Insurance versus Moral Hazard in Income-Contingent Student Loan Repayment

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MIT Sloan

September 14, 2023

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  - Accounts for $1.6 trillion in US and 10% of household debt in US and UK

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This Paper

Conditional on borrowing, how does income-contingent repayment affect **labor supply** and welfare?

1. **Setting**: Australia's Higher Education Loan Program
   - **Variation**: discontinuities in repayment rates + policy change to these rates
   - **Identification**: limited room for adverse selection and ex-ante responses
2. **Research design**: bunching at discontinuities before and after policy change
   - **Data**: universe of income tax returns + student debt balances

This Paper

Conditional on borrowing, how does income-contingent repayment affect labor supply and **welfare**?

1. Setting: Australia's Higher Education Loan Program
2. Research design: bunching at discontinuities before and after policy change
3. **Model**: life cycle model with endogenous labor supply + uninsurable wage risk
   - **Positive**: translate responses to structural parameters
   - **Normative**: characterize optimal amount of income-contingent repayment
   - Note: welfare defined as consumption-equivalents

Summary of Results

1. **Empirics**: borrowers adjust labor supply to $\downarrow$ income-contingent repayments
   - Larger responses in occupations with more hourly flexibility
   - Responses increase with debt balances and proxies for liquidity constraints

2. **Structural estimation**: responses imply relatively inelastic labor supply
   - Model replicates evidence with Frisch elasticity of **0.11** & adjustment frictions

3. **Welfare**: gains to increasing insurance with income-contingent repayment
   - Fixed repayment $\rightarrow$ optimal income-contingent loan $\Rightarrow \uparrow$ **1.3%** lifetime consumption
   - Gains from optimal equity contract larger, but much more dispersed
   - Moral hazard reduces optimal amount of insurance, but welfare cost small

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Takeaway: Income-contingent repayment creates moral hazard that changes optimal contract, but too small to justify fixed repayment

Related Literature & Contributions

1. **Insurance vs. moral hazard in social insurance** Baily 1978, Gruber 1997, Chetty 2006, 2008, Chetty-Finkelstein 2013, Ganong-Noel 2019, 2020, Auclert et al. 2019, Indarte 2023, ...
   - **Student debt overhang** Mueller-Yannelis 2019, Luo-Mongey 2019, Mezza et al. 2020, Di Maggio et al. 2021, Folch-Mazzone 2021, Ji 2021, Hampole 2022, Murto 2022, Huang 2022
   - **ICL insurance benefits** Herbst 2023, Mueller-Yannelis 2019, Gervais et al. 2022, Boutros et al. 2022, Catherine-Yannelis 2023

2. **Human capital financing** Friedman 1955, Bovenberg-Jacobs 2005, Chapman 2006, Lochner-Monge-Naranjo 2016, Stantcheva 2017, Abbott et al. 2021, Ebrahimian 2021, Herbst-Hendren 2022

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Contributions:

1. Empirical evidence of moral hazard from income-contingent repayment
   Britton-Gruber 2020, Herbst et al. 2023
2. Structural model that replicates these labor supply responses
3. Quantification of how moral hazard affects optimal policy

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3. **State-contingent securities to reduce HH debt overhang** Shiller 2004, Caplin et al. 2007, Mian-Sufi 2014, Greenwald et al. 2018, Ganong-Noel 2020, Campbell et al. 2021
4. **Bunching & labor supply elasticities** Saez 2010, Chetty et al. 2011, 2013, Kleven-Waseem 2013, Kleven 2016, Fagereng-Ring 2021

Outline

1. Institutional Background and Data
2. Labor Supply Responses to Income-Contingent Repayment
3. Life Cycle Model with Endogenous Labor Supply
4. Welfare and Fiscal Impacts of Income-Contingent Repayment
5. Conclusion

Outline

Student Loans in Australia: HELP

- Australian citizens eligible for government-provided student loans through **HELP**
- **Initial debt** = tuition – up-front payment – govt. contribution (mean = $18K USD in 2023)
- Debt grows at CPI net of **income-contingent repayments**:

$$\text{Repayment}_{it} = \text{HELP Rate}_t\left(\text{HELP Income}_{it}\right) * \text{HELP Income}_{it}$$

$$\text{HELP Income}_{it} = \text{Labor Income}_{it} + \text{Capital Income}_{it} - \text{Deductions}_{it}$$

- Repayments continue until remaining debt balance equals zero or death
  - ✗ Cannot be cancelled or discharged in bankruptcy

▸ Options ▸ Definitions ▸ Other Countries

Why Study Income-Contingent Repayment in Australia?

- Benefit #1: HELP is only government contract + no (domestic) private market
  - For domestic students, only choice is between HELP and paying up-front
  - ✓ Limited scope for **adverse selection**
- Benefit #2: debt can only be used for tuition
  - Tuition is government-controlled at 39/42 universities (public)
  - ✓ Less room for **ex-ante** moral hazard from changes in borrowing
- Benefit #3: first nationwide provider of income-contingent loans in 1989
  - ✓ Borrowers likely **understand** structure of repayment

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Good setting to identify labor supply responses to income-contingent repayment

Data

1. Universe of individual tax returns from ATO ($\sim$ US Form 1040)
   - Income components to construct HELP Income and superannuation balances
2. Administrative HELP data: debt balances, repayments, and flag for new debt
3. 2016 Household Census: self-reported hours and mortgage + rent payments
4. HILDA: survey data on hours worked and asset holdings

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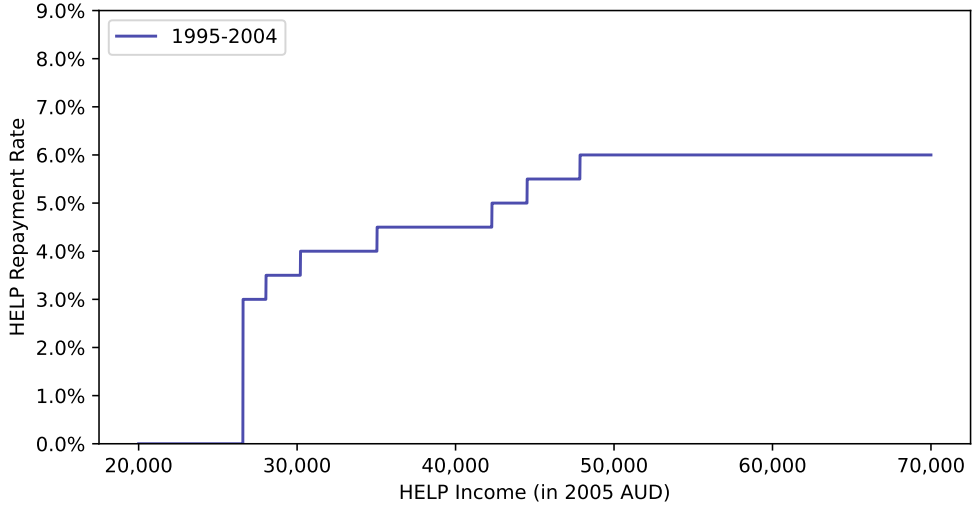
Sample: around 3 million debtholders between ages 20-64 during 1991-2018

- Average HELP income = \$28K (95% labor income), average debt at 26 = \$13K

▸ Summary Stats ▸ Debt by Age ▸ Debt Repay

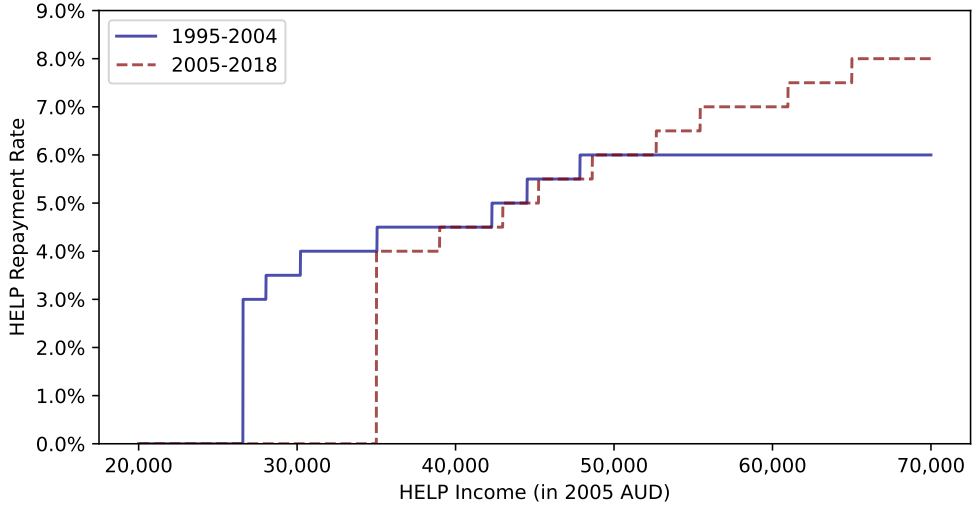
Identifying Variation: Discontinuities in Repayment Rates



