Marginal tax rates and the taxable earnings cap



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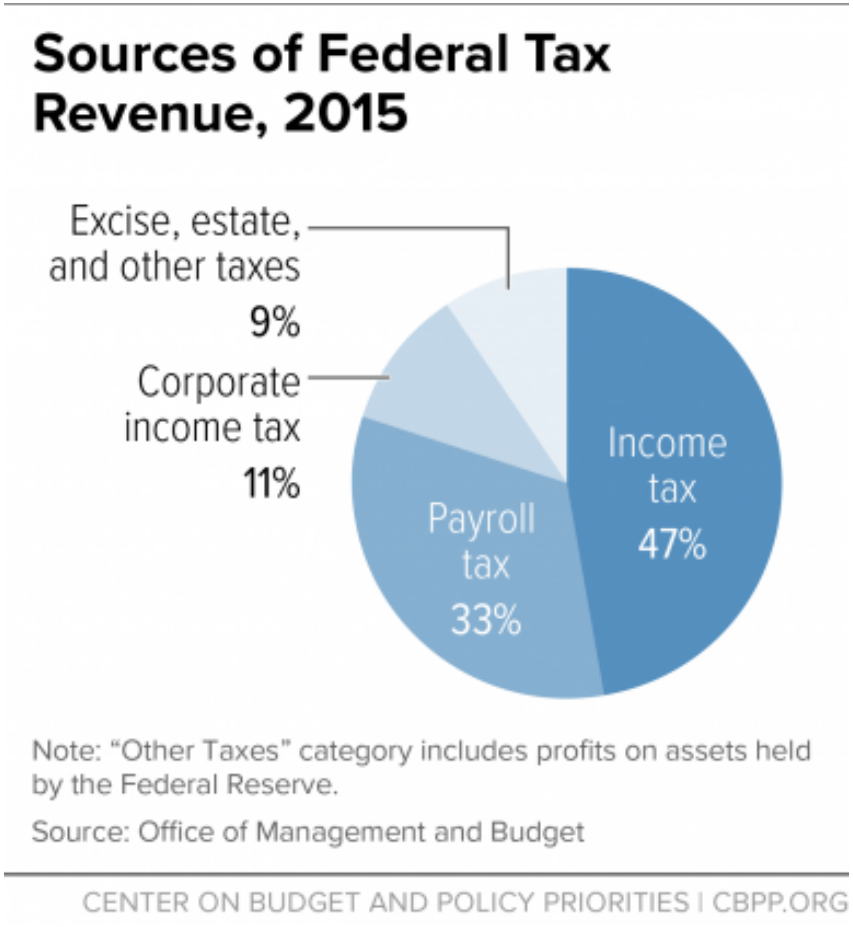
Sources of federal revenue



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Preferences and Human Capital Accumulation

- **Preferences** over consumption and leisure:

$$\underbrace{\sum_{j=1}^{J_{SS-1}} \beta^{j-1} u_j(c_j, 1 - n_j - s_j)}_{\textbf{Pre-retirement utility}} + \underbrace{\sum_{j=J_{SS}}^{J} \beta^{j-1} u_j(c_j, 1)}_{\textbf{Post-retirement utility}}$$

- **Human capital** evolves via a Ben-Porath technology:

$$h_{j+1} = (1 - \delta^h) h_j + a h_j^{\phi} s_j^{\theta}$$

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Government Policies $(2/2)$

- **Federal income tax**
  - Average tax rate: $t(y/\bar{y}) = \eta_0 + \eta_1 \log(y/\bar{y})$

- **Government consumption** balances government budget

$$G \quad + \quad [Benefit\ expenditures] \quad = \quad [Payroll\ tax\ revenue] \\ + [Income\ tax\ revenue]$$

