The Optimal Size and Progressivity of Old-Age Social Security

Francisco Cabezón

September 28, 2022

Princeton University

Motivation: General

1 Public pensions are the largest welfare program.
- 1/4 of government revenue (OECD)

2 Public pensions are experiencing extensive reforms

3 (Almost) every public pension system shares three attributes:
(i) earning deductions finance benefits
(ii) benefits that depend (positively) on earnings
(iii) retirement age (Kolsrud et al. [2021])

- This paper: combines theory and evidence on pension reforms to evaluate welfare effects of reforms and characterize optimal level of (i) pension contribution rate, and (ii) the relationship between lifetime earnings and benefits

Motivation: General

1 Public pensions are the largest welfare program.
- 1/4 of government revenue (OECD)

2 Public pensions are experiencing extensive reforms

3 (Almost) every public pension system shares three attributes:
(i) earning deductions finance benefits
(ii) benefits that depend (positively) on earnings
(iii) retirement age (Kolsrud et al. [2021])

- This paper: combines theory and evidence on pension reforms to evaluate welfare effects of reforms and characterize optimal level of (i) pension contribution rate, and (ii) the relationship between lifetime earnings and benefits

Motivation: General

1 Public pensions are the largest welfare program.
- 1/4 of government revenue (OECD)

2 Public pensions are experiencing extensive reforms

3 (Almost) every public pension system shares three attributes:
(i) earning deductions finance benefits
(ii) benefits that depend (positively) on earnings
(iii) retirement age (Kolsrud et al. [2021])

- This paper: combines theory and evidence on pension reforms to evaluate welfare effects of reforms and characterize optimal level of (i) pension contribution rate, and (ii) the relationship between lifetime earnings and benefits

Motivation: General

1 Public pensions are the largest welfare program.
   - 1/4 of government revenue (OECD)

2 Public pensions are experiencing extensive reforms

3 (Almost) every public pension system shares three attributes:
   (i) earning deductions finance benefits
   (ii) benefits that depend (positively) on earnings
   (iii) retirement age (Kolsrud et al. [2021])

- This paper: combines theory and evidence on pension reforms to evaluate welfare effects of reforms and characterize optimal level of (i) pension contribution rate, and (ii) the relationship between lifetime earnings and benefits

Questions

- Two questions:
  1. [Size] What are the welfare effects and the optimal level of the pension contribution rate?
  2. [Allocation] What are the welfare effects and optimal level of benefits' progressivity?

- Answer: incentive distortion vs redistribution

Questions

- Two questions:
  1. [Size] What are the welfare effects and the optimal level of the pension contribution rate?
  2. [Allocation] What are the welfare effects and optimal level of benefits' progressivity?

- Answer: incentive distortion vs redistribution

Questions

- Two questions:
  1. [Size] What are the welfare effects and the optimal level of the pension contribution rate?
  2. [Allocation] What are the welfare effects and optimal level of benefits' progressivity?

- Answer: incentive distortion vs redistribution

Questions

- Latest reform in Chile (2021):
  - Reduce progressivity of benefits.

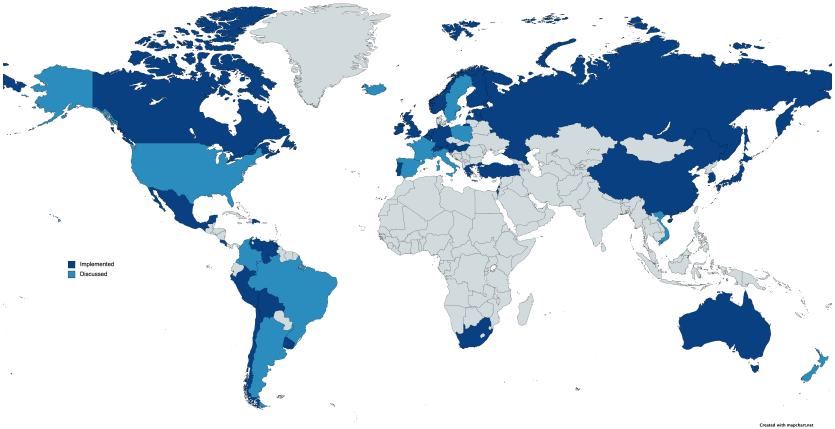
- Latest proposal US (BCP):
  - Increase payroll tax 1%.
  - Increase progressivity of benefits.

Questions

- Latest reform in Chile (2021):
  - Reduce progressivity of benefits.
- Latest proposal US (BCP):
  - Increase payroll tax 1%.
  - Increase progressivity of benefits.

Questions

- Countries that have discussed or **implemented** an increase in progressivity or contribution rate in the last 20 years:



Determinants of welfare effects

- Behavioral distortion:
  1. How forward-looking are workers? (benefit design)
  2. How do workers respond to the net-of-tax rate? (earning deduction)
  3. How effective is retirement income to increase retirement consumption?
- Redistribution:
  1. Heterogeneous productivity
  2. Heterogeneous retirement preparation
- Adding to the mix: behavioral biases

Determinants of welfare effects

- Behavioral distortion:
  1. How forward-looking are workers? (benefit design)
  2. How do workers respond to the net-of-tax rate? (earning deduction)
  3. How effective is retirement income to increase retirement consumption?
- Redistribution:
  1. Heterogeneous productivity
  2. Heterogeneous retirement preparation
- Adding to the mix: behavioral biases

Determinants of welfare effects

- Behavioral distortion:
  1. How forward-looking are workers? (benefit design)
  2. How do workers respond to the net-of-tax rate? (earning deduction)
  3. How effective is retirement income to increase retirement consumption?
- Redistribution:
  1. Heterogeneous productivity
  2. Heterogeneous retirement preparation
- Adding to the mix: behavioral biases

Determinants of welfare effects

- Theoretical: capture and put elements together
  - How: social insurance (Baily [1978] and Chetty [2006])
    + optimal linear income-tax (Sheshinski [1972] among others)
    + behavioral biases (Farhi and Gabaix [2020])

- Empirical: estimate parameters
  - How: admin data
    + merged panel survey
    + three sources of quasi-experimental variation

Determinants of welfare effects

- Theoretical: capture and put elements together
  - How: social insurance (Baily [1978] and Chetty [2006])
    + optimal linear income-tax (Sheshinski [1972] among others)
    + behavioral biases (Farhi and Gabaix [2020])

- Empirical: estimate parameters
  - How: admin data
    + merged panel survey
    + three sources of quasi-experimental variation

Results

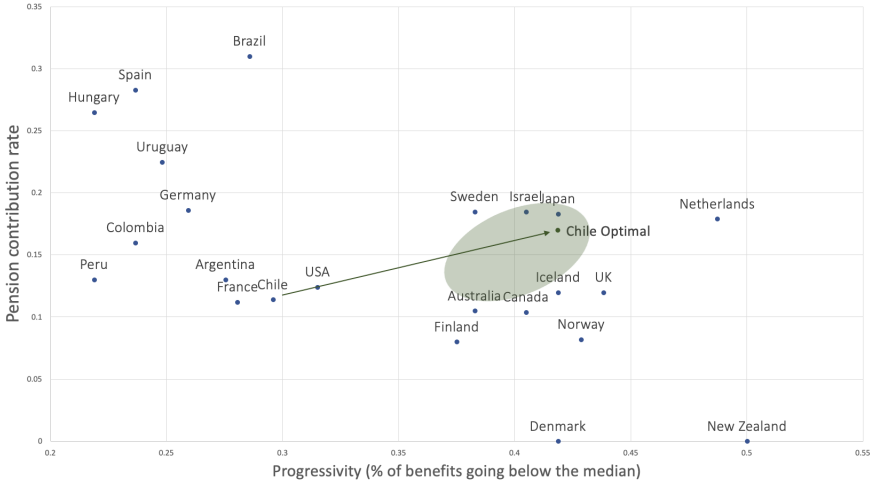
Determinants:

- Distortion of taxable earnings has a significant economic cost:
  - fiscal externality (2/3)
  - bias correction (1/3)
- Income transfers at retirement are effective to improve retirement preparation.
- Small value of intra-worker redistribution.
- Large value of inter-worker redistribution.

Overall welfare of reforms:

- Socially desirable to increase pension contribution rate and benefits' progressivity

Results: optimal design



Guideline

1 Motivation

2 Framework

3 Context and data

4 Empirical Estimation

5 Results

Framework

- Simple life-cycle model.
- Two periods: active ($t = 1$) and retired ($t = 2$).
- When active:
  - Generate taxable earnings (z_i):
    - pay pension contribution (κ)
    - pay income taxes (τ)
  - Decide pension savings (s)
  - Generate non-taxable income (χ)
- Pension contribution is invested until retirement with return (R)

Framework

- When retired:
  - No taxable earnings.
  - Pension with two components:
    (i) earnings dependent: personal pension contribution after tax (ϕ) on them

$$a(z_i) = R(1-\phi)kz_i$$

    (ii) lump-sum: funded by tax on pension contribution plus other government spending on pensions

$$b = \phi Rk\overline{z} + \overline{E}$$

- Workers exhibit present-focused bias (Farhi and Gabaix [2020]).