Note: Repayment schedule indexed to CPI, 1 AUD in 2005 $\sim$ 1.2 USD in 2020

▸ Marginal Rates ▸ News ▸ Treatment

Identifying Variation: Policy Change to Repayment Rates



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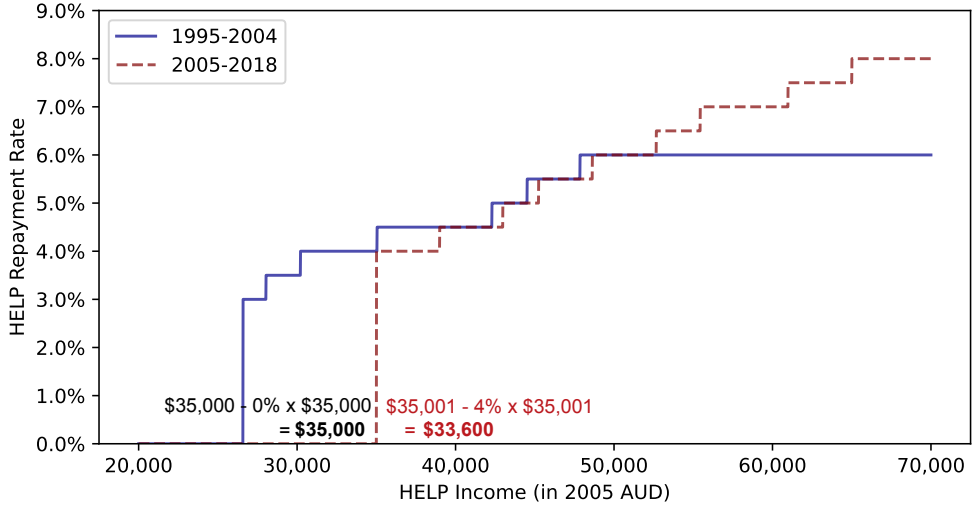
Repayment Threshold Increases **Average** Repayment Rate



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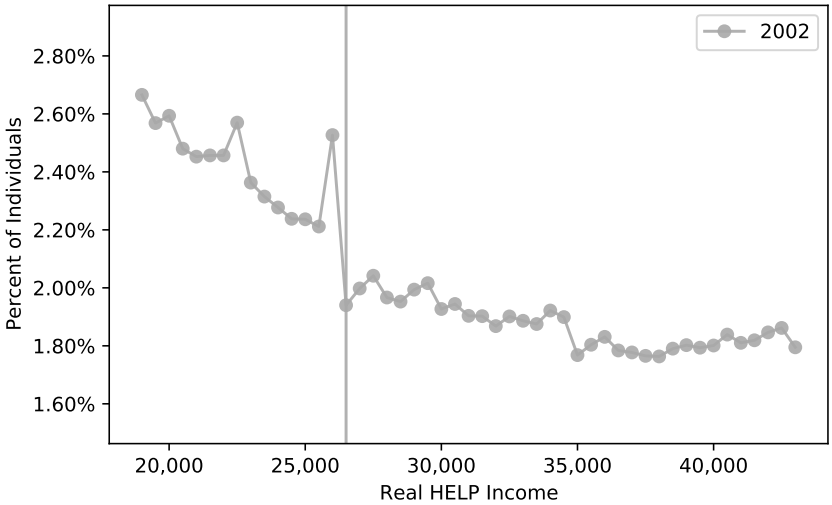

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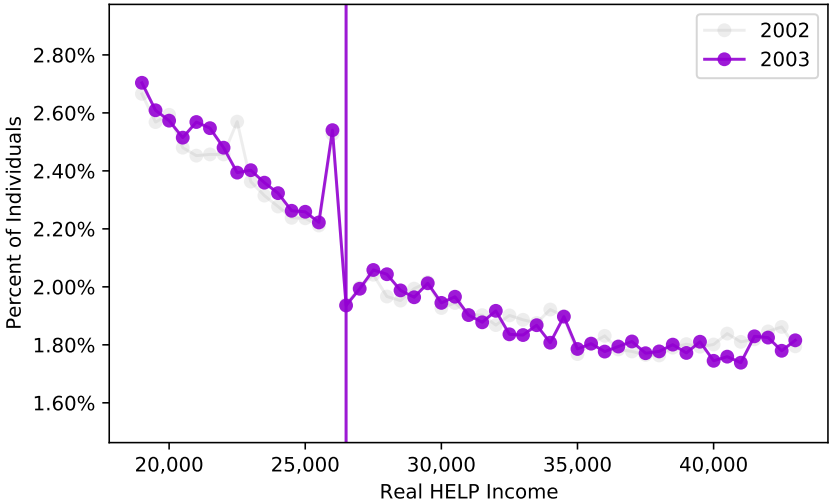

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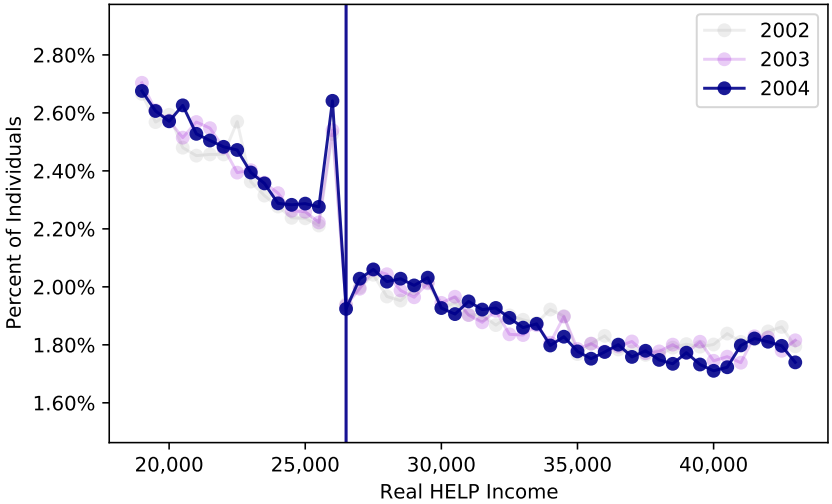

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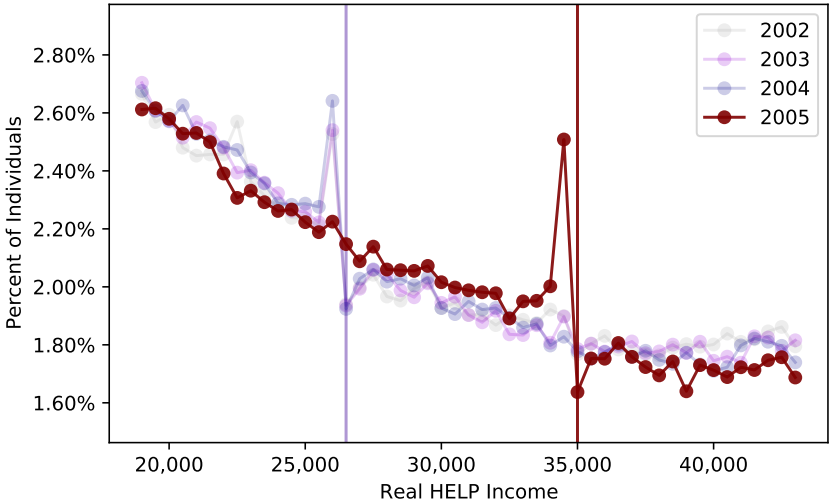

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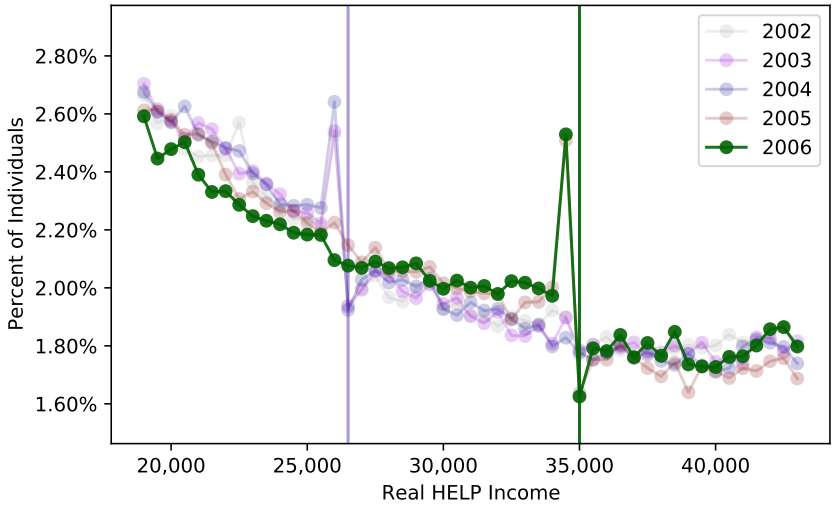