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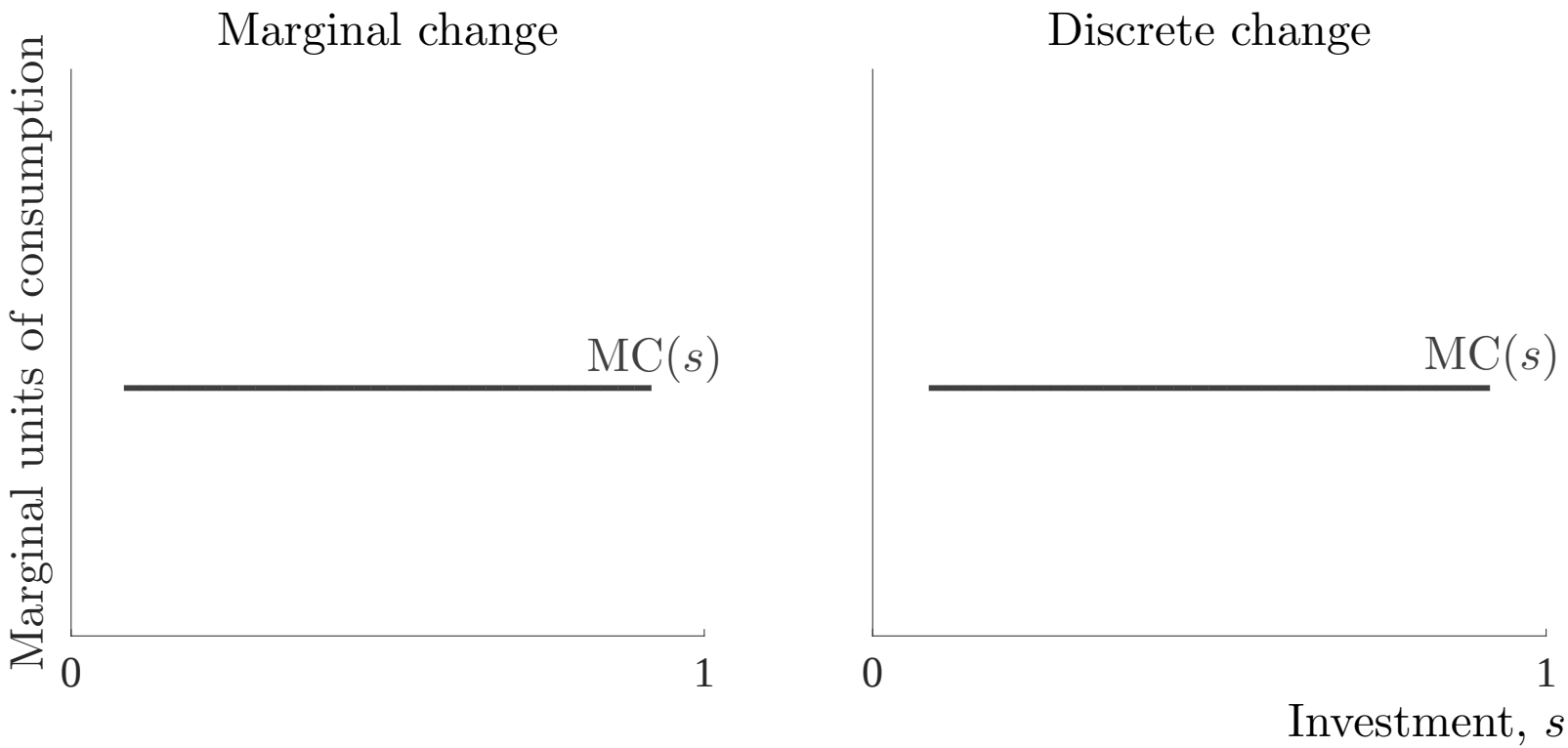
Eliminating cap eliminates non-convexity in budget set