Framework

- Workers' problem:

$$\widehat{U}^i = \widehat{U}(c_{i1}, c_{i2}, z_i, s_i, \chi_i)$$

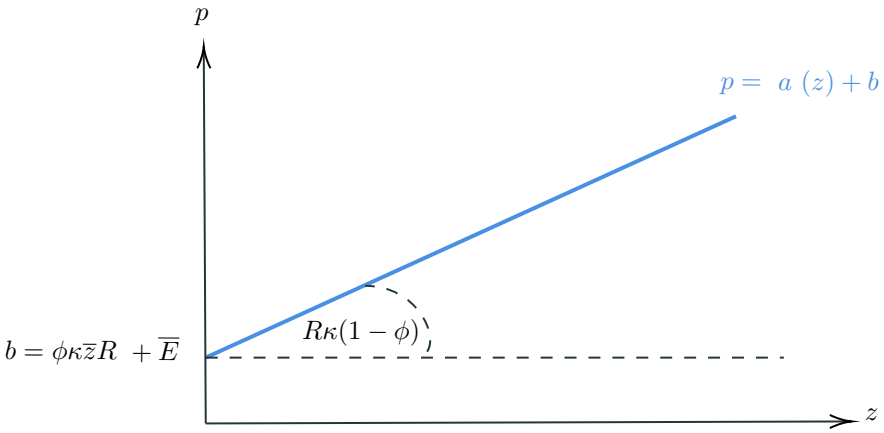
subject to:

$$c_{i1} \in B_{i1}(z, \chi) = z_i(1 - \kappa - \tau) + s + g_i(\chi)$$
$$c_{i2} \in B_{i2}(z, \chi) = a(z_i) + b + f(s)$$
$$a(z_i) = (1 - \phi)\kappa z_i R$$
$$b = \phi\kappa\overline{z}R + \overline{E}$$

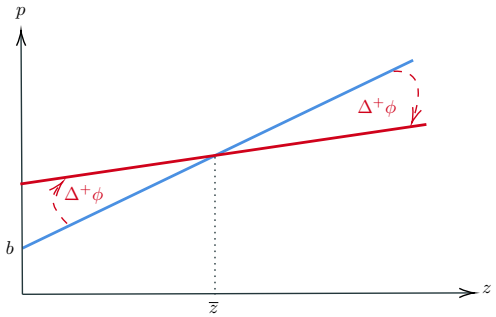
Framework

- Two parameters:
  - pension contribution (κ): controls inter-temporal redistribution.
  - benefits' progressivity (ϕ): controls inter-worker redistribution.

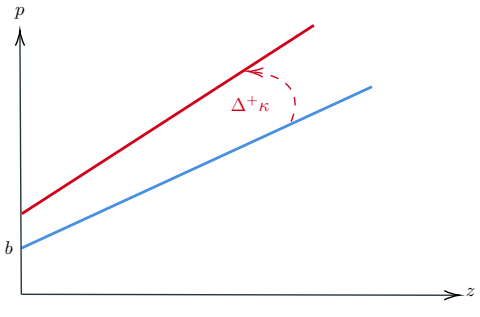
Framework



Framework: reforms



(a) Increase in benefits' progressivity



(b) Increase in contribution rate

Framework

- Any fiscal effect of reforms through τ is compensated with a change in $\overline{E}$.
- By construction, reforms are budget-balanced.
- Government maximizes an utilitarian welfare function, where workers can be biased ($U^i \neq \widehat{U}^i$):

$$W(\kappa, \phi) = \int_i U^i(c_{i1}, c_{i2}, s_i, z_i, \chi_i) di$$

Framework

- Assumption to simplify social gains of reforms.

Framework

- Two standard assumptions.

Assumption (Separable preferences)

$$\frac{\partial^2 U}{\partial k \partial l} = 0 \quad for\ k, l \in \{c_1, c_2, z, \chi\}\ and\ k \neq l$$

Assumption (Present-focused bias)

$$\frac{\partial \widehat{U}}{\partial c_2} = \beta \frac{\partial U}{\partial c_2}$$

Framework

- Three data-limitation assumptions.

Assumption
(i) Iso-elastic

(ii) No response of active income other than taxable earnings.

(iii) Return to personal savings is R.

Framework

- Two definitions.

Definition (Retirement preparedness)

$$d_i = U_{c_{i1}}(c_{i1}) - U_{c_{i2}}(c_{i2})R$$

(distance to the Euler equation of worker i)

Definition (Marginal propensity to consume)

$$\mu = \frac{\partial c_2}{\partial b}$$

- Welfare effects of marginal reform to benefits' progressivity:

$$\begin{aligned}\frac{dW}{d\phi} =& - R\kappa \left(\mu Cov\left[d_i, z_i\right] + Cov\left[U_{c1}(c_{i1}), z_i\right]\right) \\ &+ (\tau + \phi\kappa) R\overline{z}[-\varepsilon_{mz} + \varepsilon_{bz}] \int_i (\mu d_i + U_{c1}(c_{i1}))di \\ &+ \mu(1-\beta)(1-\phi)\kappa\overline{z}[-\varepsilon_{mz} + \varepsilon_{bz}] \int_i (\mu d_i + U_{c1}(c_{i1}))di\end{aligned}$$

Framework

- Welfare effects of marginal reform to benefits' progressivity:

$$\frac{dW}{d\phi} = \underbrace{-R\kappa\left(\mu Cov\left[d_i, z_i\right] + Cov\left[U_{c1}(c_{i1}), z_i\right]\right)}_{\text{Inter-worker redistribution}}$$
$$\underbrace{+(\tau + \phi\kappa)R\overline{z}[-\varepsilon_{mz} + \varepsilon_{bz}]\int_i(\mu d_i + U_{c1}(c_{i1}))di}_{\text{Fiscal externality}}$$
$$\underbrace{+(1-\beta)\mu(1-\phi)\kappa\overline{z}\int_i(\mu d_i + U_{c1}(c_{i1}))[-\varepsilon_{mz} + \varepsilon_{bz}]di}_{\text{Bias correction}}$$

Framework

- Welfare effects of marginal reform to benefits' progressivity:

$$\frac{dW}{d\phi} = \underbrace{-R\kappa\left(\mu Cov\left[d_i, z_i\right] + Cov\left[U_{c1}(c_{i1}), z_i\right]\right)}_{\text{Inter-worker redistribution}}$$
$$\underbrace{+(\tau + \phi\kappa)R\overline{z}[-\varepsilon_{mz} + \varepsilon_{bz}]\int_i(\mu d_i + U_{c1}(c_{i1}))di}_{\text{Fiscal externality}}$$
$$\underbrace{+(1-\beta)\mu(1-\phi)\overline{z}\kappa[-\varepsilon_{mz} + \varepsilon_{bz}]\int_i(\mu d_i + U_{c1}(c_{i1}))di}_{\text{Bias correction}}$$

Elements:

1 Insurance against heterogeneity: productivity and retirement preparation

Framework

- Welfare effects of marginal reform to benefits' progressivity:

$$\frac{dW}{d\phi} = \underbrace{-R\kappa\left(\mu Cov\left[d_i, z_i\right] + Cov\left[U_{c1}(c_{i1}), z_i\right]\right)}_{\text{Inter-worker redistribution}}$$
$$\underbrace{+(\tau + \phi\kappa)R\bar{z}[-\varepsilon_{mz} + \varepsilon_{bz}]\int_i(\mu d_i + U_{c1}(c_{i1}))di}_{\text{Fiscal externality}}$$
$$\underbrace{+(1-\beta)\mu(1-\phi)\kappa\bar{z}[-\varepsilon_{mz} + \varepsilon_{bz}]\int_i(d_i + U_{c1}(c_{i1}))di}_{\text{Bias correction}}$$

Elements:

1. Insurance against heterogeneity: productivity and retirement preparation
2. Behavioral distortion: consumption timing and taxable earnings

Framework

$$\frac{dW}{d\phi} = \underbrace{-R\kappa\left(\mu Cov\left[d_i, z_i\right] + Cov\left[U_{c1}(c_{i1}), z_i\right]\right)}_{\text{Intra-worker redistribution}}$$

$$\underbrace{+(\tau + \phi\kappa)R\overline{z}[-\underbrace{\varepsilon_{mz}}_{\Delta\text{Slope}} + \underbrace{\varepsilon_{bz}}_{\Delta\text{Intercept}}]\int_i(\mu d_i + U_{c1}(c_{i1}))di}_{\text{Fiscal externality}}$$

$$\underbrace{+(1-\beta)\mu x(1-\phi)\kappa\overline{z}[-\underbrace{\varepsilon_{mz}}_{\Delta\text{Slope}} + \underbrace{\varepsilon_{bz}}_{\Delta\text{Intercept}}]\int_i(d_i + U_{c1}(c_{i1}))di}_{\text{Bias corrrection}}$$

Elements:

1. Insurance against heterogeneity: productivity and retirement preparation
2. Behavioral distortion: consumption timing and taxable earnings

Framework

$$\frac{dW}{d\kappa} = \underbrace{\mu Cov\left[d_i, z_i\right] + \mu\overline{dz}}_{\text{Intra-worker redistribution}} \underbrace{- R\kappa\left(\mu Cov\left[d_i, z_i\right] + Cov\left[U_{c1}(c_{i1}), z_i\right]\right)}_{\text{Inter-worker redistribution}}$$

$$\underbrace{+(\tau+\phi\kappa)R\overline{z}\left[\underbrace{\frac{1-\kappa}{1-\tau}\varepsilon_{(1-\tau)z}}_{\Delta\text{net-of-tax}} - \underbrace{\frac{1-\phi}{\phi}\varepsilon_{mz}}_{\Delta\text{Slope}} + \underbrace{\varepsilon_{bz}}_{\Delta\text{Intercept}}\right]\int_i(\mu d_i + U_{c1}(c_{i1}))di}_{\text{Fiscal externality}}$$

$$\underbrace{+(1-\beta)\mu(1-\phi)\kappa\overline{z}\left[\underbrace{\frac{1-\kappa}{1-\tau}\varepsilon_{(1-\tau)z}}_{\Delta\text{net-of-tax}} - \underbrace{\frac{1-\phi}{\phi}\varepsilon_{mz}}_{\Delta\text{Slope}} + \underbrace{\varepsilon_{bz}}_{\Delta\text{Intercept}}\right]\int_i(d_i + U_{c1}(c_{i1}))di}_{\text{Bias correction}}$$

Elements:

1. Insurance against heterogeneity: productivity and retirement preparation
2. Behavioral distortion: consumption timing and taxable earnings

- Two last assumptions:

Assumption (State dependence)

$$\frac{\partial U(c)}{\partial c_2} = \delta\theta \frac{\partial U(c)}{\partial c_1}$$

for any consumption $c > 0$.