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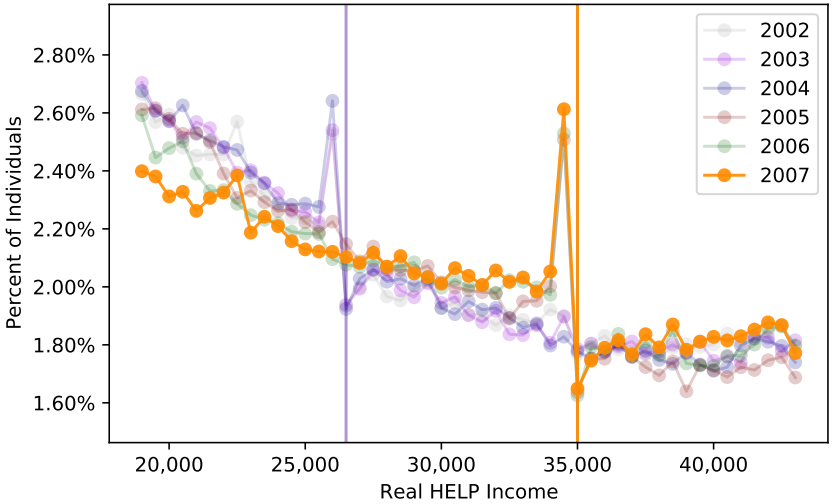

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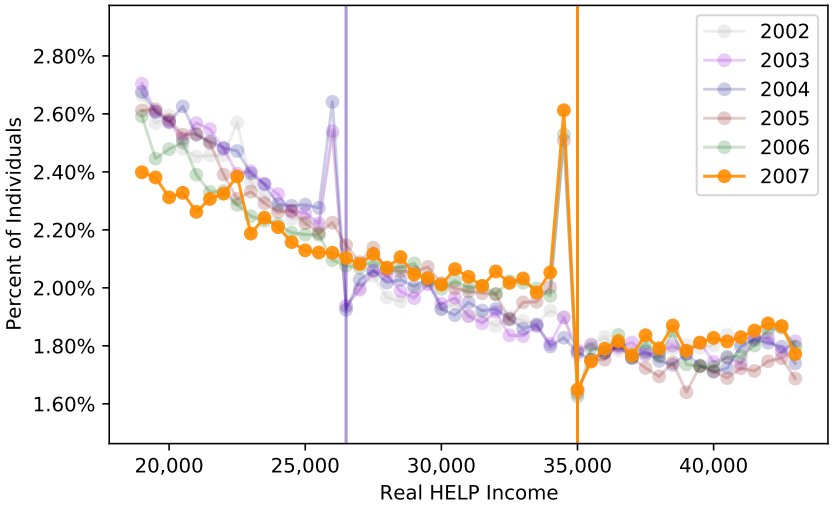
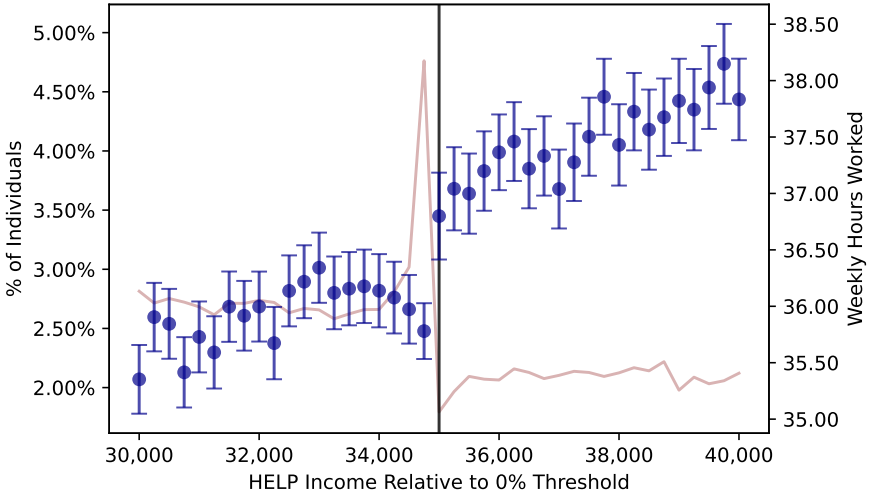


- Bunching present in labor income but not for non-debtholders

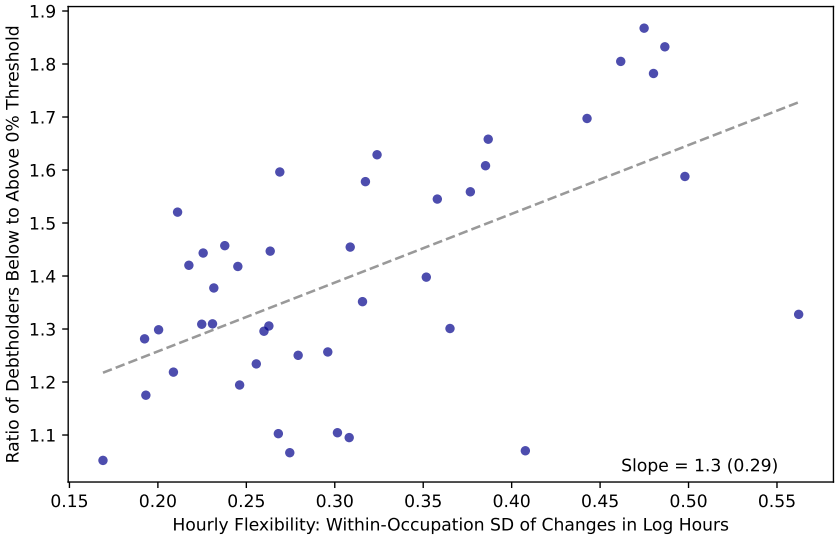
Labor | Non-Debt

Borrowers Below Repayment Threshold Work Fewer Hours



- In 2016, reduction is around **1** hour/week = 2.6% of standard workweek

More Bunching in Occupations with Greater Hourly Flexibility



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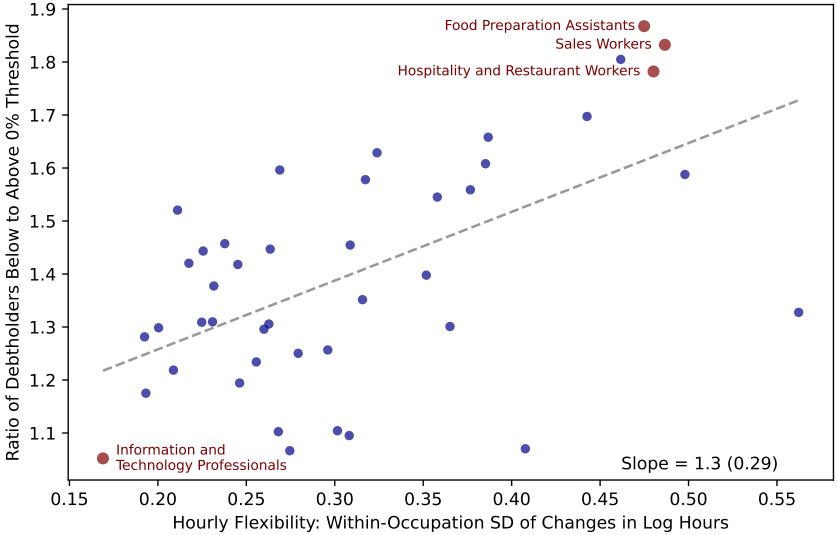

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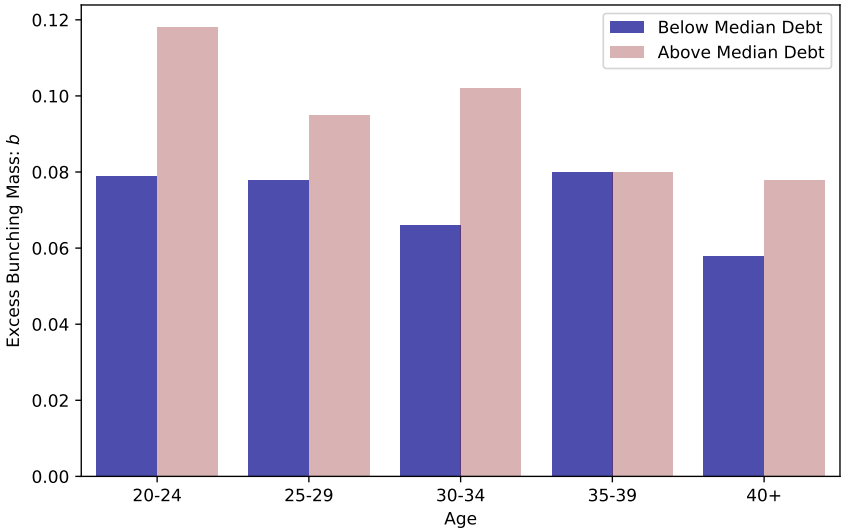
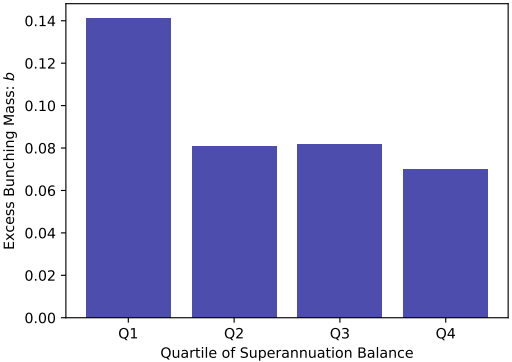
Bunching Increases with Debt and Decreases with Age



