Optimal Taxation with Risky Human Capital and Retirement Savings

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Motivation

Classic PF problem:

- How to insure against risk in lifetime income?

Two concerns:

- Income distributions different between college and non-college
- Recent studies suggest that individuals are present biased

Current policies and proposals:

- Pay as You Earn Repayment Plan
- Retirement Parity for Student Loans Act

This paper

Mirrlees taxation + education + present-biased agents

Traditional Mirrlees taxation:

- unobservable productivity ⇒ efficiency vs. equity
- exogenous productivity + time-consistent agents

This paper:

- education ⇒ endogenous productivity
- present-biased agents ⇒ paternalistic government

New insights on policy design

Preview of findings

1. Generous student loans to entice present-biased agents
2. Education dependent retirement policies
   - help all college graduates save
   - only help non-college grads with low-income with savings
3. Income tax quantitatively similar to time-consistent case
4. Retirement Parity for Student Loans Act
5. Potentially significant welfare gains

Related literature

1. **Mirrlees taxation with behavioral bias:**
   - Farhi and Gabaix (2017), Lockwood (2018), Yu (2018), Moser and de Souza e Silva (2019)

2. **Optimal human capital policy**
   - Bovenberg and Jacobs (2005), Bohacek and Kapicka, (2008), Grochulski and Piskorski (2010), Kapicka (2015), Gary-Bobo and Trannoy (2015), Findeisen and Sachs (2016), Stantcheva (2017), Koeniger and Prat (2018), Markis and Pavan (2018)

Model

Setup overview

Three periods: student $\to$ work $\to$ retire

Student:

- Innate ability: $\gamma \in \{H, L\}$ each with share π_γ
- Education: $e \in \{e_L, e_H\}$
- Human capital: $\kappa(e, \gamma)$ strictly increasing in e and γ

Work:

- Productivity θ drawn from $F(\theta|\kappa)$
  - FOSD: for any θ and $\kappa > \kappa'$, $F(\theta|\kappa) < F(\theta|\kappa')$
- Production technology: $y = \theta l$

Retire:

- Consume savings

Present bias

(γ, θ)-workers have utility

$$U_1(c_1, c_2, y; \gamma, \theta, e) = u(c_1) - h\left(\frac{y}{\theta}\right) + \beta\delta_2 u(c_2)$$

γ-students have utility

$$U_0\Big(\{c_t\}_t, e, y; \gamma\Big) = u(c_0) + \beta\delta_1(e)\int_\Theta \left[u(c_1) - h\left(\frac{y}{\theta}\right) + 1\delta_2 u(c_2)\right] f(\theta|\kappa(e,\gamma))\, d\theta$$

Key:

- Immediate gratification ($\beta < 1$)
- Disagreement between selves (time inconsistency)

Government

- Only observes education e and output y
- H-agents invest $e = e_H$ and L-agents invest $e = e_L$
- Paternalistic: offset present bias

Mechanism design approach:

- Gov. designs: $P = \{c_0(\gamma), c_1(\gamma, \theta), c_2(\gamma, \theta), y(\gamma, \theta)\}$
- Require P to be incentive compatible

Incentive compatibility

Ex-post IC: workers report θ truthfully

- $\forall \gamma, \theta, \theta'$
$$U_1(\gamma, \theta) = U_1(\theta; \gamma, \theta) \geq U_1(\theta'; \gamma, \theta)$$

Ex-ante IC: students report γ truthfully

-
$$U_0\left(H\right) = U_0\left(H; H\right) \geq U_0\left(L; H\right)$$

Planning problem

Paternalistic gov. maximizes

$$\max_{P} \sum_{\gamma} \pi_{\gamma} \Bigg\{ u\big(c_0(\gamma)\big) + 1\delta_1(e_{\gamma}) \int_{\Theta} \left[u(c_1(\gamma,\theta)) - h\left(\frac{y(\gamma,\theta)}{\theta}\right) + 1\delta_2 u(c_2(\gamma,\theta)) \right] f(\theta|\kappa_{\gamma})\, d\theta \Bigg\}$$

subject to

$$\sum_{\gamma} \pi_{\gamma} \left\{ -c_0(\gamma) - e_{\gamma} + \frac{1}{R_1(e_{\gamma})} \int_{\Theta} \left[-c_1(\gamma,\theta) - \frac{1}{R_2} c_2(\gamma,\theta) \right] f(\theta|\kappa_{\gamma})\, d\theta \right\} \leq \sum_{\gamma} \pi_{\gamma} \left\{ \frac{1}{R_1(e_{\gamma})} \int_{\Theta} y(\gamma,\theta) f(\theta|\kappa_{\gamma})\, d\theta \right\},$$

and ex-ante and ex-post IC constraints.