Assumption (CRRA)
Preferences for consumption are CRRA with relative risk aversion parameter γ.

Framework

- Approximation to marginal utility of consumption:

$$d_i(c_{i1}, c_{i2}) \approx U_{c_1}(c_{i1}) \left[(1-\theta) + \theta\gamma \frac{c_{i2} - c_{i1}}{c_{i2}} \right] \tag{1}$$

$$U_{c_1}(c_{i1}) \approx U_{c_1}(\overline{c}) \left[1 - \gamma \frac{c_1 - \overline{c}}{\overline{c}} \right] \tag{2}$$

- Two moments:
  1. Consumption drop at retirement:
  $$Cov \left[\frac{c_{i1} - c_{i2}}{c_{i1}}, z_i \right]$$
  2. Active-life consumption:
  $$Cov \left[c_{i1}, z_i \right]$$

Framework: Empirical objective

1 Behavioral distortion:
- Net-of-tax rate: payroll tax $[\varepsilon_{(1-\tau)z}]$
- Slope: benefit-earnings link $[\varepsilon_{mz}]$
- Intercept: future pension benefit $[\varepsilon_{bz}]$
- MPC: MPC from pension benefit $[\mu]$

2 Redistribution:
- Moments:
  - Productivity: $Cov\left[c_{i1}, z_i\right]$
  - Retirement preparation: $Cov\left[\frac{\Delta c_i}{c_{i1}}, z_i\right]$

- Parameters: γ, θ, β, R

Distortion vs redistribution $\Rightarrow$ Empirical question

Framework: Empirical objective

1 Behavioral distortion:
- Net-of-tax rate: payroll tax $[\varepsilon_{(1-\tau)z}]$
- Slope: benefit-earnings link $[\varepsilon_{mz}]$
- Intercept: future pension benefit $[\varepsilon_{bz}]$
- MPC: MPC from pension benefit $[\mu]$

2 Redistribution:
- Moments:
  - Productivity: $Cov\left[c_{i1}, z_i\right]$
  - Retirement preparation: $Cov\left[\frac{\Delta c_i}{c_{i1}}, z_i\right]$

- Parameters: γ, θ, β, R

Distortion vs redistribution $\Rightarrow$ Empirical question

Framework: Empirical objective

1 Behavioral distortion:
- Net-of-tax rate: payroll tax $[\varepsilon_{(1-\tau)z}]$
- Slope: benefit-earnings link $[\varepsilon_{mz}]$
- Intercept: future pension benefit $[\varepsilon_{bz}]$
- MPC: MPC from pension benefit $[\mu]$

2 Redistribution:
- Moments:
  - Productivity: $Cov\left[c_{i1}, z_i\right]$
  - Retirement preparation: $Cov\left[\frac{\Delta c_i}{c_{i1}}, z_i\right]$

- Parameters: γ, θ, β, R

Distortion vs redistribution $\Rightarrow$ Empirical question

Framework: Empirical objective

1 Behavioral distortion:
- Net-of-tax rate: payroll tax $[\varepsilon_{(1-\tau)z}]$
- Slope: benefit-earnings link $[\varepsilon_{mz}]$
- Intercept: future pension benefit $[\varepsilon_{bz}]$
- MPC: MPC from pension benefit $[\mu]$

2 Redistribution:
- Moments:
  - Productivity: $Cov\left[c_{i1}, z_i\right]$
  - Retirement preparation: $Cov\left[\frac{\Delta c_i}{c_{i1}}, z_i\right]$

- Parameters: γ, θ, β, R

Distortion vs redistribution $\Rightarrow$ Empirical question

Framework: Empirical objective

1 Behavioral distortion:
- Net-of-tax rate: payroll tax $[\varepsilon_{(1-\tau)z}]$
- Slope: benefit-earnings link $[\varepsilon_{mz}]$
- Intercept: future pension benefit $[\varepsilon_{bz}]$
- MPC: MPC from pension benefit $[\mu]$

2 Redistribution:
- Moments:
  - Productivity: $Cov\left[c_{i1}, z_i\right]$
  - Retirement preparation: $Cov\left[\frac{\Delta c_i}{c_{i1}}, z_i\right]$

- Parameters: γ, θ, β, R

Distortion vs redistribution $\Rightarrow$ Empirical question

Guideline

1 Motivation

2 Framework

3 Context and data

4 Empirical Estimation

5 Results

Context: Chilean Pension System

- Chilean pensions have two components
  1. Self-funded pension.
  2. Public subsidy that complements self-funded pension.

1 Self-funded pension:

- Forced DC system, where 10% of worker's payroll income goes to a personal account.
- Personal account is invested until retirement by private pension funds administrators (PFAs).
- PFA charges a fee.
- At retirement, pension saving stock is converted in a pension flow.

Context: Chilean Pension System

2 Public Subsidy

- Introduced in 2008.
- Government means-tested subsidy.
- Subsidy phase-out with self-funded pension.
- This subsidy is large:
  - 67% of 65+ people receives it.
  - Represents 35% of their benefit.

Data

- Admin data:
  - Panel data of monthly payroll earnings (1981-2020).
  - Pensions savings amount, administrator and type of investment.
  - Annual taxable earnings (2005-2019)
  - Demographics.

Data

- Survey data:
  - Panel with 7 rounds: 2002, 2004, 2006, 2009, 2012, 2015, 2020
  - Self-reported income and consumption.
  - Demographics.
  - Matched to the admin data.

Guideline

1 Motivation

2 Framework

3 Context and data

4 Empirical Estimation

- Behavioral distortion
- Redistribution moments
- Other parameters

5 Results

Empirical Estimation

Estimation:
1. Behavioral distortion

Behavioral distortion

1. Marginal propensity to consume from pension benefit: μ
2. Taxable earnings elasticity to future pension benefit: ε_{bz}
3. Taxable earnings elasticity to benefit-earnings link: ε_{mz}
4. Taxable earnings elasticity to net-of-tax rate: $\varepsilon_{\tau z}$

Behavioral distortion

1. Marginal propensity to consume from pension benefit: μ **[novel]**
2. Taxable earnings elasticity to future pension benefit: ε_{bz} **[novel]**
3. Taxable earnings elasticity to benefit-earnings link: ε_{mz} **[novel]**
4. Taxable earnings elasticity to net-of-tax rate: $\varepsilon_{\tau z}$

Behavioral distortion: future pension benefit

- Objective: effect of future pension benefit on taxable earnings.
- Shock: Great Financial Crisis shock to pension savings.
- Treatment assignment: age-dependent investment strategy of pension savings.
- Estimation method: IV
- Finding: income elasticity to future pension benefit of 0.11 [0.08, 0.13]

Behavioral distortion: future pension benefit

- Pension savings invested in stock market.
- Great financial crisis generates a large shock to returns.
- Investment strategies (riskiness) are age-dependent.

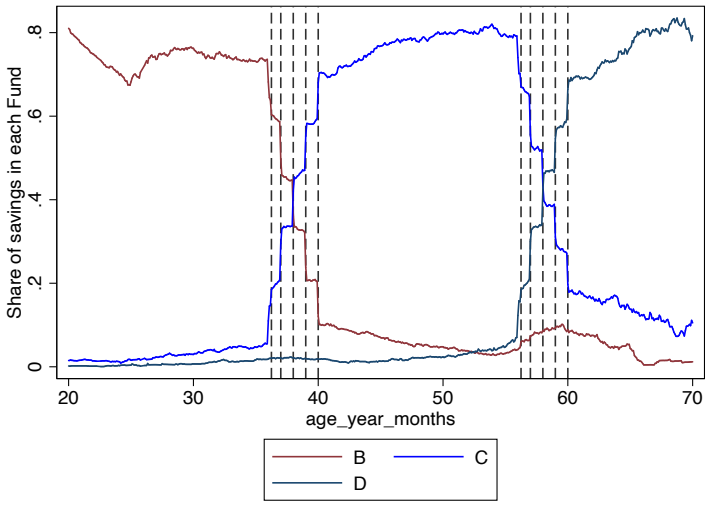
$$\Rightarrow \text{Age-dependent shock to future pension benefit}$$

Behavioral distortion: future pension benefit

- Savings are allocated across Funds by workers' age.
- Specifically there are switchs at:
  - Males: 36, 40, 56 and 60 yo
  - Females: 36, 40, 51 and 55 yo

Behavioral distortion: future pension benefit

- Males investment composition by age in months:



Behavioral distortion: future pension benefit

- Exposition to risk at the crisis sub-prime made a large difference in returns between funds.

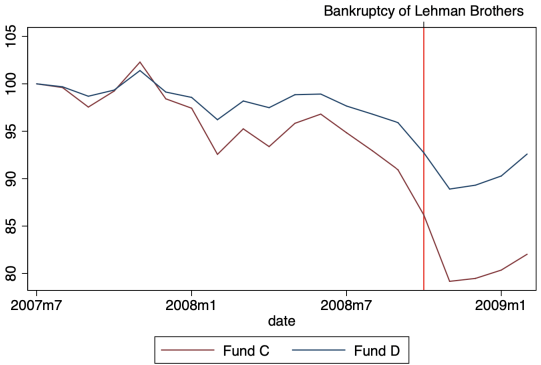


Figure 1: Crash

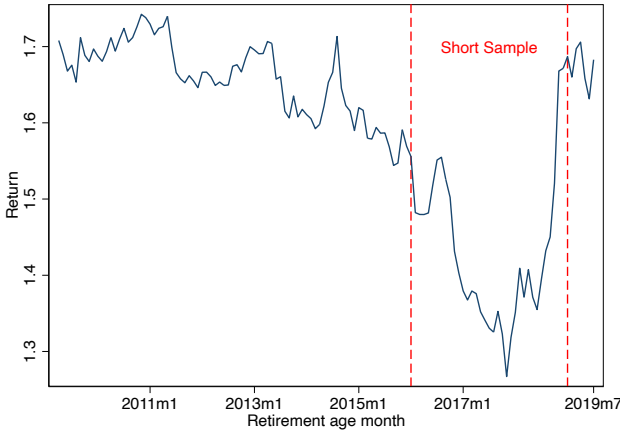
Figure 2: Recovery

Behavioral distortion: future pension benefit

- Switching savings between funds in the wrong moment is costly.