▸ b Details

Bunching Increases with Proxies for Liquidity-Constraints



House Prices | Wage Growth

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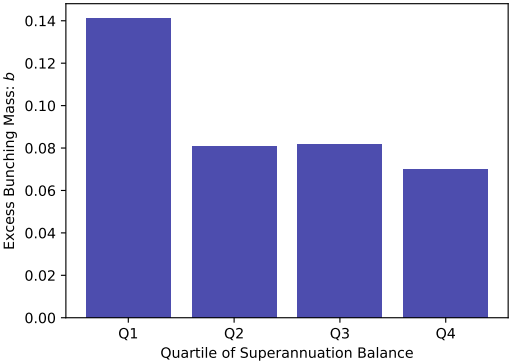

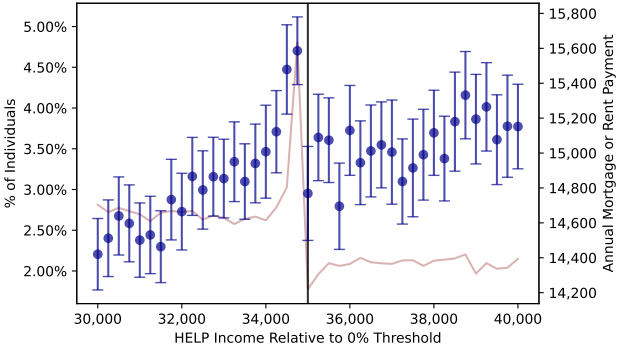

House Prices | Wage Growth

Facts about moral hazard:

1. Borrowers reduce labor income in response to income-contingent repayment
   - Reflects labor supply: "bunchers" work fewer hours and in more flexible occupations
2. Size of moral hazard varies based on
   - Liquidity: increases with liquidity demands and decrease with retirement wealth
   - Dynamics: increases with debt balances
3. Limited evidence of future wage reductions from reducing labor supply

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Questions for model:

1. How large are these labor supply responses quantitatively?
2. Do they imply the costs of income-contingent repayment exceed the benefits?

Outline

Model Description

Life cycle model with debt $+$ $\underbrace{\text{incomplete markets}}_{\Rightarrow \text{ demand for insurance}}$ $+$ $\underbrace{\text{endogenous labor supply}}_{\Rightarrow \text{ moral hazard}}$

Life cycle model with debt + incomplete markets + endogenous labor supply

- Overlapping generations born at 22 with heterogeneous assets, wage, and debt
- From 22 to 64, individuals choose consumption, c_a, and labor supply, ℓ_a
  - Wage rate subject to idiosyncratic shocks (no agg. risk, partial eq.)
  - Shocks are uninsurable: borrowing allowed up to age-dependent limit with interest
- After age 64, individuals retire and choose consumption c_a

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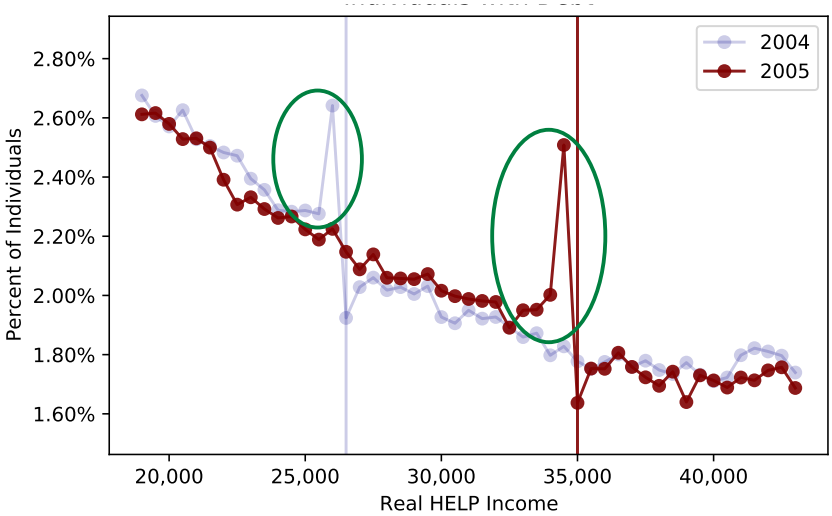
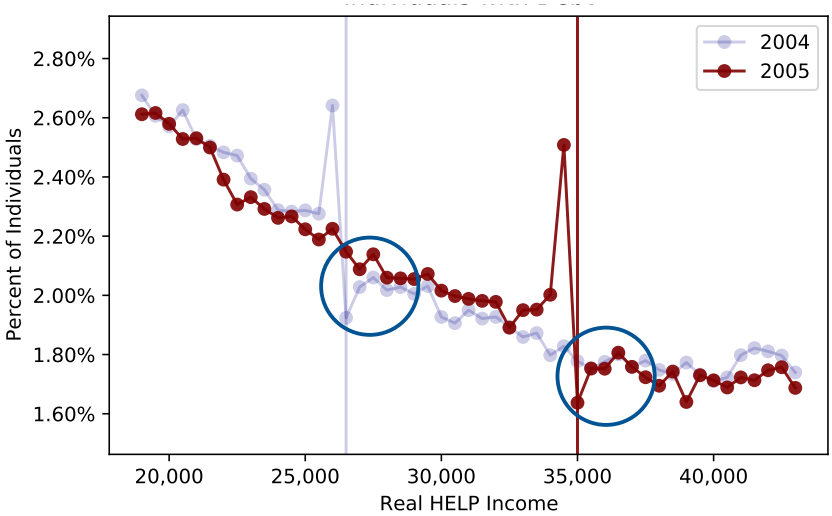
- After age 64, individuals retire and choose consumption c_a
- **Government**
  - Revenues: progressive income taxes, debt repayments
  - Expenses: initial debt, means-tested unemployment benefits & retirement pension

Bunching Consistent with Positive Labor Supply Elasticity



- Increase in repayment rate at threshold $\Rightarrow$ smaller return to labor supply

Mass Above Threshold **Inconsistent** with Frictionless Model



- Moving above to below threshold $\Rightarrow$ more leisure **and** \$1400 more cash-on-hand

Labor Supply Optimization Frictions

- Choice of ℓ_a subject to two **optimization frictions** to give mass above threshold
- **Time**-dependent adjustment (Calvo):
  - Fraction λ hit by shock and adjust l_a, other $1-\lambda$ set $l_a = l_{a-1}$
  - E.g. inattention, arrival of opportunities to change hours/jobs
- **State**-dependent adjustment (sS):
  - Individuals hit by Calvo shock incur utility cost f if they choose $l_a \neq l_{a-1}$
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- Extension: add learning-by-doing to generate long-run cost of bunching

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) =$$

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$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq \underline{A}_{a+1}, \\ \ell_a}}$$

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq A_{a+1}, \\ \ell_a}} \underbrace{c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}}}_{\substack{\text{utility of consumption} \\ \text{\& disutility of labor}}}$$

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Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq A_{a+1}, \\ \ell_a}} \left\{ \left[\underbrace{c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}}}_{\text{utility of consumption \& disutility of labor}} - \underbrace{f * \mathbf{1}_{\ell_a \neq \ell_{a-1}}}_{\text{adjustment cost}} \right]^{1-\sigma} + \beta \left[m_a \mathbf{E}_\mathbf{a} \left(\underbrace{V_{a+1}(\mathbf{s}_{a+1})}_{\text{continuation value}}{}^{1-\gamma} \right) \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq \underline{A}_{a+1}, \\ \ell_a}} \left\{ \left[c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}} - f * \mathbf{1}_{\ell_a \neq \ell_{a-1}} \right]^{1-\sigma} + \beta \left[m_a \mathbf{E_a} \left(V_{a+1}(\mathbf{s}_{a+1})^{1-\gamma} \right) \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

$$c_a + A_{a+1} + \underbrace{d(y_a, D_a, t)}_{\substack{\text{debt} \\ \text{repayment}}} + \underbrace{\tau(y_a)}_{\text{taxes + ui}} = \underbrace{y_a}_{\substack{\text{labor} \\ \text{income}}} + \underbrace{A_a R}_{\substack{\text{capital} \\ \text{income}}}$$

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq \underline{A}_{a+1}, \\ \ell_a}} \left\{ \left[c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}} - f * \mathbf{1}_{\ell_a \neq \ell_{a-1}} \right]^{1-\sigma} + \beta \left[m_a \mathbf{E_a} \left(V_{a+1}(\mathbf{s}_{a+1})^{1-\gamma} \right) \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

$$c_a + A_{a+1} + d(y_a, D_a, t) + \tau(y_a) = y_a + A_a R$$

$$y_a = \ell_a w_a, \quad \log w_a = \underbrace{g_a}_{\substack{\text{age} \\ \text{profile}}} + \underbrace{\theta_a}_{\substack{\text{permanent} \\ \text{income}}} + \underbrace{\epsilon_a}_{\substack{\text{transitory} \\ \text{shock}}}$$