Wedges

Assume $R_t \delta_t = 1$

- Savings wedge for γ-students:

$$\tau_0^k(\gamma) = 1 - \frac{u'\left(c_0\left(\gamma\right)\right)}{\mathbb{E}_\theta\left[u'\left(c_1\left(\gamma,\theta\right)\right)\right]}$$

- Savings wedge for (γ,θ)-workers:

$$\tau_1^k(\gamma,\theta) = 1 - \frac{u'\left(c_1\left(\gamma,\theta\right)\right)}{u'\left(c_2\left(\gamma,\theta\right)\right)}$$

- Labor wedge for (γ,θ)-workers:

$$\tau^w(\gamma,\theta) = 1 - \frac{\frac{1}{\theta} h'\left(\frac{y(\gamma,\theta)}{\theta}\right)}{u'\left(c_1\left(\gamma,\theta\right)\right)}$$

Theoretical characterization

Savings wedges: time-consistent case

Intertemporal distortion of γ-student:

$$\frac{1}{u'(c_0(\gamma))} = \mathbb{E}_\theta \left(\frac{1}{u'(c_1(\gamma,\theta))} \right)$$

- $u'(c_0(\gamma)) < \mathbb{E}[u'(c_1(\gamma,\theta))]$
- $\tau_0^k(\gamma) > 0$: restricted savings
  - High savings $\Rightarrow$ expensive to reward high output in future

Intertemporal distortion of (γ,θ)-worker:

$$u'(c_1(\gamma,\theta)) = u'(c_2(\gamma,\theta))$$

- $\tau_1^k(\gamma) = 0$: consumption smoothing
- No uncertainty after work life $\Rightarrow$ no need for distortions in future

Savings wedges: present-biased students

For *H*-agents:

$$\frac{1}{u'\left(c_0\left(H\right)\right)} > \mathbb{E}_\theta\left(\frac{1}{u'\left(c_1\left(H,\theta\right)\right)}\right)$$

- $\tau_0^k\left(H\right)$ is larger $\Rightarrow$ intertemporal distortion exacerbated

For *L*-agents:

$$\frac{1}{u'\left(c_0\left(L\right)\right)} < \mathbb{E}_\theta\left(\frac{1}{u'\left(c_1\left(L,\theta\right)\right)}\right)$$

- $\tau_0^k\left(L\right)$ is smaller $\Rightarrow$ intertemporal distortion is weakened

Discussion of savings wedge

Encouraging education investment:

1. $c_0 \uparrow$ for educated agents
2. commitment device for educated agents
3. additional distortions for uneducated agents

Therefore,

1. increase τ_0^k of educated relative to uneducated
   - Policy implication: generous student loans
2. help educated agents smooth consumption
   - Policy implication: subsidize retirement savings for college grads
3. help uneducated commit only if output is likely from L-agent
   - Policy implication: subsidize retirement savings of low income

Savings wedges: present-biased workers

For *H*-agents:

$$\frac{u_1'\left(c_1\left(H,\theta\right)\right)}{u_2'\left(c_2\left(H,\theta\right)\right)} > \beta$$

- offset present bias

For *L*-agents: there exists Γ such that

$$\frac{u_1'\left(c_1\left(L,\theta\right)\right)}{u_2'\left(c_2\left(L,\theta\right)\right)} \begin{cases} > \beta & \text{if } \Gamma > \frac{f\left(\theta|\kappa_{L,H}\right)}{f(\theta|\kappa_L)} \\ = \beta & \text{if } \Gamma = \frac{f\left(\theta|\kappa_{L,H}\right)}{f(\theta|\kappa_L)} \\ < \beta & \text{if } \Gamma < \frac{f\left(\theta|\kappa_{L,H}\right)}{f(\theta|\kappa_L)} \end{cases}$$

- More likely from *L*-agent than *H*-agent $\Rightarrow$ offset present bias
- More likely from *H*-agent than *L*-agent $\Rightarrow$ exacerbate present bias

Discussion of savings wedge

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Labor wedge

$$\frac{\tau^{w}(H,\theta)}{1-\tau^{w}(H,\theta)} = A_{H}(\theta)\, B_{H}(\theta)\left[C_{H}(\theta) - D_{H}(\theta) + E_{H}(\theta)\right],$$

$$\frac{\tau^{w}(L,\theta)}{1-\tau^{w}(L,\theta)} = A_{L}(\theta)\, B_{L}(\theta)$$

$$\times\left[C_{L}(\theta) - \left(\frac{1-F(\theta|\kappa_{L,H})}{1-F(\theta|\kappa_{L})}\right) D_{L}(\theta) + \frac{h(\theta|\kappa_{L})}{h(\theta|\kappa_{L,H})} E_{L}(\theta)\right],$$

where $h(\theta|\kappa) = \frac{f(\theta|\kappa)}{1-F(\theta|\kappa)}$

- **Intratemporal component**: A, B, C (Diamond, 1998; Saez, 2001)
- **Intertemporal component**: D (Golosov et. al., 2016)
- **Present-bias component**: E