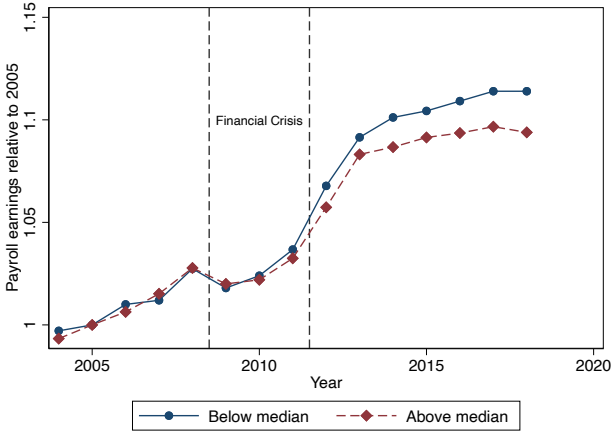
Behavioral distortion: future pension benefit

- Return during last 10 years of active life:



Behavioral distortion: future pension benefit

- Reduced form: taxable earnings of more vs less exposed to GFC



Behavioral distortion: future pension benefit

- Two stage estimation:
  1. First stage: FC shock on pension payment
  2. Second stage: pension payment shock on taxable income
- First stage:

$$log(p_{ia}) = \alpha_t + \gamma_a + X_i\beta_1 + \beta_2 log(D_{ia}) + \epsilon_i$$

  where:
  - D_{ia}: is the return obtained during the financial crisis on pension savings.
- Second stage:

$$log(y_{it}) = \alpha_t + \gamma_a + X_i\beta_1 + \gamma\widehat{log(p_{ia})} + u_{it}$$

Behavioral distortion: future pension benefit

VARIABLES	(1) Future Pension	(2) Future Pension	(3) Future Pension
GFC shock to pension savings	0.903*** [0.008]	0.899*** [0.008]	0.856*** [0.004]
Observations	108,129	108,129	48,026
R-squared	0.584	0.591	0.557
Age Controls	No	Yes	Yes
Other Controls	No	Yes	Yes
Crisis Definition	Short	Short	Long
Sample Definition	Narrow	Narrow	Narrow
SE	Robust	Robust	Robust

Behavioral distortion: future pension benefit

VARIABLES	(1) log(Income)	(2) log(Income)	(3) log(Income)
% Shock to Pension	-0.155*** [0.051]	-0.115*** [0.023]	-0.121*** [0.036]
Observations	216,200	111,738	281,227
R-squared	0.550	0.579	0.562
Controls	Yes	Yes	Yes
Crisis Definition	Long	Long	Short
Sample Definition	Wide	Narrow	Wide
Clustered SE	Sex-Dob	Sex-Dob	Sex-Dob

Behavioral distortion: MPC from pension benefit

- Objective: MPC at retirement from pension benefit.
- Shock: Great Financial Crisis shock to pension savings.
- Treatment assignment: age-dependent investment strategy of pension savings.
- Estimation method: IV
- Finding: MPC of 0.79.

Marginal propensity to consume from pension benefit

- Same shock to pension payment, first stage in levels:

$$p_{ia} = \alpha_t + \gamma_a + X_i\beta_1 + \beta_2 D_{ia} + \epsilon_i$$

- Dependent variable is now non-durable consumption at retirement (in level)

$$c_{i2} = \alpha_t + \gamma_a + X_i\beta_1 + \gamma\widehat{p_{ia}} + u_{it}$$

Marginal propensity to consume from pension benefit

	(1)	(2)	(3)	(4)	(5)
VARIABLES	E. disp. income	E. disp. income	E. disp. income	E. disp. income	E. disp. income
Pension benefit	0.843***	0.798***	0.798***	0.798***	0.693**
	[0.092]	[0.093]	[0.202]	[0.201]	[0.345]
Observations	1,173	1,173	1,173	1,173	660
Controls	No	Age-Gender	Age-Gender	Age-Gender	Age-Gender
SE	None	None	Robust	Cluster DoB	Cluster DoB
Crisis definition	Long	Long	Long	Long	Short

$$\Rightarrow \mu = 0.8$$

- Income transfer at retirement are **effective** in increasing retirement consumption.

Behavioral distortion: benefit-earnings link

- Objective: effect of benefit-earnings link on taxable earnings.
- Shock: Public subsidy introduction in July 2008 $\Rightarrow$ Implicit tax on pension savings.
- Treatment assignment: threshold on pension savings to receive subsidy.
- Estimation method: RDD
- Finding: income elasticity to benefits' progressivity of 0.22 [0.1, 0.32]

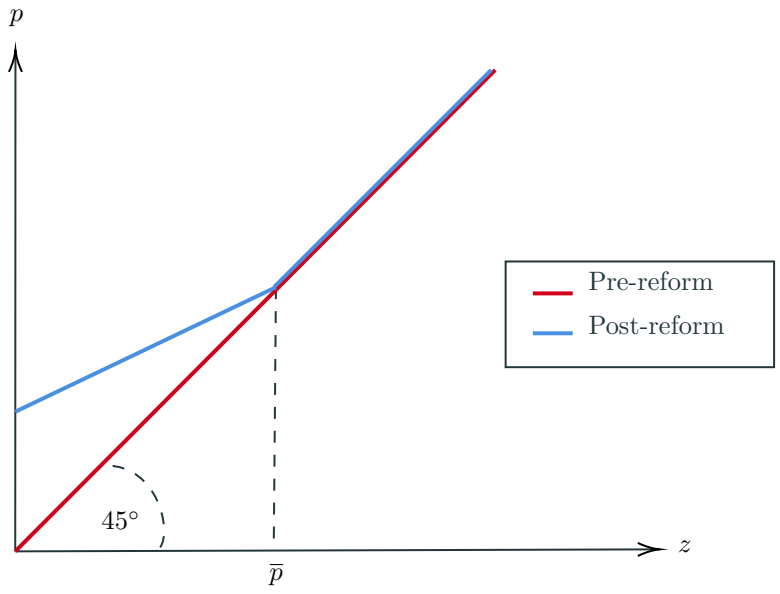
Behavioral distortion: benefit-earnings link

- Pension subsidy introduced in 07/2008.
- The subsidy phases-out with self-funded pension $\Rightarrow$ 33% implicit tax on marginal pension saving.
- Receiver if:
  - self-funded pension below threshold ($PMAS$).
  - 60% poorer of population.

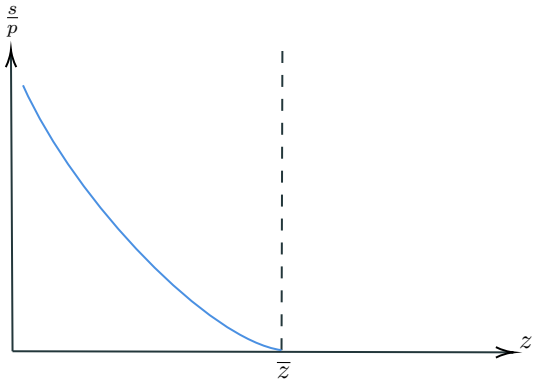
Behavioral distortion: benefit-earnings link

- Challenges:
  1. Split income from benefit-earnings link effects
  2. Receiver (treatment) assignment
- Solution: use the $PMAS(\overline{p})$ threshold using savings before retirement.

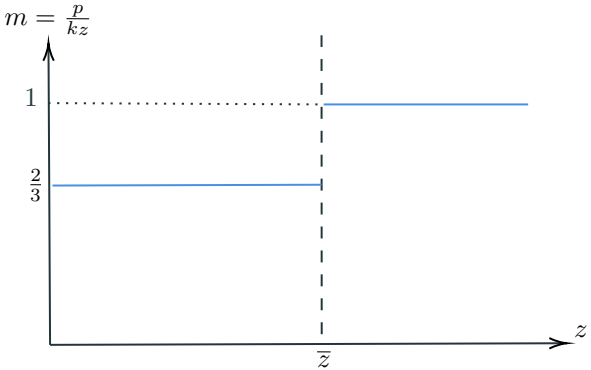
Behavioral distortion: benefit-earnings link



Behavioral distortion: benefit-earnings link



(a) Subsidy



(b) Benefit-earnings slope

Behavioral distortion: benefit-earnings link

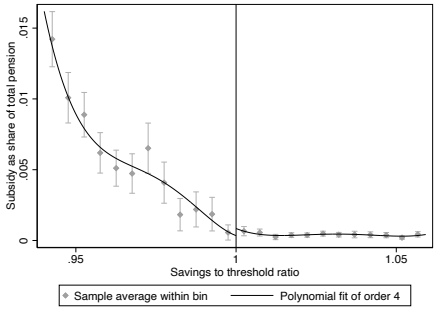


Figure 3: Subsidy as share of total pension benefit

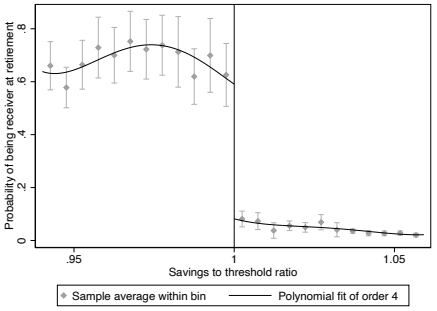


Figure 4: Probability of being a receiver

Behavioral distortion: benefit-earnings link

- Identification strategy.
- $PMAS$ threshold:
  - isolate change in B-C link from larger pension benefit
  - assign treatment
- Use pre-subsidy savings to instrument distance to threshold.
- Use subsidy introduction to build placebo on years before the subsidy.