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq \underline{A}_{a+1}, \\ \ell_a}} \left\{ \left[c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}} - f * \mathbf{1}_{\ell_a \neq \ell_{a-1}} \right]^{1-\sigma} + \beta \left[m_a \mathbf{E}_{\mathbf{a}} \left(V_{a+1}(\mathbf{s}_{a+1})^{1-\gamma} \right) \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

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$$\mathbf{s}_a = \begin{pmatrix} a & t & A_a & D_a & \theta_a & \epsilon_a & \ell_{a-1} & \omega_a \end{pmatrix}$$

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq \underline{A}_{a+1}, \\ \ell_a}} \left\{ \left[c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}} - f * \mathbf{1}_{\ell_a \neq \ell_{a-1}} \right]^{1-\sigma} + \beta \left[m_a \mathbf{E}_{\mathbf{a}} \left(V_{a+1}(\mathbf{s}_{a+1})^{1-\gamma} \right) \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

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- a = age
- t = year to keep track of policy change

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq \underline{A}_{a+1}, \\ \ell_a}} \left\{ \left[c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}} - f * \mathbf{1}_{\ell_a \neq \ell_{a-1}} \right]^{1-\sigma} + \beta \left[m_a \mathbf{E}_{\mathbf{a}} \left(V_{a+1}(\mathbf{s}_{a+1})^{1-\gamma} \right) \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

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$$\mathbf{s}_a = \begin{pmatrix} a & t & A_a & D_a & \theta_a & \epsilon_a & \ell_{a-1} & \omega_a \end{pmatrix}$$

- A_a = savings from previous period
- D_a = debt = $R_d D_{a-1} - d_t(y_{a-1}, D_{a-1}, t)$

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq \underline{A}_{a+1}, \\ \ell_a}} \left\{ \left[c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}} - f * \mathbf{1}_{\ell_a \neq \ell_{a-1}} \right]^{1-\sigma} + \beta \left[m_a \mathbf{E_a} \left(V_{a+1}(\mathbf{s}_{a+1})^{1-\gamma} \right) \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

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- θ_a = permanent income = $\rho \theta_{a-1} + \nu_a$ $\qquad$ $\nu_a \sim N(0, \sigma_\nu^2)$
- ϵ_a = transitory shock $\sim N(0, \sigma_\epsilon)$

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq \underline{A}_{a+1}, \\ \ell_a}} \left\{ \left[c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}} - f * \mathbf{1}_{\ell_a \neq \ell_{a-1}} \right]^{1-\sigma} + \beta \left[m_a \mathbf{E_a} \left(V_{a+1}(\mathbf{s}_{a+1})^{1-\gamma} \right) \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

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- ϵ_a = transitory shock $\sim N(0, \sigma_\epsilon)$ Extension: learning-by-doing

Optimization Problem of Individuals Hit by Calvo Shock

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$$\mathbf{s}_a = \begin{pmatrix} a & t & A_a & D_a & \theta_a & \epsilon_a & \ell_{a-1} & \omega_a \end{pmatrix}$$

- ℓ_{a-1} = labor supply from previous period
- ω_a = Calvo shock that determines whether ℓ_a can be adjusted $\sim$ Bernoulli(λ)

Optimization Problem of Individuals Hit by Calvo Shock

$$V_a(\mathbf{s}_a) = \max_{\substack{A_{a+1} \geq \underline{A}_{a+1}, \\ \ell_a}} \left\{ \left[c_a - \kappa \frac{\ell_a^{1+\phi^{-1}}}{1+\phi^{-1}} - f * \mathbf{1}_{\ell_a \neq \ell_{a-1}} \right]^{1-\sigma} + \beta \left[m_a \mathbf{E_a} \left(V_{a+1}(\mathbf{s}_{a+1})^{1-\gamma} \right) \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

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$$\mathbf{s}_a = \begin{pmatrix} a & t & A_a & D_a & \theta_a & \epsilon_a & \ell_{a-1} & \omega_a \end{pmatrix}$$

- Sources of ex-ante heterogeneity:
  - θ_0 = initial permanent income $\sim N(0, \sigma_I^2)$
  - D_0 = initial debt, A_0 = initial assets

ESTIMATION

First-Stage Calibration

- **Interest rates and borrowing**:
  - Interest rate = 1.84%, borrowing rate = CC rate, debt interest rate = 0%
  - Borrowing limit = average CClimit by age
- **Demographics**: cohort birth rates and mortality risk taken from life tables
  - Consumption adjusted for equivalence scale using HH size Lusardi et al. 2017
- **Government**: use exact (non-smooth) formulas provided by ATO
- **Initial conditions**: assets and debt distributions taken from data at age 22
- **Baseline RRA and EIS**: $\gamma = \frac{1}{\sigma}$ = 2.23 (time-separable)
  - Welfare analysis: consider alternative values + preference for early resolution

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- **Learning-by-doing extension**: $\alpha = 0.24 =$ median value from Best-Kleven 2013

Second-Stage Simulated Method of Moments

$$\text{Parameters} = \left(\qquad \right)$$

- **Simulated policy change**: unanticipated change in HELP formula at $t = 2005$
- **Estimation** via SMM with 47 moments $+$ 14 parameters
  - Find parameters that minimize % difference between data & model moments

Second-Stage Simulated Method of Moments: Identification

$$\text{Parameters} = \left(\overbrace{\phi \quad f \quad \lambda}^{\text{labor supply}} \right)$$

- Labor supply elasticity: identified by bunching below repayment threshold
- Frictions: identified by mass above repayment threshold

▸ Elasticities ▸ SMM Objective

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- Separate identification of frictions
  - Moments: heterogeneity in bunching with **debt**, bunching at **0.5%** threshold
  - **Intuition**: with $f = 0$, decision to bunch depends on Calvo shock not incentives

▸ Elasticities ▸ SMM Objective

Second-Stage Simulated Method of Moments: Identification

$$\text{Parameters} = \Big(\overbrace{\underbrace{\phi \quad f \quad \lambda}_{\text{labor supply}} \quad \kappa \quad \beta}^{\text{preferences}} \quad \underbrace{\delta_0 \quad \delta_1 \quad \delta_2 \quad \delta_0^E \quad \delta_1^E}_{\text{wage profile}} \quad \underbrace{\rho \quad \sigma_\nu \quad \sigma_\epsilon \quad \sigma_i}_{\text{wage risk}} \Big)$$

- Labor supply elasticity: identified by bunching below repayment threshold
- Frictions: identified by mass above repayment threshold
- Separate identification of frictions
  - Moments: heterogeneity in bunching with **debt**, bunching at **0.5%** threshold
  - **Intuition**: with $f = 0$, decision to bunch depends on Calvo shock not incentives
- Note: wage profile & risk cannot be estimated separately in first-stage

▸ Other Parameters ▸ Elasticities ▸ SMM Objective

Parameter Estimates

Parameter		Estimation: Baseline
Labor supply elasticity	ϕ	0.114
Fixed adjustment cost	f	\$377
Calvo parameter	λ	0.183
Labor supply scaling parameter	κ	0.560
Time discount factor	β	0.973
Wage profile parameters	δ_0	8.922
	δ_1	0.073
	δ_2	-0.001
	δ_0^E	-0.487
	δ_1^E	0.020
Persistence of permanent shock	ρ	0.930
Standard deviation of permanent shock	σ_ν	0.236
Standard deviation of transitory shock	σ_ϵ	0.130
Standard deviation of individual FE	σ_i	0.599

▸ Full

Parameter Estimates

Parameter		Estimation	
		Baseline	No Frictions
Labor supply elasticity	ϕ	0.114	0.005
Fixed adjustment cost	f	\$377	·
Calvo parameter	λ	0.183	·
Labor supply scaling parameter	κ	0.560	0.030
Time discount factor	β	0.973	0.996
Wage profile parameters	δ_0	8.922	9.862
	δ_1	0.073	0.111
	δ_2	-0.001	-0.002
	δ_0^E	-0.487	-0.294
	δ_1^E	0.020	0.032
Persistence of permanent shock	ρ	0.930	0.914
Standard deviation of permanent shock	σ_ν	0.236	0.076
Standard deviation of transitory shock	σ_ϵ	0.130	0.504
Standard deviation of individual FE	σ_i	0.599	0.101