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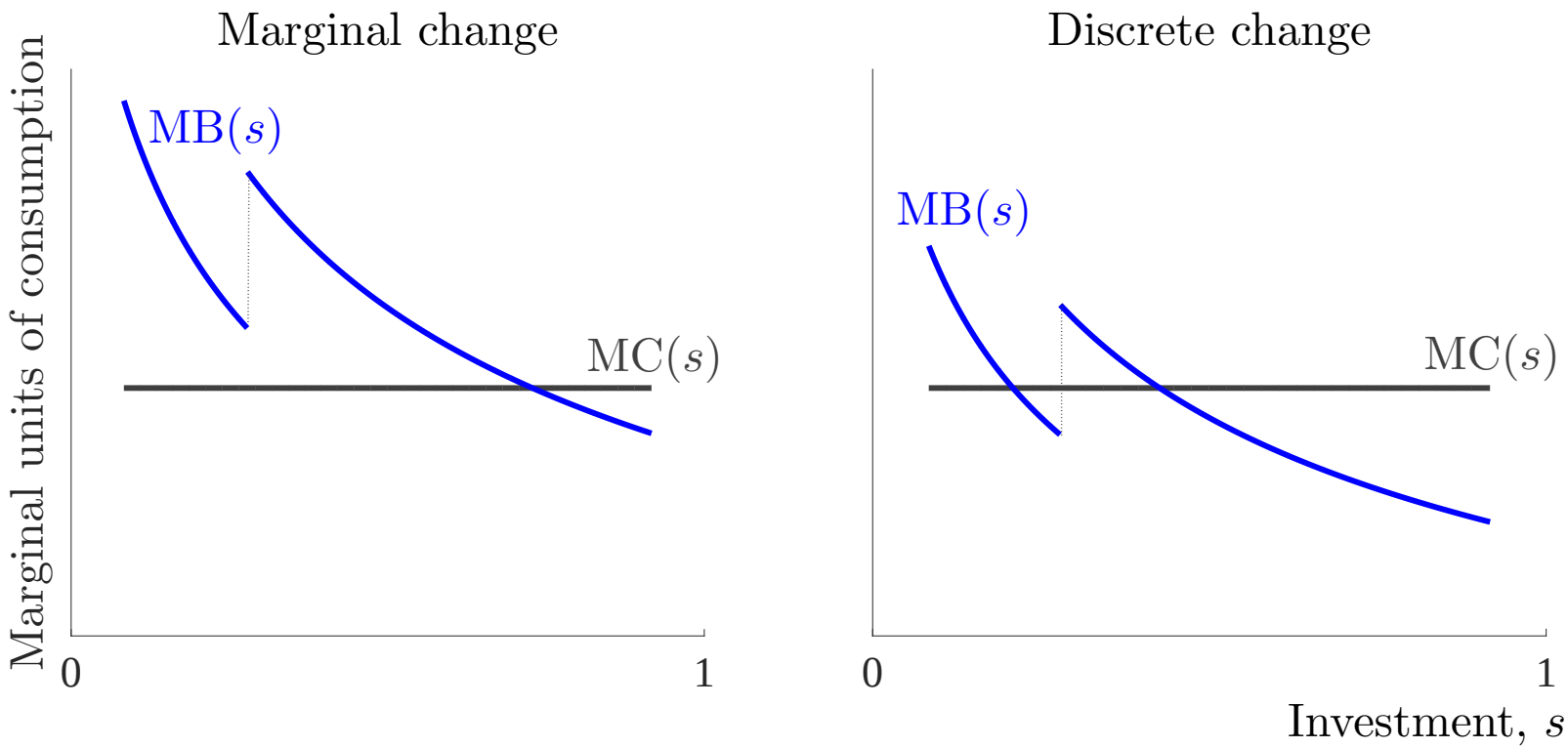