Behavioral distortion: benefit-earnings link

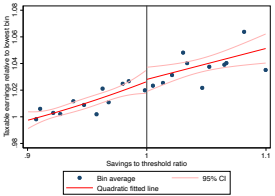


Figure 5: One year before subsidy introduction

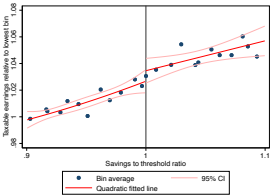


Figure 6: One year after subsidy introduction

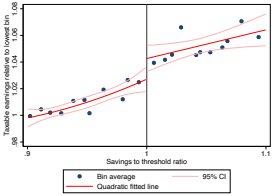


Figure 7: Two year after subsidy introduction

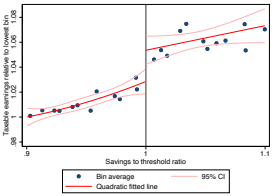


Figure 8: Three year after subsidy introduction

Behavioral distortion: benefit-earnings link

- Two-stage RDD, where the instrument in the first stage is pre-subsidy savings.
- First stage is the probability of receive the subsidy:

$$D_i = \alpha_0 + \mathbb{1}\left[A_i^{Pre} < c\right](h(A_i^{Pre} - c)) + \mathbb{1}\left[A_i^{Pre} > c\right](h(A_i^{Pre} - c)) + \gamma \cdot \mathbb{1}[A_i^{Pre} > c] + \alpha_1 X_i^{'} + \epsilon_i$$

- Second stage is the effect of that probability on taxable income after the introduction of the subsidy:

$$y_i = \beta_0 + \mathbb{1}\left[A_i^{Pre} < c\right](g(A_i^{Pre} - c)) + \mathbb{1}\left[A_i^{Pre} > c\right](g(A_i^{Pre} - c)) + \rho \cdot \widehat{D_i} + \beta_1 X_i^{'} + \mu_i$$

Behavioral distortion: benefit-earnings link

- Those just below the subsidy threshold are much more likely of receiving the subsidy:

VARIABLES	(1) Subsidy Receiver	(2) Subsidy Receiver	(3) Subsidy Receiver	(4) Subsidy Receiver	(5) Subsidy Receive
Above Threshold	-0.235*** [0.031]	-0.274*** [0.029]	-0.251*** [0.018]	-0.277*** [0.019]	-0.335*** [0.022]
Observations	16,851	16,851	16,851	12,889	13,275
R-squared	0.063	0.193	0.202	0.163	0.200
Controls	No	Yes	Yes	Yes	Yes
Trend	Linear	Linear	4th-polynomial	4th-polynomial	4th-polynomial
Bandwith	Default	Default	Default	Narrow	Donuth-hole
Clustered SE	DoB	DoB	DoB	DoB	DoB
F	378.3	403.8	327.6	193.4	255.4

Behavioral distortion: benefit-earnings link

- Those more likely to receive the subsidy, reduce their taxable earnings after the subsidy introduction:

	(1)	(2)	(3)	(4)
VARIABLES	log(Income)	log(Income)	log(Income)	log(Income)
Elasticity	-0.150***	-0.144***	-0.151***	-0.149***
	[0.05]	[0.04]	[0.04]	[0.04]
Observations	16,851	16,851	12,570	13,303
Controls	No	Yes	Yes	Yes
Bandwith	Default	Default	Narrow	Donut-hole
Clustered SE	DoB	DoB	DoB	DoB

Back

Behavioral distortion: payroll tax

- Objective: effect of net-of-tax-rate on payroll earnings.
- Shock: Change in Planvital AFP managment fee in July 2014.
- Treatment assignment: affiliation to Planvital PFA.
- Estimation method: diff-in-diff.
- Finding: income elasticity to payroll tax of 0.38 [0.27, 0.49]

Behavioral distortion: payroll tax

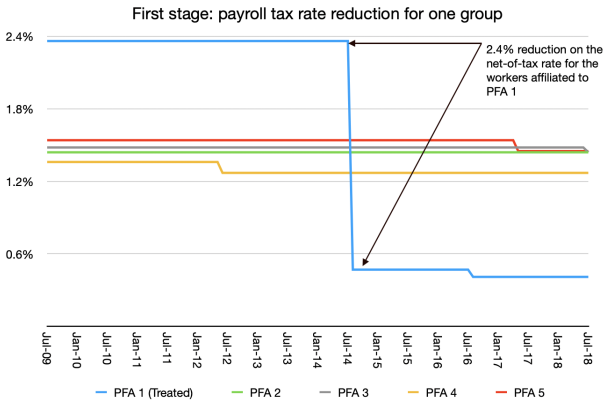
- Chilean pension system provides variation to identify the elasticity wrt to taxes:

$$\varepsilon_{\tau z}$$

- Income deduction is 10% plus the PFA fee. Net-of-deductions payroll income is $z(1 - 10\% - fee - other)$
- Fee acts as payroll tax.
- Each PFA sets the "fee" independently.

Behavioral distortion: payroll tax

- Sharp change in one of the fund administrator fee in 2014.



Behavioral distortion: payroll tax

- I follow a dif-in-dif approach:

$$y_{iat} = \alpha_t + \gamma_a + X_i\phi + \beta D_{iat} + \epsilon_{it}$$

where:

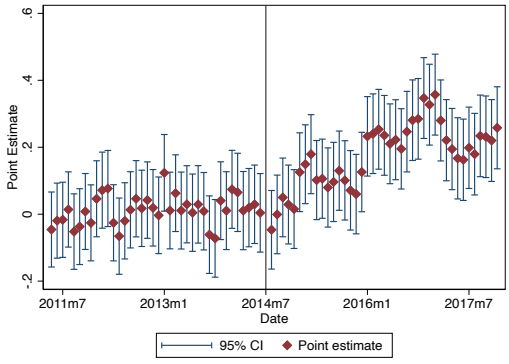
- D_{iat}: is the log of the change in the net-of tax rate of worker i in period t with respect to the fee before the fee reduction.

	(1)	(2)	(3)	(4)
ETI	0.372***	0.386***	0.386***	0.386**
	[0.066]	[0.043]	[0.039]	[0.112]
Observations	1,298,805	1,298,802	1,298,802	1,298,802
R-squared	0.012	0.572	0.572	0.572
Switchers	No	No	No	No
Controls	No	Yes	Yes	Yes
PFA Trend	No	Yes	Yes	Yes
Clustered SE	None	None	PFAxDate	Worker

Behavioral distortion: payroll tax

- To support the causality interpretation, I also run the following dynamic estimation:

$$y_{iat} = \alpha_t + \gamma_a + X_i\phi + \sum_{k=-K+e}^{e-1} \beta_t D_{iat}^k + \sum_{k=e+1}^{e+K} \beta_t D_{iat}^k + \epsilon_{it}$$



Estimation:
2. Redistribution moments

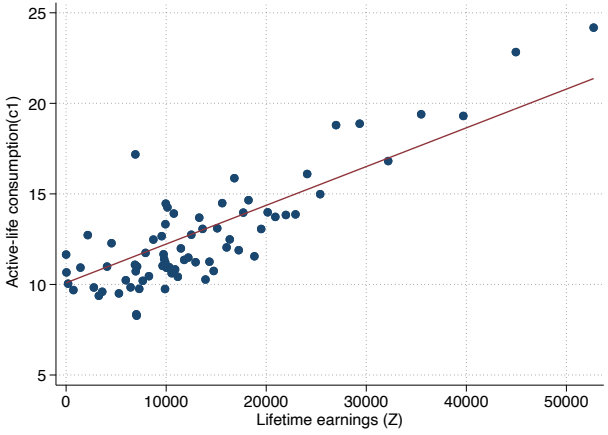
Redistribution moments

- Aim: relationship between lifetime earnings and active consumption, consumption drop.
- Panel survey merged with the admin data:

$$(c_{i1}, c_{i2}, z_i)$$

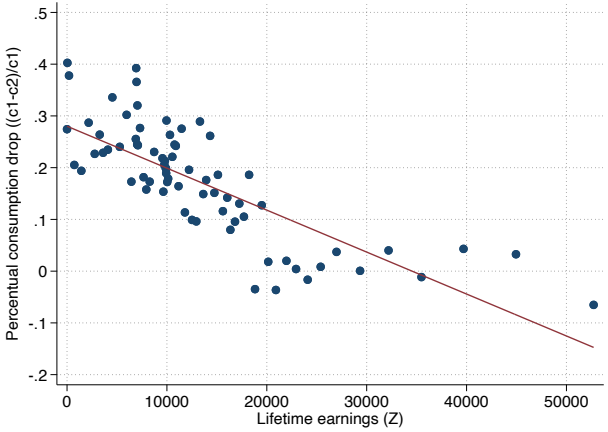
Redistribution moments

- $Cov[c_{i1}, z_i]$: productivity and lifetime earnings



Redistribution moments

- $Cov\left[\frac{\Delta c_i}{c_{i1}}, z_i\right]$: consumption drop and lifetime earnings



Consumption drop at retirement: Mechanism

- Low income workers have:
  - Smaller pension replacement rate of total income (formal+ informal).
  - Less private savings.
  - Retirement is more likely an unexpected shock.
  - Lower protection against job termination.
  - More dependent on government support at retirement.
- In sum: preparedness for retirement is increasing on lifetime payroll earnings.

retirement

Consumption drop at retirement: Mechanism

- Lifetime payroll earnings are a good tagging for:
  - Productivity
  - Retirement preparedness

  $\Rightarrow$ large inter-worker redistribution value

Estimation:
3. Other Parameters

Identification

- Parameters calibration:
  - [γ] Risk aversion: calibrate with literature estimates. (Landais and Spinnewijn (2021))
    $\Rightarrow \gamma = [2, 4]$
  - [θ] State dependent preferences: calibrate with literature. (Battistin et. al. (2009))
    $\Rightarrow$ 9.8% of consumption drop.
  - [β] Present-focused bias: 0.82 (Cheung et. al. (2021))
  - [R] pension funds' average return in 2010-2020.
    $\Rightarrow R = 1.048 = \delta^{-1}$

Results

Results

- Pension system design distorts taxable earnings.
- Income transfers at retirement are effective to improve retirement preparation.
- Lifetime payroll earnings are a good tagging for
  - productivity
  - retirement preparation.