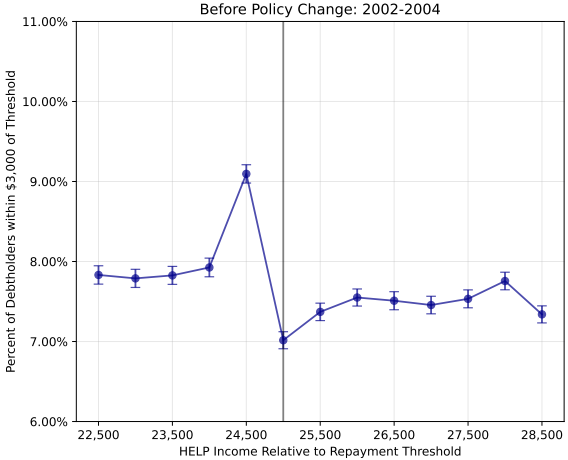
▸ Full

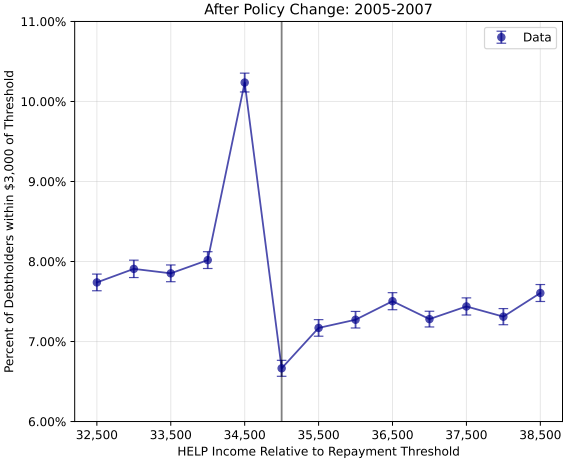
Parameter Estimates

Parameter		Estimation		
		Baseline	No Frictions	LBD
Labor supply elasticity	ϕ	0.114	0.005	0.082
Fixed adjustment cost	f	\$377	·	\$762
Calvo parameter	λ	0.183	·	0.346
Labor supply scaling parameter	κ	0.560	0.030	1.242
Time discount factor	β	0.973	0.996	0.951
Wage profile parameters	δ_0	8.922	9.862	9.197
	δ_1	0.073	0.111	0.070
	δ_2	−0.001	−0.002	−0.001
	δ_0^E	−0.487	−0.294	−0.480
	δ_1^E	0.020	0.032	0.018
Persistence of permanent shock	ρ	0.930	0.914	0.889
Standard deviation of permanent shock	σ_ν	0.236	0.076	0.288
Standard deviation of transitory shock	σ_ϵ	0.130	0.504	0.064
Standard deviation of individual FE	σ_i	0.599	0.101	0.625

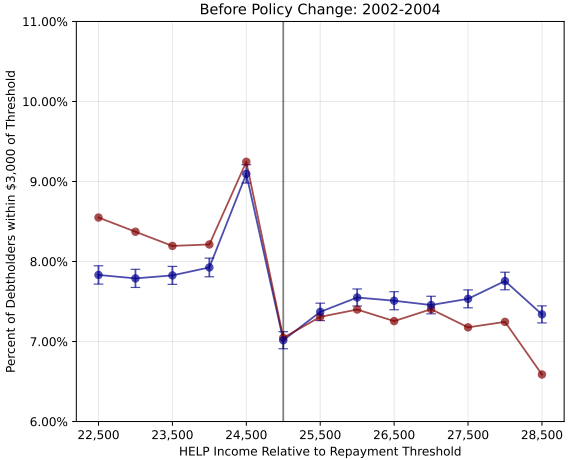
▸ Full

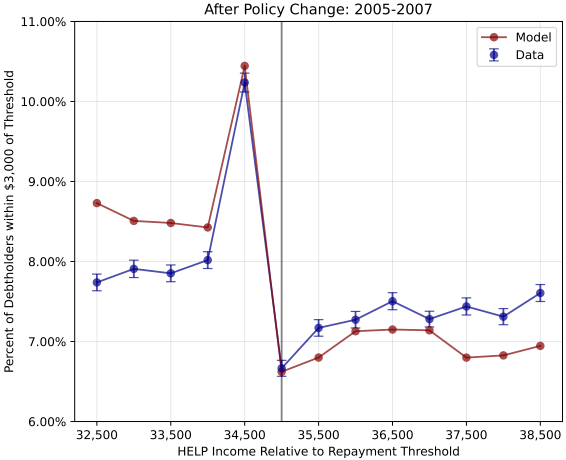
Model Fit: Bunching Before and After Policy Change



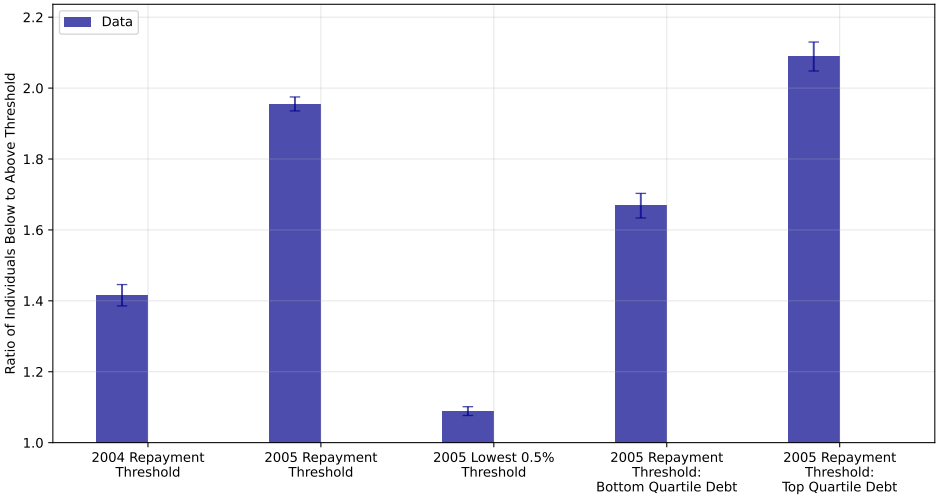


Model Fit: Bunching Before and After Policy Change



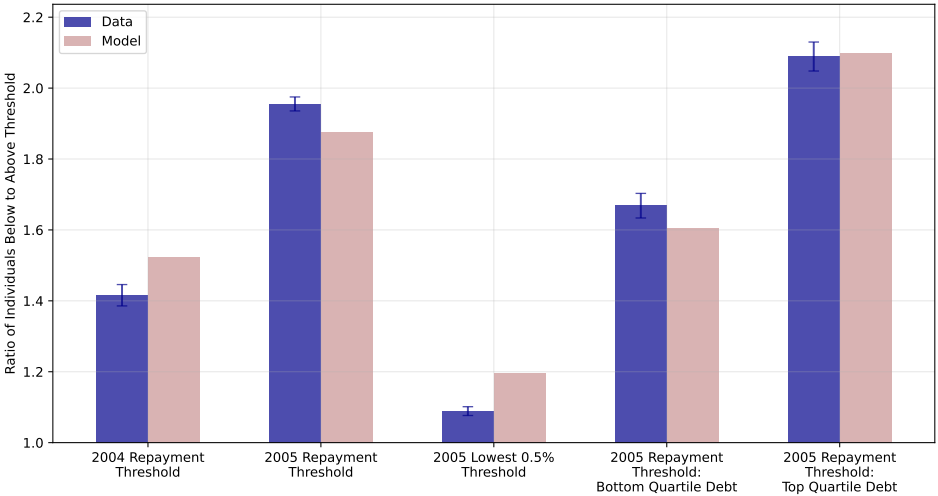


Model Fit: Bunching Heterogeneity



▸ Other Moments ▸ Dynamics ▸ Liquidity

Model Fit: Bunching Heterogeneity



▸ Other Moments ▸ Dynamics ▸ Liquidity

Outline

Normative Perspective

What repayment contract best balances insurance with moral hazard?

- Consider social planner that maximizes borrower welfare with **one** contract
  - Problem faced by governments with one contract (e.g. Australia, UK)
  - Contract is subsidized with zero interest rate
  - Borrowing choices & prices held fixed

What repayment contract best balances insurance with moral hazard?

- Consider social planner that maximizes borrower welfare with **one** contract
  - Problem faced by governments with one contract (e.g. Australia, UK)
  - Contract is subsidized with zero interest rate
  - Borrowing choices & prices held fixed
- **Step 1**: **Existing** income-contingent loans vs. fixed repayment (not budget-neutral)
  - Four contracts: HELP 2004, HELP 2005, US Old & New IBR = $\psi * \max\{y - K, 0\}$
- **Step 2**: **Optimal** income-contingent contracts vs. fixed repayment (budget-neutral)

Government Budget = Expected Discounted Value of Payments

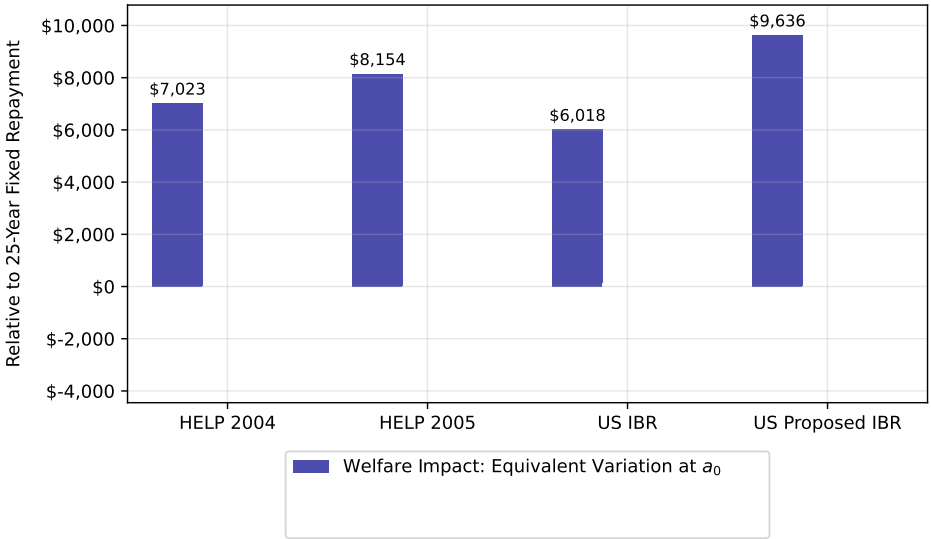
- **Government budget** defined as:

$$\mathcal{G} = \mathbf{E}_0 \sum_{a=a_0}^{a_T} \frac{\text{Repayments}_a + \text{Taxes}_a - \text{Transfers}_a}{\mathcal{R}_a}$$

$$\mathcal{R}_a = \underbrace{\beta^{-(a-a_0)}}_{\text{individual time preference}} * \underbrace{\prod_{s=0}^{a-a_0} m_s}_{\text{mortality}}$$