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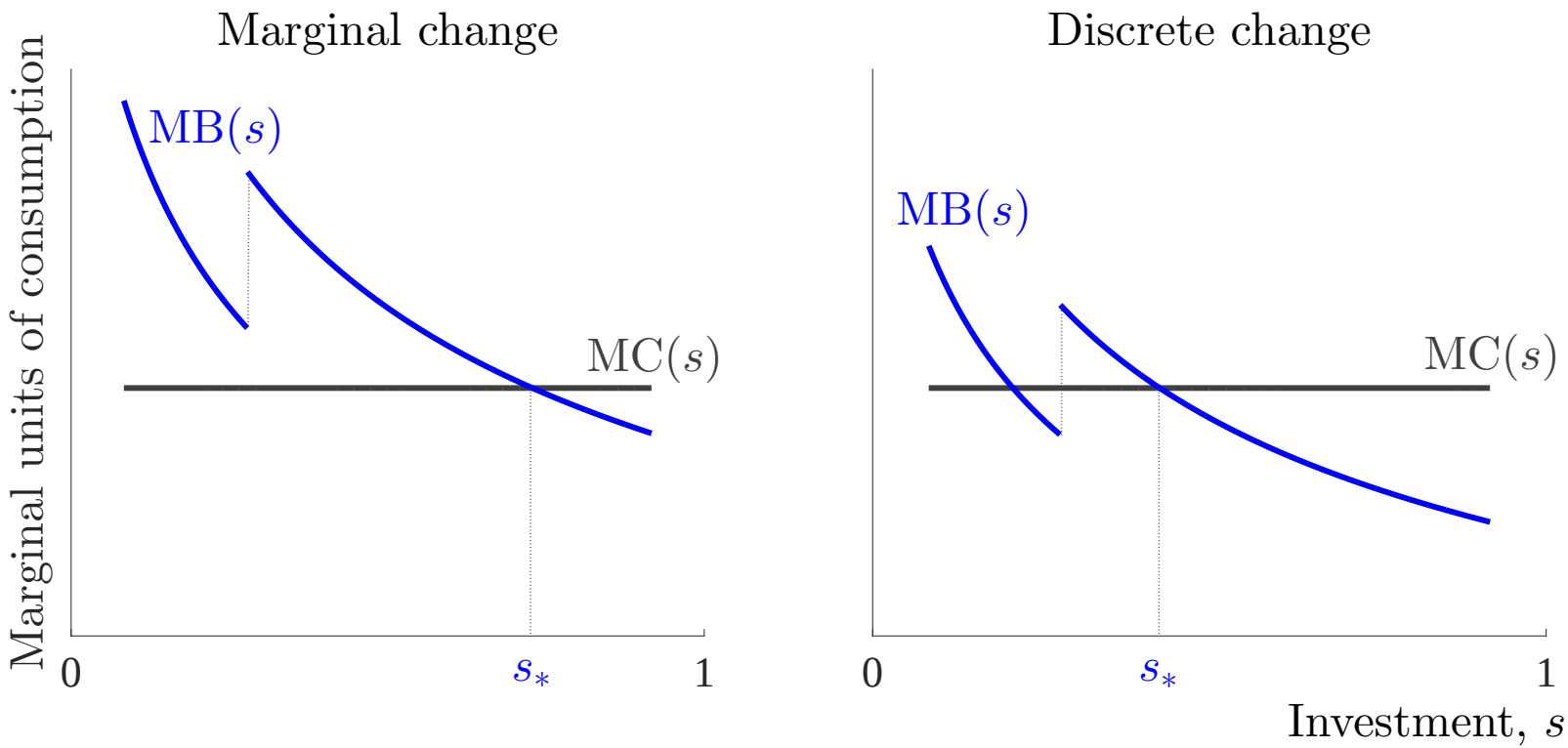