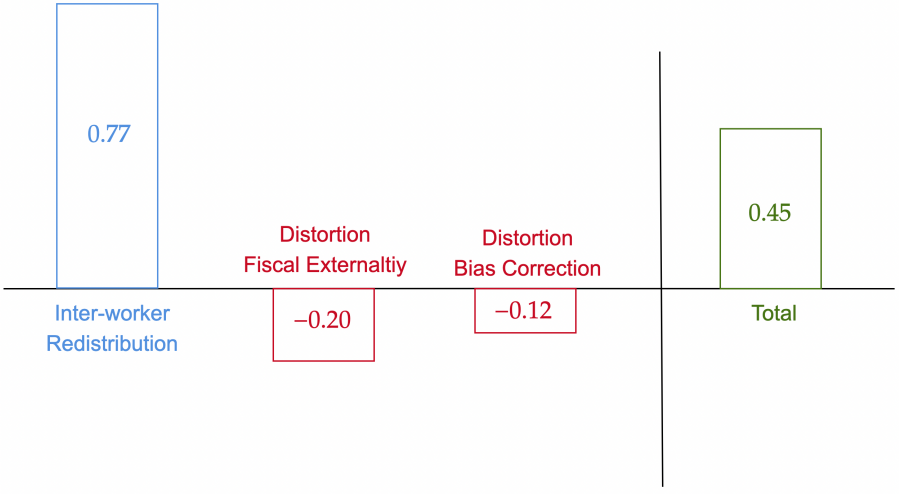
Results

- Money-metric social gain as share of mechanical transfer of reform:

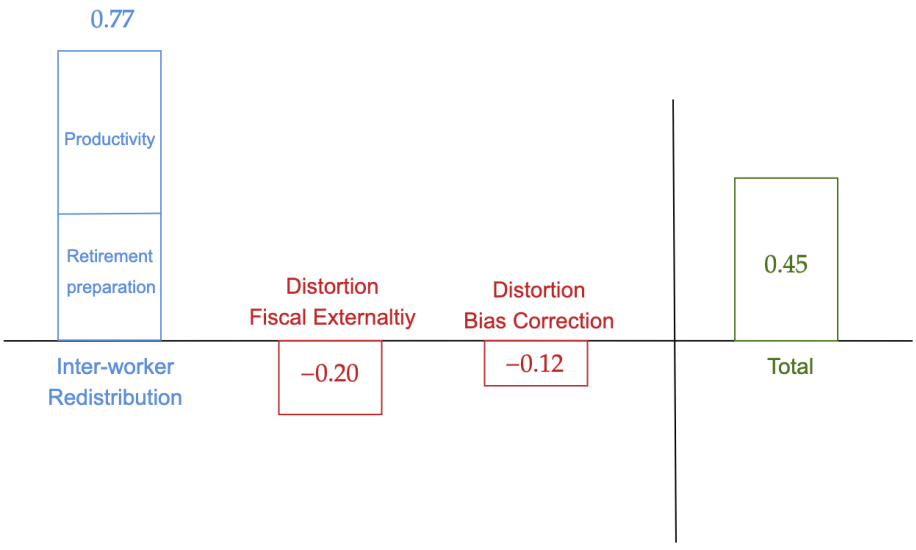
$$M^{\phi} = \frac{\frac{dW}{d\phi} \Big/ (\mu \bar{d} + \overline{U_{c_2}})}{\kappa R \sum_i z_i}$$

$$M^{\kappa} = \frac{\frac{dW}{d\kappa} / (\mu \bar{d} + \overline{U_{c_2}})}{R \sum_i z_i}$$

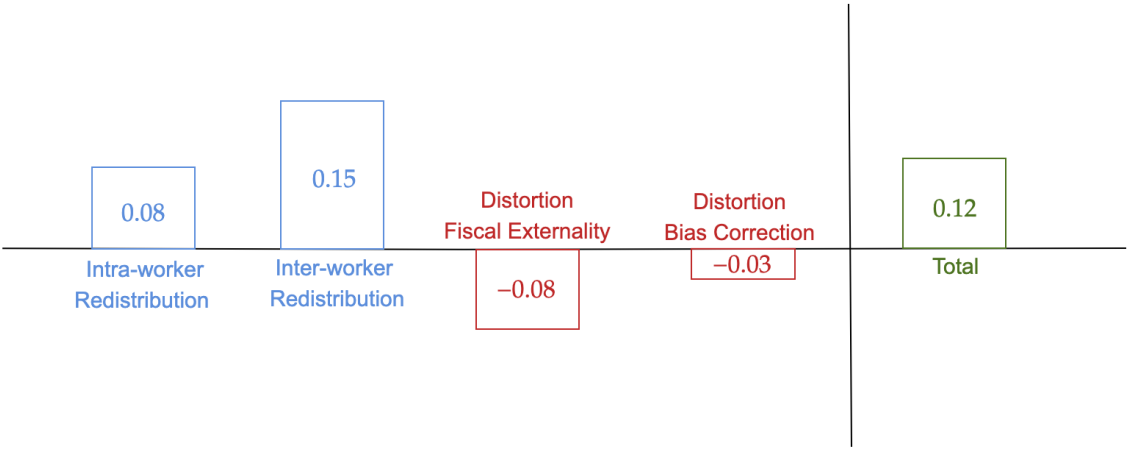
Results: decomposition of progressivity



Results: decomposition of progressivity



Results: decomposition of contribution rate



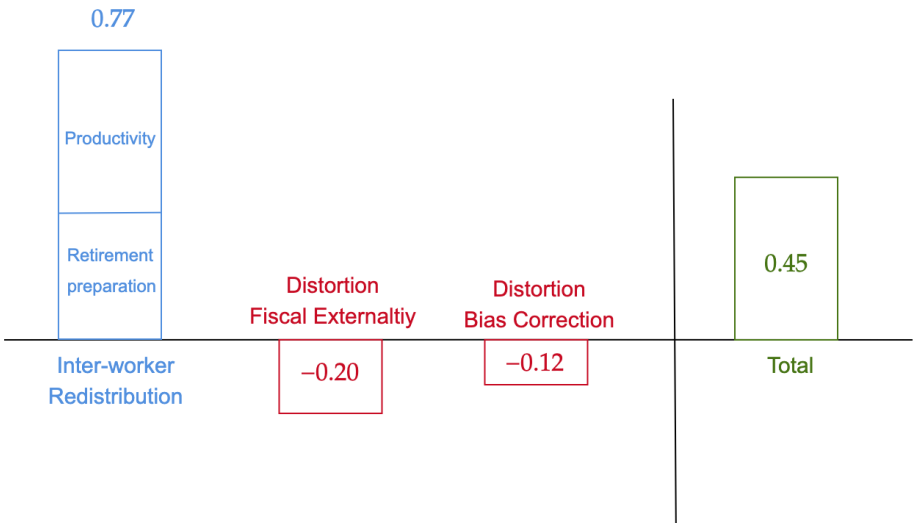
robustness

Results: optimal policy

- Moving from small reform to optimal level.
- Welfare effect of reforms as FOC.
- SOC are satisfied for all $\phi, \kappa \in [0, 1]$