- Robustness with $\mathcal{R}_a \in \{\text{risk-free rate}, \text{risk-free rate} + 4\%\}$
- **Benchmark**: 25-Year Fixed Repayment = similar duration, not income-contingent

Existing Income-Contingent Loans vs. Fixed Repayment



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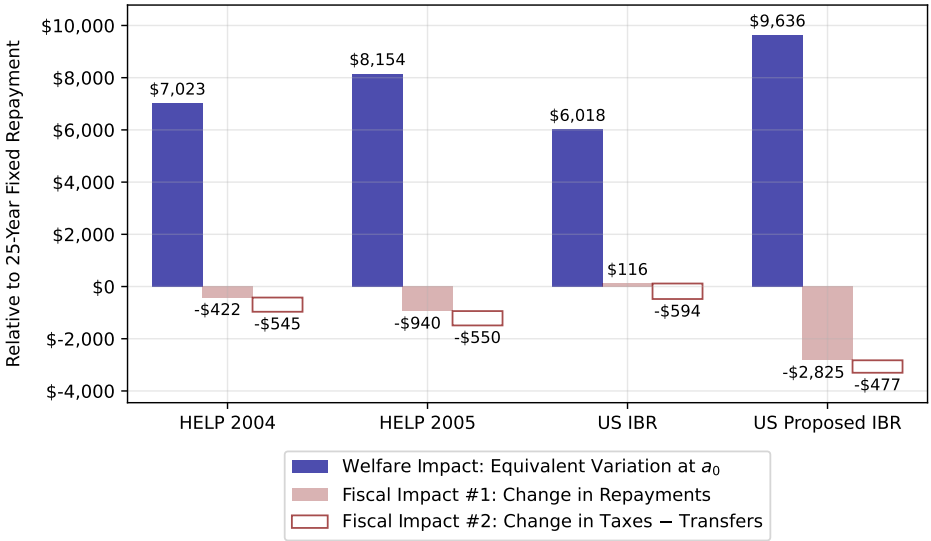

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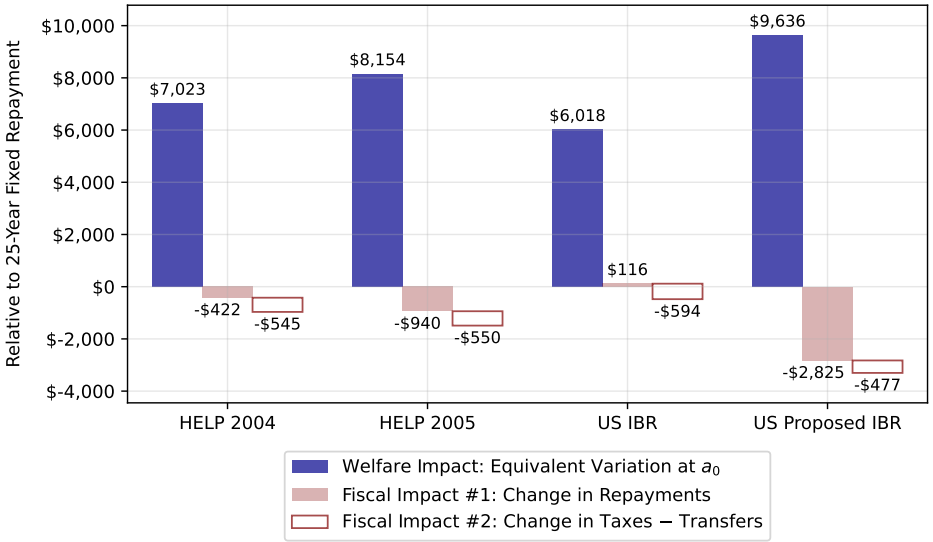


▸ Decomposition ▸ MVPF

- Contracts have different fiscal costs $\Rightarrow$ need to balance government budget
- **Next**: solve **constrained** planner's problem to construct contracts with same cost

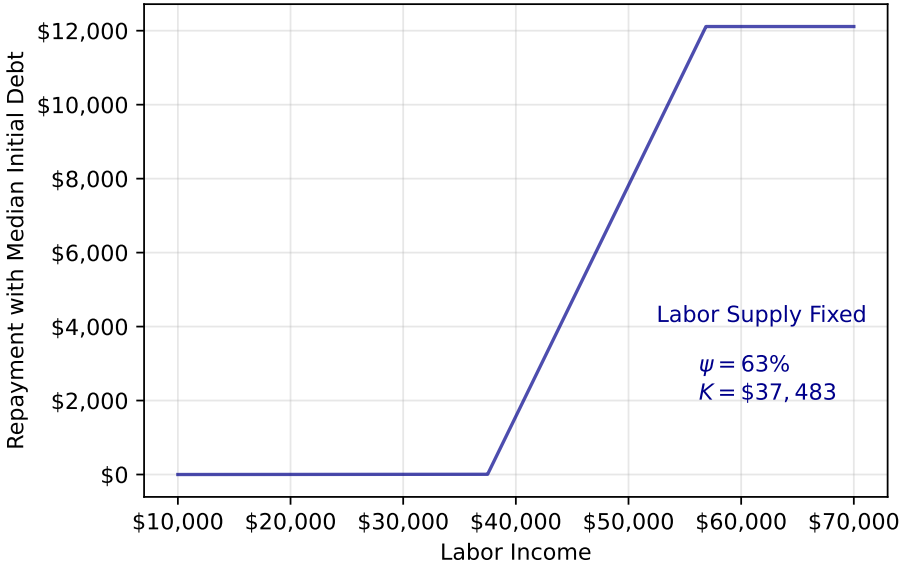
$$\max_{\psi, K} \mathbf{E}_0 \left(V_{a_0}^{1-\gamma} \right)^{\frac{1}{1-\gamma}}$$

subject to:

$$\mathbf{E}_0 \sum_{a=a_0}^{a_T} \frac{\text{Repayments}_a + \text{Taxes}_a - \text{Transfers}_a}{\mathcal{R}_a} \geq \mathcal{G}_{\text{25-Year Fixed}} \tag{1}$$

$$\text{Repayments}_a = \min \left\{ \psi * \max \left\{ y_a - K, 0 \right\}, D_a \right\} \tag{2}$$

Solution to Constrained Planner's Problem



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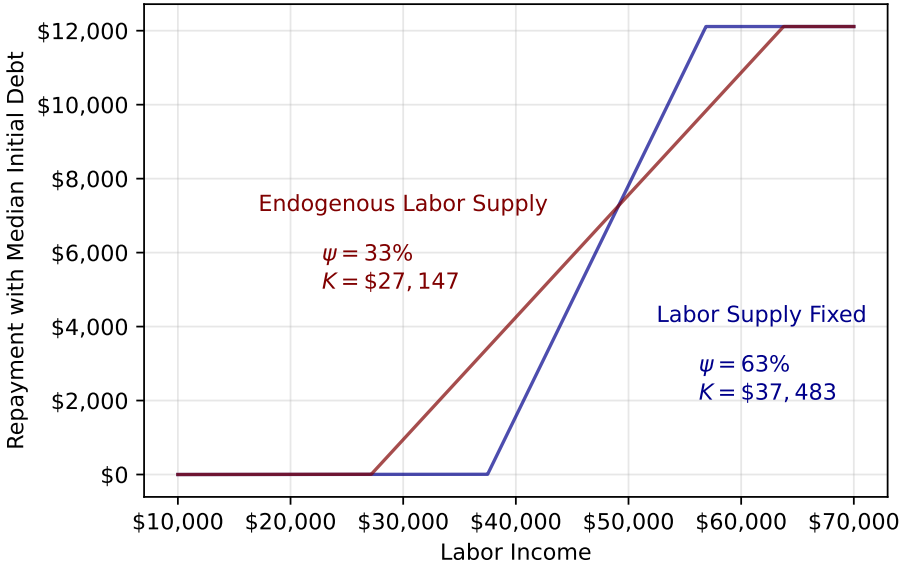
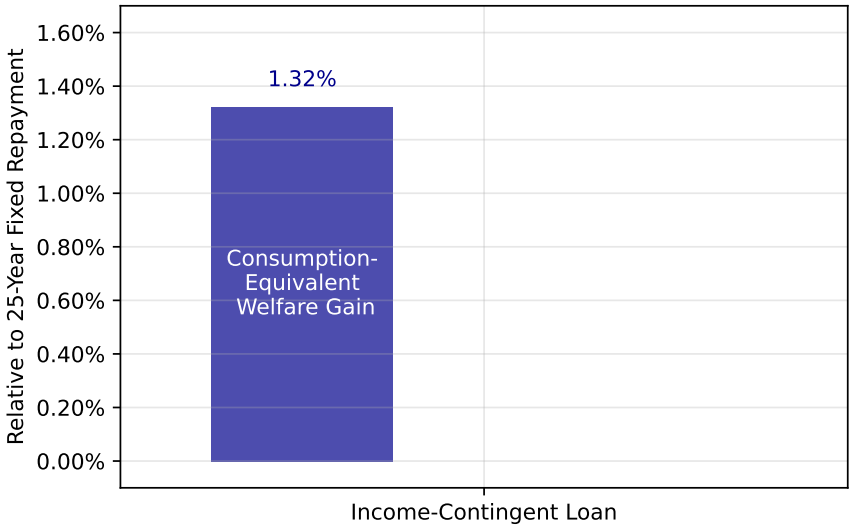