Effects of present bias on labor wedge

$$E_\gamma(\theta) = \underbrace{\left[\frac{u'(c_1(\gamma,\theta))}{\beta u'(c_2(\gamma,\theta))} - 1\right]}_{\text{disagreement component}} - \underbrace{\left(\frac{1-\beta}{\beta}\right)\frac{u'(c_1(\gamma,\theta))}{\phi}}_{\text{myopic component}}.$$

Myopic component:

- Present-biased students undervalue returns from education
- Lockwood (2018)

Disagreement component:

- Present-biased worker views savings subsidies as ‘distortion’

Opposing forces: ambiguous effect on labor wedge

Policy implementation

Current policy debate on student loans

Consensus: ease student loan burden

How?

- Employer Participation in Repayment Act of 2019
  - employer helps repay student loans using pretax income
- Retirement Parity for Student Loans Act of 2018
  - employer contributes to 401(k) while employees repay student loans

This paper: foundation for Retirement Parity for Student Loans Act

Retirement Parity for Student Loans Act

Education policy:

- Student loans: $L(e)$
- Income-contingent repayment: $r(e,y)$

Retirement policy:

- Income-contingent social security benefits: $a(y)$
- 401(k): matching rate α and contribution limit $\bar{s}$ and $\alpha r(e,y)$ saved

Taxes:

- Income tax: $T(y)$
- Tax deduction on student loans: $g(r)$
- Tax on bonds: $T^k(b)$
- Tax on retirement account: T^{ra}

Optimum can be implemented with above policies Comparison with literature

Numerical analysis

Parameterizing the model

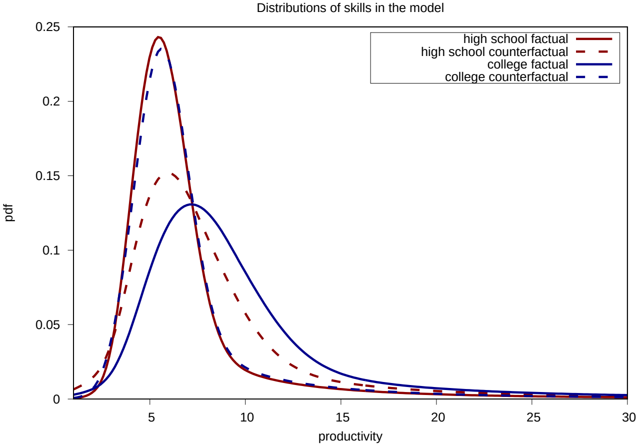
Symbol	Meaning	Value	
$\pi(L)$	Share of low type	0.64	
$\pi(H)$	Share of high type	0.36	
σ	Risk aversion	2	
η	Frisch elasticity	0.5	
Discount factors:		Present-bias	Time-cons.
β	Short-term factor	0.7	1.0
$\delta_0(L)$	HS period 1 long-term factor	0.00	0.00
$\delta_1(L)$	HS period 2 long-term factor	1.00	1.00
$\delta_2(L)$	HS retirement long-term factor	0.254	0.142
$\delta_0(H)$	COL period 1 long-term factor	0.115	0.151
$\delta_1(H)$	COL period 2 long-term factor	0.885	0.849
$\delta_2(H)$	COL retirement long-term factor	0.287	0.167

Functional forms: $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$, $h(\ell) = \frac{\ell^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}}$

Estimating productivity distributions

- Factual and counterfactual lifetime income distributions
  - Cunha and Heckman (2007) Reference income distributions
- Construct economy with "current policies"
  - progressive income taxes
  - Social security and corresponding taxes
  - 401(k) with matching contributions
  - (unconditional) college loan subsidy
- Assume normal-lognormal-Pareto shape distributions
- Match income dist. of simulated agent populations.