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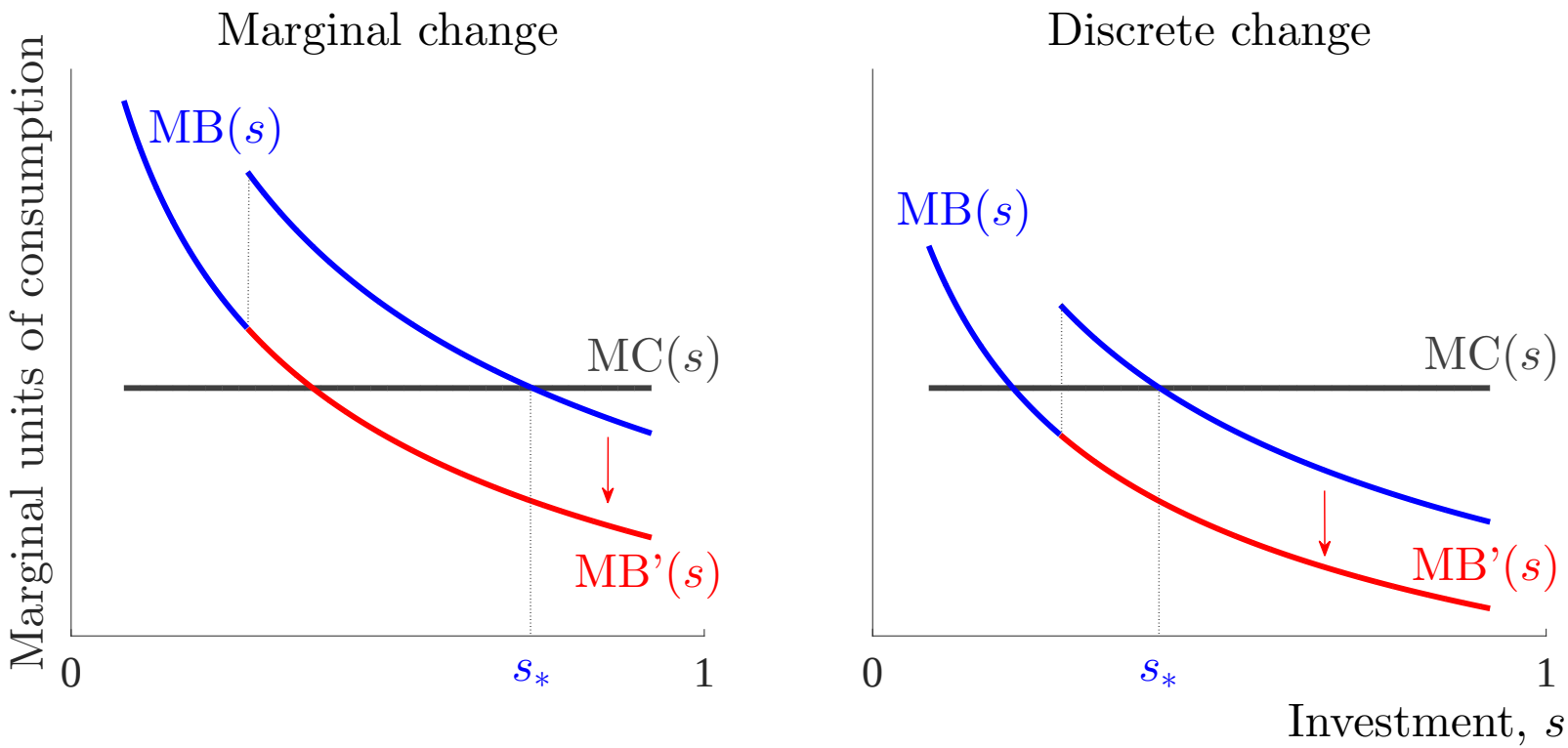