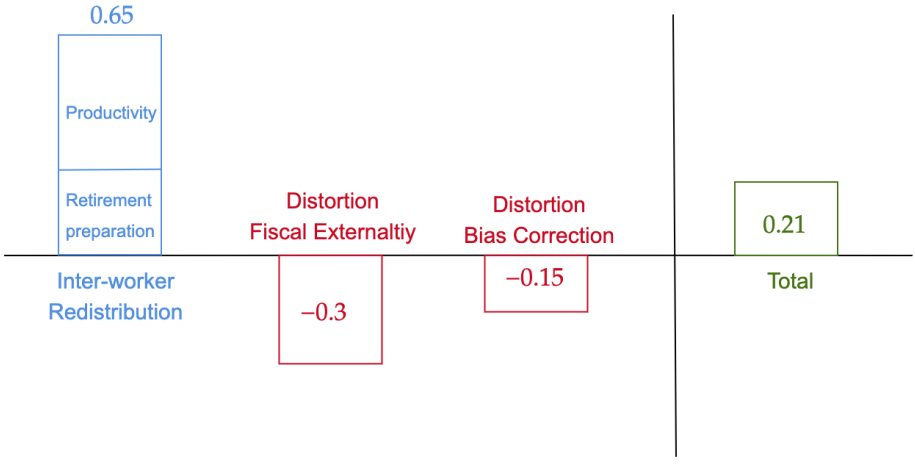
Results: optimal policy

- Initial point: $\kappa = 11.5\%, \phi = 33\%$



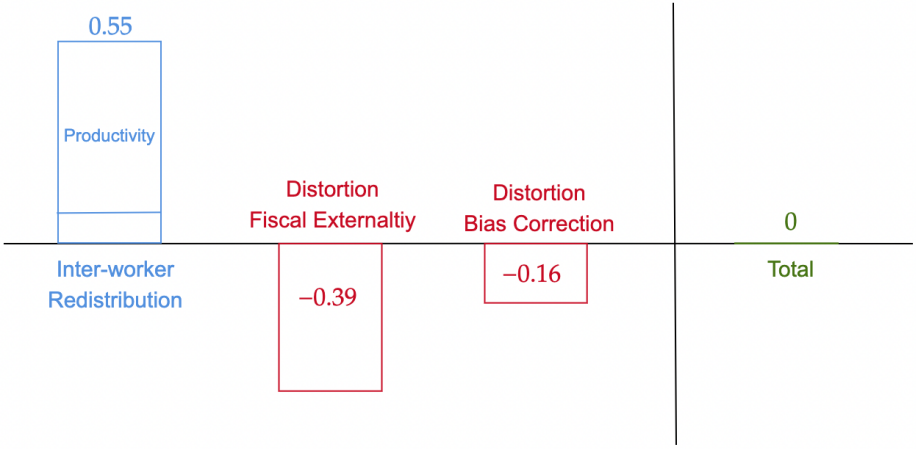
Results: optimal policy

- Midpoint: $\kappa = 14\%, \phi = 45\%$



Results: optimal policy

- Optimal point: $\kappa = 16.8\%, \phi = 68\%$

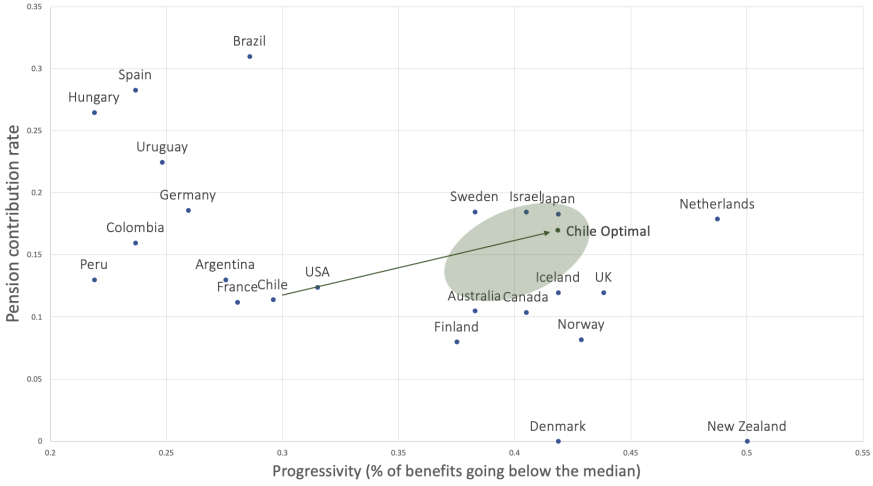


Results: optimal design

- Optimal pension contribution rate: 16.8%
  $\Rightarrow$ 3.1% of GDP to 4.4%.

- Optimal tax on pension contribution: 68%
  $\Rightarrow$ 42% of benefits go to workers below the median of active life earnings

Results: optimal design

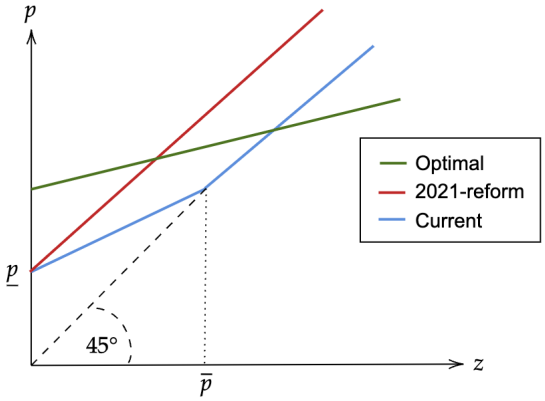


Findings: Policy recommendation

- Benefits should be focus on low-income workers.
- Increase in pension contribution is desirable only if extra-funds are spent progressively.

Findings: the case of Chile

- In 2021 Chile approved a reform to reduce progressiveness of benefits.
- Government subsidy is replaced by a lump-sum transfer.
- Optimal design keeping spending constant is a progressive subsidy:



Findings: the case of the US

- Latest proposal of reform (BPC):

  "Commission on Retirement Security and Personal Savings (2016)"

- Proposed policy reforms:

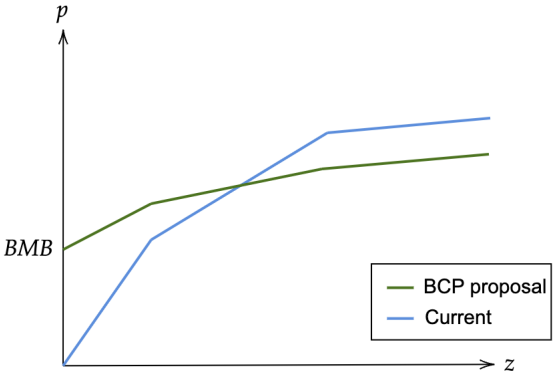
1 Increase pension contribution rate:

10. Recommendation: Gradually increase the payroll-tax rate by 1 percentage point.

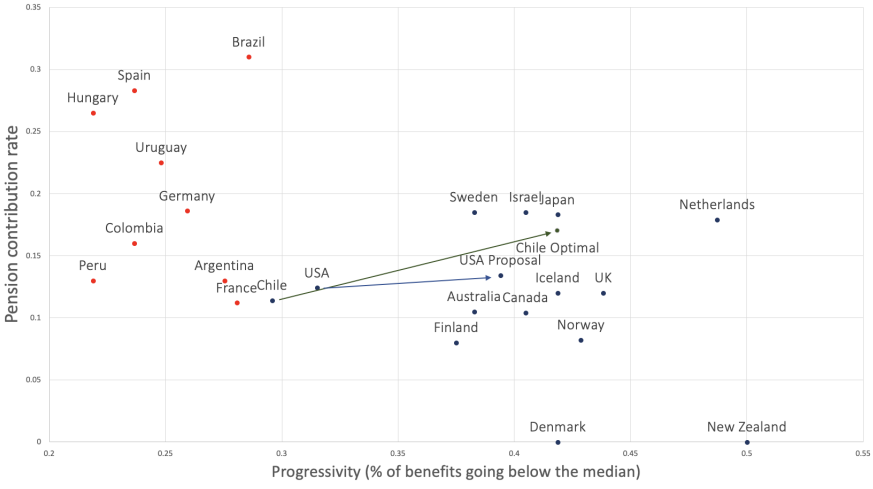
Findings: the case of the US

2 Make benefits more progressive wrt to lifetime earnings:

- Increase AIME and PIA relationship between for low earners
- Reduce AIME and PIA relationship between for high earners
- Add a Basic Minimum Benefit (BMB) that phases-out with PIA



Results: optimal design



Extension

Heterogeneous life expectancy:

- Payroll lifetime earnings are a good predictor of life expectancy
- Low income workers have shorter LE: 12% less retired time.
- Reinforces social desirability of increasing benefits' progressivity

Discussion

- Pension funds and local economic development. (Burga and Cabezon [2022])
  - Causal evidence that local investment of pension funds increases local economic activity.
  - Peru changed in the share of pension funds that can be invested abroad.
  - Firms directly and indirectly exposed to PFs got negatively affected: access to capital, investment, productivity, wages, output.
- Optimal Life Cycle Liquidity (Cabezon and Guarda [2022]):
  - Extend model from 2 to 70 periods using a HAM.
  - Policy evaluation: Age dependent earning deductions and benefits.
  - Earning deductions and benefits $\Rightarrow$ control workers liquidity during life cycle
  - Optimal design considering life cycle of income, consumption and present-focused bias.
- Optimization frictions (Agersnap and Cabezon [Work in Progress]):
  - Quarter credits in the US Social Security $\Rightarrow$ large discontinuity on benefits (NPV $\sim$\$45,000).
  - Notches to uncover optimization frictions. Who?

Discussion

- Pension funds and local economic development. (Burga and Cabezon [2022])
  - Causal evidence that local investment of pension funds increases local economic activity.
  - Peru changed in the share of pension funds that can be invested abroad.
  - Firms directly and indirectly exposed to PFs got negatively affected: access to capital, investment, productivity, wages, output.
- Optimal Life Cycle Liquidity (Cabezon and Guarda [2022]):
  - Extend model from 2 to 70 periods using a HAM.
  - Policy evaluation: Age dependent earning deductions and benefits.
  - Earning deductions and benefits $\Rightarrow$ control workers liquidity during life cycle
  - Optimal design considering life cycle of income, consumption and present-focused bias.
- Optimization frictions (Agersnap and Cabezon [Work in Progress]):
  - Quarter credits in the US Social Security $\Rightarrow$ large discontinuity on benefits (NPV $\sim$\$45,000).
  - Notches to uncover optimization frictions. Who?

Discussion

- Pension funds and local economic development. (Burga and Cabezon [2022])
  - Causal evidence that local investment of pension funds increases local economic activity.
  - Peru changed in the share of pension funds that can be invested abroad.
  - Firms directly and indirectly exposed to PFs got negatively affected: access to capital, investment, productivity, wages, output.
- Optimal Life Cycle Liquidity (Cabezon and Guarda [2022]):
  - Extend model from 2 to 70 periods using a HAM.
  - Policy evaluation: Age dependent earning deductions and benefits.
  - Earning deductions and benefits $\Rightarrow$ control workers liquidity during life cycle
  - Optimal design considering life cycle of income, consumption and present-focused bias.
- Optimization frictions (Agersnap and Cabezon [Work in Progress]):
  - Quarter credits in the US Social Security $\Rightarrow$ large discontinuity on benefits (NPV $\sim$\$45,000).
  - Notches to uncover optimization frictions. Who?

Conclusion

- Reforms are costly:
  - Workers are forward-looking
  - Workers respond to net-of-tax rate
- Large value for inter-worker redisitribution:
  - Productivity.
  - Consumption drop.
  - Benefits are consumed at retirement.