Parameterizing the productivity distributions



Source: calibrated to fit income distributions in Cunha and Heckman (2007)

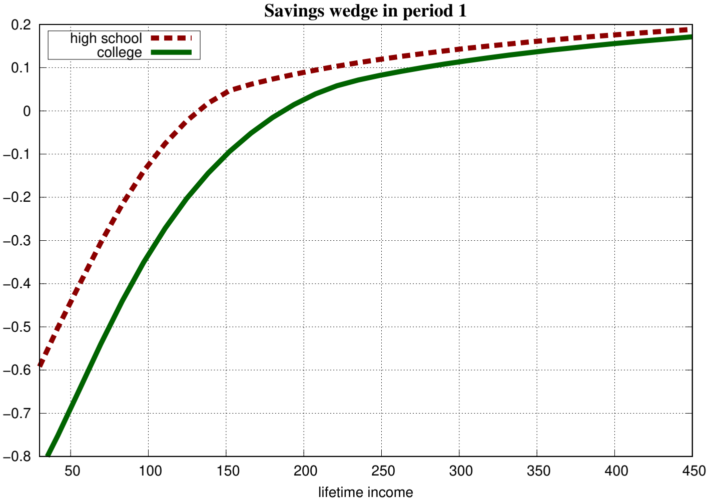
Present-biased vs time-consistent agents

- **First-period savings wedge:**

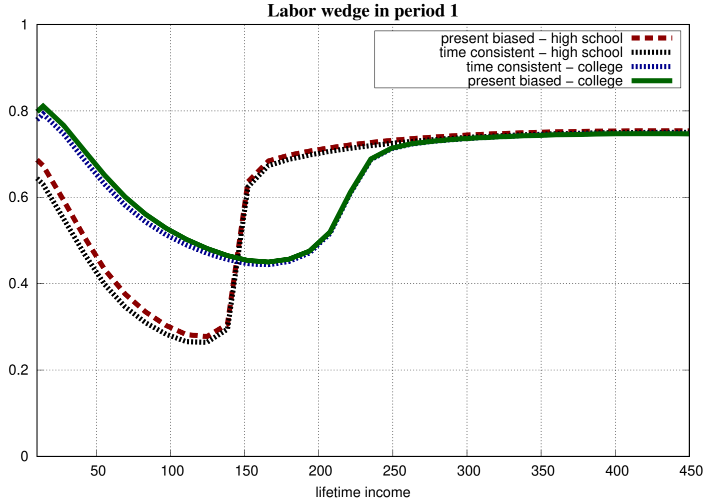
	Present-biased	Time-consistent
$\tau_0^k(L)$	1.0000	1.0000
$\tau_0^k(H)$	0.3232	0.2776

- **Second-period savings wedge:**
    - zero for time-consistent agents

Savings wedge



Labor wedge: present-biased vs. time-cons.



Welfare gains of optimal policies

- Welfare gains relative to optimal policy for time-consistent agents?
- Gains in terms of fraction of lifetime consumption.
- Under what implementation of time-consistent policies?
  - Laissez-faire savings
  - Mandatory (but uncontingent) savings

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Table: Welfare gains over optimal policies for time-consistent agents

	Mandatory savings	Laissez-faire
% increase in lifetime consumption	1.12	1.18

Conclusion

Extensions and future work

Extensions:

- Heterogeneous β
- Non-sophisticated agents

Future work:

1. Correct for the underestimation of high-income individuals
2. Explore implementation with simple instruments

Appendix

Implementation in Literature

Findeisen and Sachs (2016):

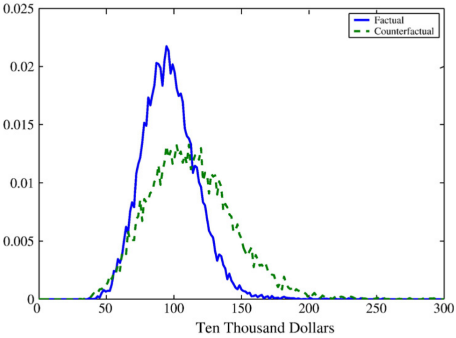
- Income-contingent college loans
- Difference: FS focuses on TC $\Rightarrow$ retirement policy not important for pre-work incentives

Moser and Olea de Souza e Silva (2019):

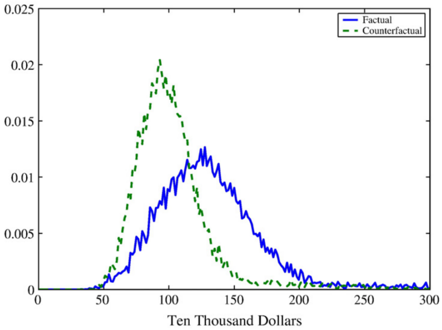
- uses different savings tools to separate productivity
  - low-productivity $\Rightarrow$ social security, high-productivity $\Rightarrow$ retirement accounts
- Difference: MO focuses on exogenous productivity $\Rightarrow$ savings wedges in $t = 1$ are different

Back to implementation

Reference income distributions



(a) High school



(b) College

Source: Cunha and Heckman (2007)

Back to calibration