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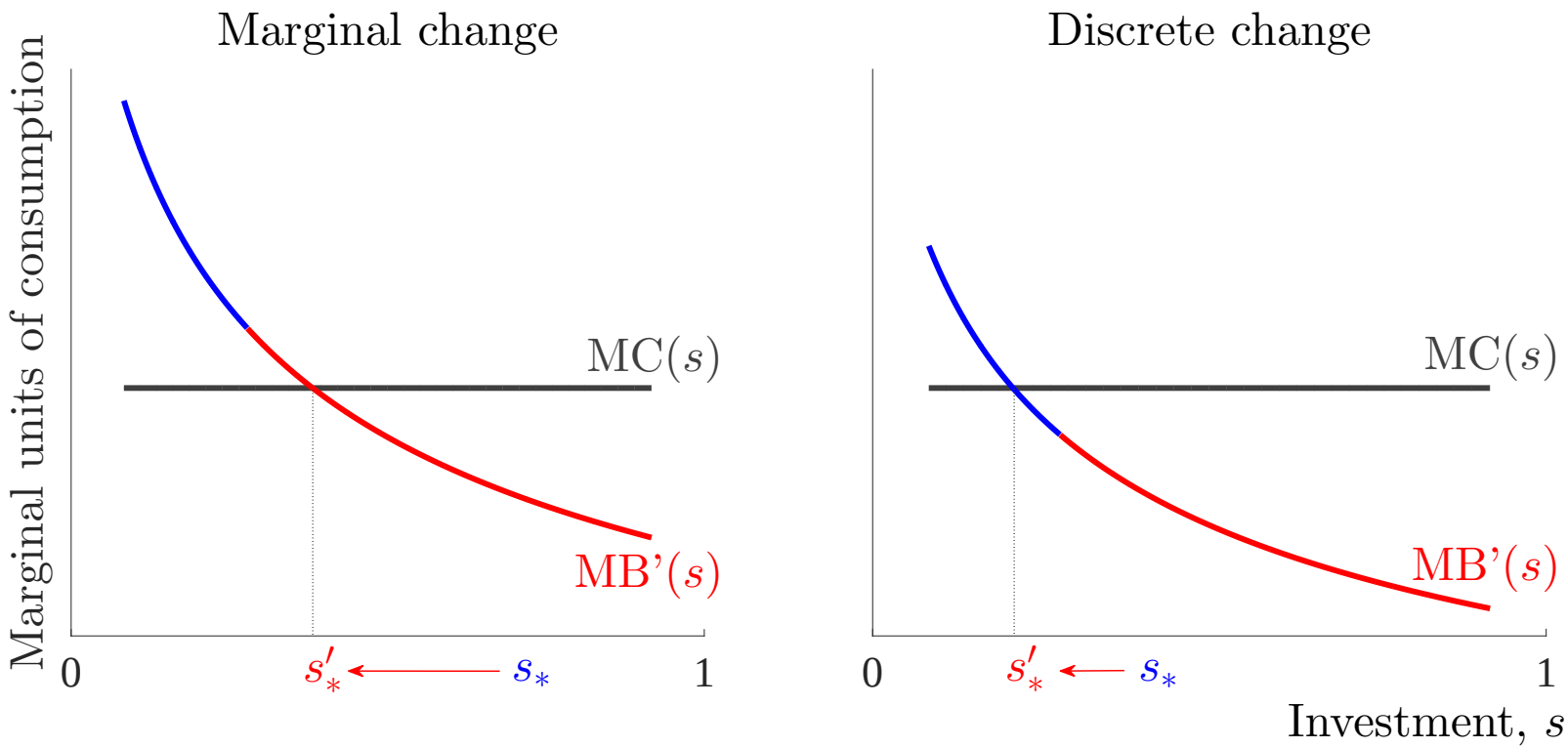

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Worker's problem

$$\max_{\{s_j,c_j\}_{j=1}^{2}} \quad u(c_1) + \beta u(c_2)$$

$$s.t. \quad c_1 + c_2 = (1-\tau)h_1(1-s_1) + (\hat{\tau}-\tau)\max\{h_1(1-s_1) - \hat{e}, 0\}$$

$$+ (1-\tau)h_2(1-s_2) + (\hat{\tau}-\tau)\max\{h_2(1-s_2) - \hat{e}, 0\} \ ;$$

$$h_2 = h_1 + s_1^{\theta} \ ;$$

$$s_j \in [0,1] \ \forall j \ .$$

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Decision problem of a retiree, $j \geq J_{SS}$

State of a worker given by $z = (k, h, \bar{e}, a)$.

$$
\begin{aligned}
V_j(z) = \max_{c,k'} \quad & u_j(c\ ,\ 1) + \beta V_{j+1}(z') \\
s.t. \quad & c + k' = (1 - t(y/\bar{y}))y + b(\bar{e})\ ; \\
& y = k(1 + r)\ ; \\
& \bar{e}' = \bar{e}\ ; \\
& k' \geq \underline{k}\ .
\end{aligned}
$$

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Impact of reforms on economic aggregates

	R1 $(\uparrow G)$	**R2** $(\downarrow \tau^{SS})$	**R3** $(\uparrow b)$
Consumption	-2.9%	-1.8%	-2.3%
Output	-2.1%	-2.2%	-3.1%
Physical Capital	-1.3%	-1.9%	-3.4%
Human Capital	-2.5%	-2.3%	-3.0%
Hours Worked	-1.2%	-1.0%	-1.6%
H.C. Investment	-5.1%	-4.5%	-5.9%

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