Conclusion

- Benefits should be focus on low-income workers.
- Increase in pension contribution is desirable only if extra-funds are spent progressively.

Thanks for your attention.

(jfcabezon@princeton.edu)

Empirical estimation: Lifetime earning Distribution

- Who is forced to pay pension contribution? Who is receives transfer at retirement?
- Depends on lifetime payroll income.
  1. Present value of lifetime payroll earnings (Z_i) (admin date)
  2. Self-reported non-durable consumption before and after retirement (c_{i1}, c_{i2}) (survey)

$$M_i = (Z_i, c_{i1}, c_{i2})$$

Consumption drop at retirement

- Mechanism behind drop.

1 Savings for retirement:

  - Less access to investment instrument. Figure
  - Less usage of tax favored pension savings.
  - Less likely of owning house at retirement.

back

Consumption drop at retirement

2 Reason to stop working:

- More likely to be health problems. Figure
- More likely to be job termination.

Consumption drop at retirement

3 Sources of income at retirement:

- Forced pension savings are less important.
- Other savings are less important. Figure
- Government support is more important.

Consumption drop at retirement

4 Characteristic of retired:

- Worse self-reported health.
- Less educated. Figure

Consumption drop at retirement

5 Characteristic of job prior retirement:

- Smaller share of earnings are covered by forced savings. Figure
- Less likely of having a formal contract.
- More likely is a temporal job.
- Less likely of receiving severance at job termination (retirement).

Consumption drop at retirement

6 Pension system protection against income drop at retirement:

- Pension benefit replaces a smaller share of their prior retirement earnings. Figure

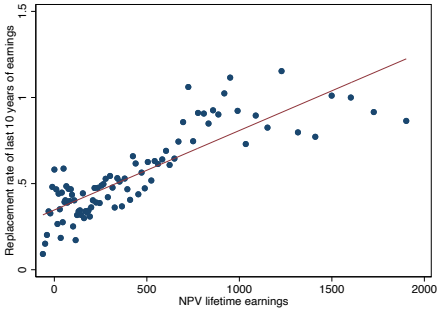
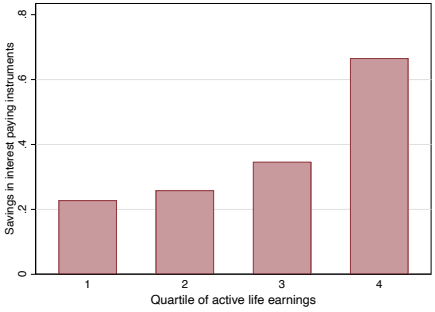


Figure 9: Pension benefit replacement rate of last 10 years of self-reported income

back

Retirement preparedness



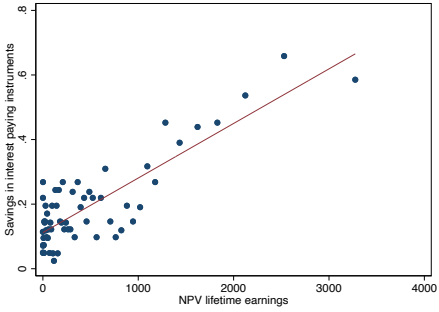
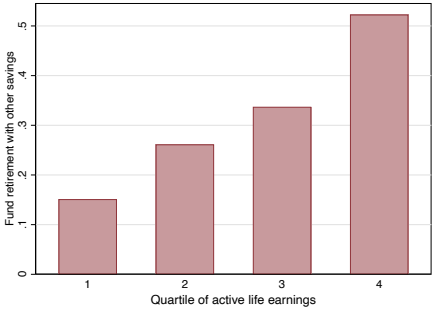


Figure 10: Access to saving isntrument (savings account, capital market isntruments, etc)

back

Retirement preparedness



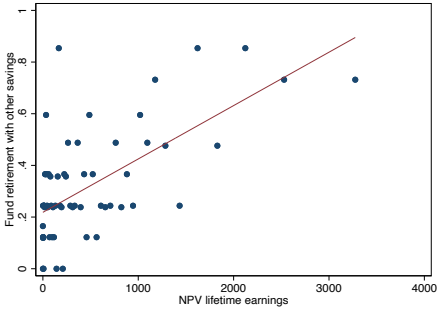


Figure 11: Funds retirement with other savings

back

Retirement preparedness

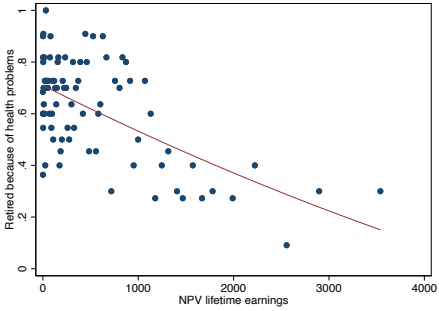


Figure 12: Stop working as consequence of health problems

back

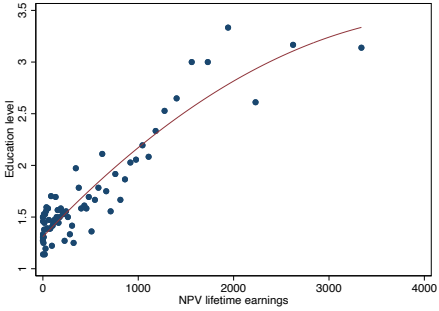
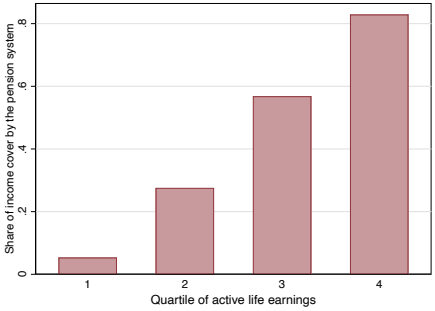


Figure 13: Education level

back



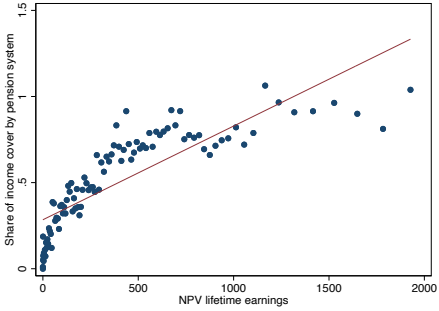
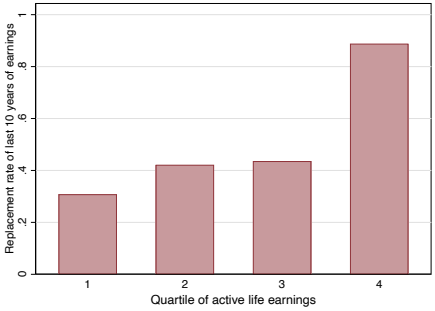


Figure 14: Share of income covered by pension system

back

Retirement preparedness



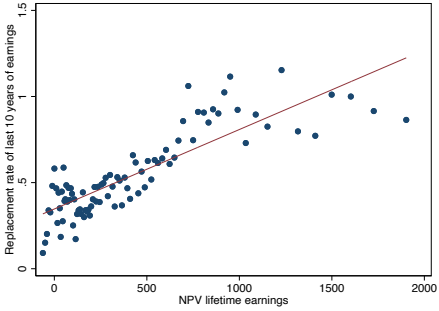
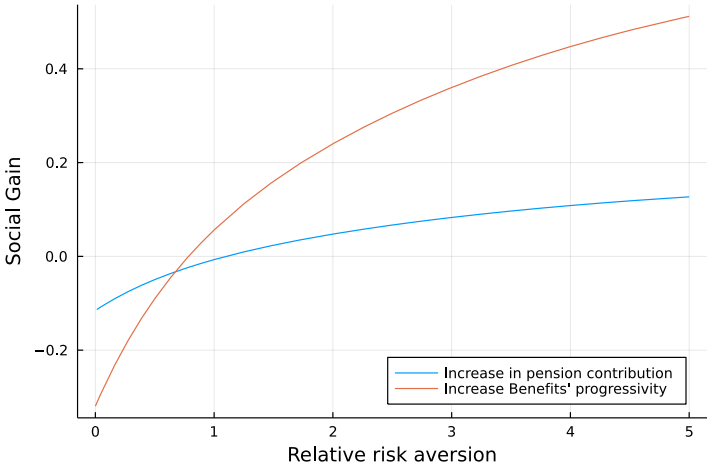


Figure 15: Pension benefit replacement rate of last 10 years of self-reported income

back

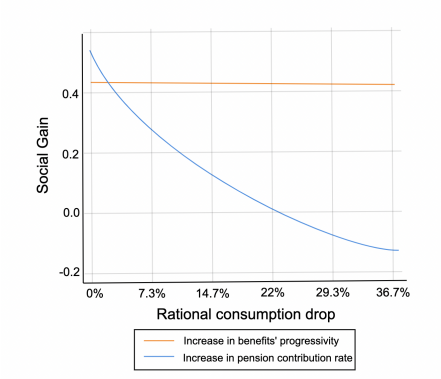
Robustness

- Comparative statistics of social gains of reforms with respect to the RRA (γ).



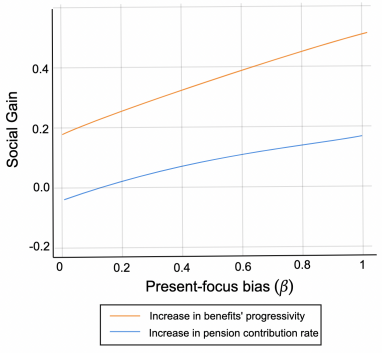
Robustness

- Comparative statistics of social gains of reforms with respect to the state-dependent preferences (θ).



Robustness

- Comparative statistics of social gains of reforms with respect to the hyperbolic-discounting (β).



back