Constrained-Optimum = 1.3% Increase in Lifetime Consumption



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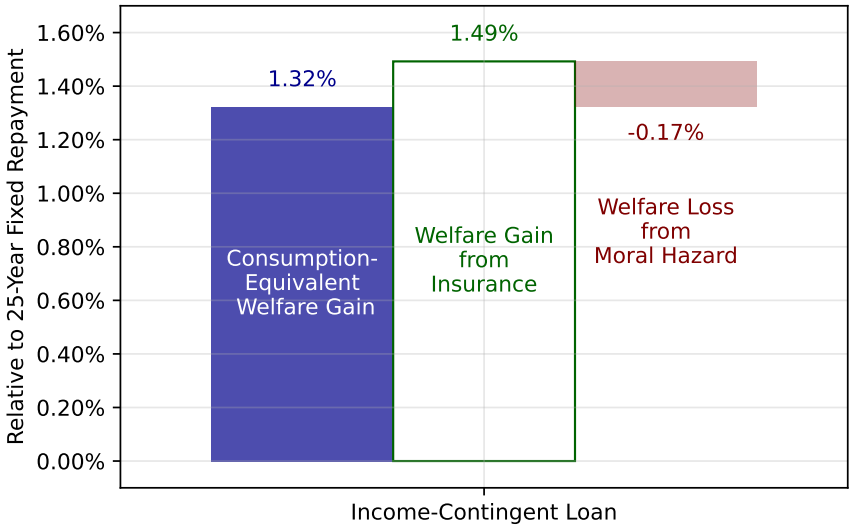

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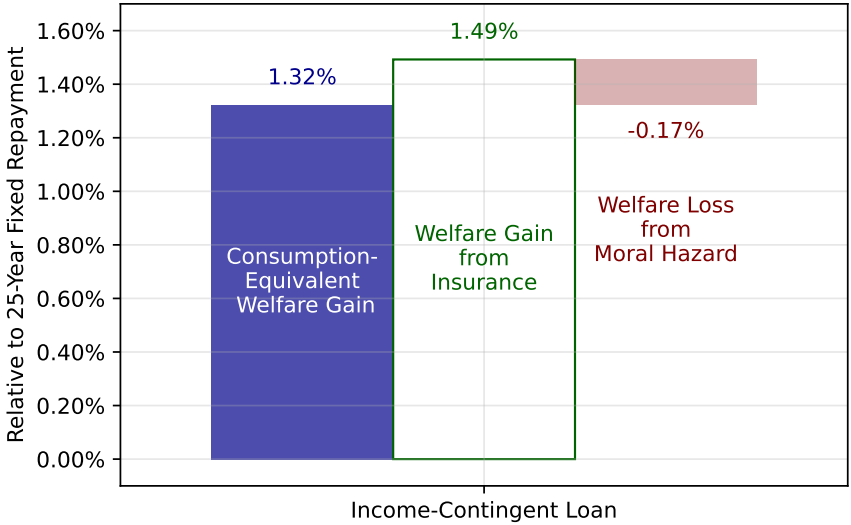
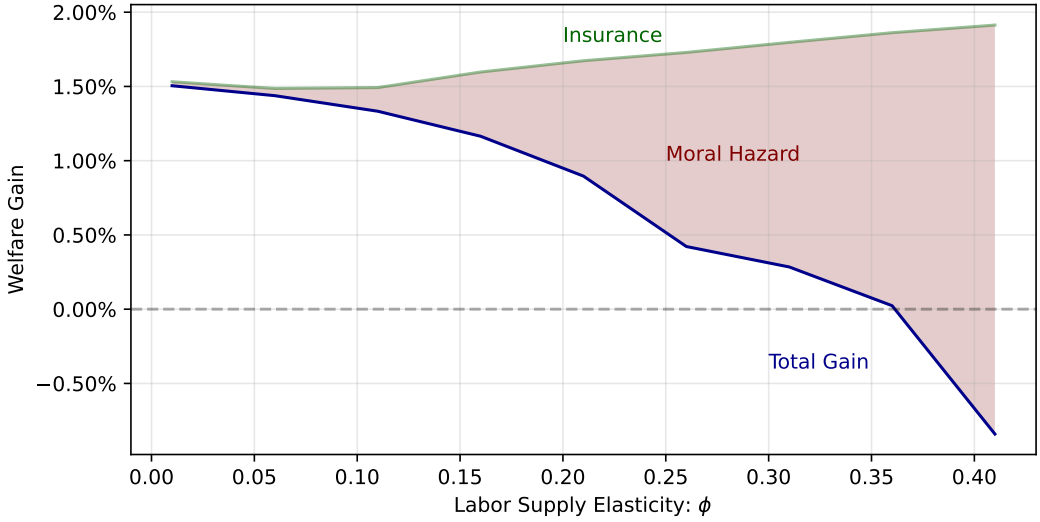


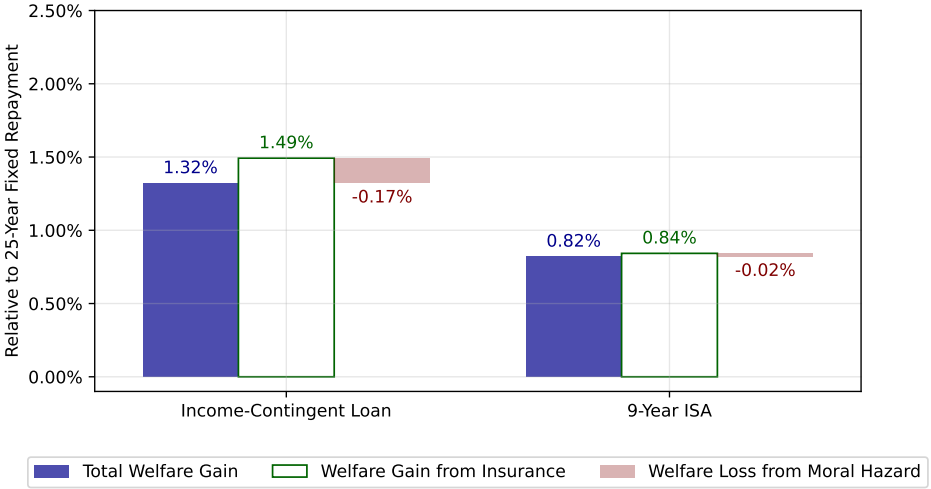
▸ Alt. Models ▸ Distribution ▸ Restrict $\psi \leq 10\%$ ▸ Forgiveness

Welfare Gain is Positive as Long as $\phi < 0.37$



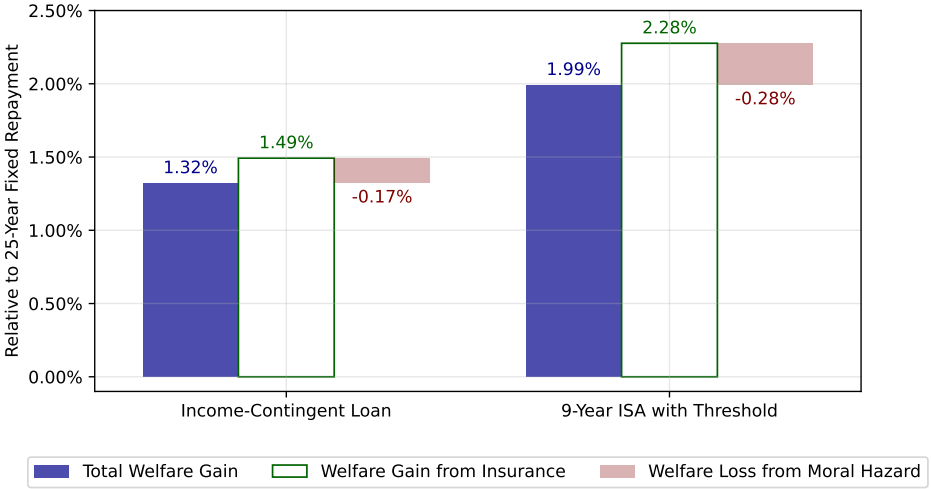
▸ Alt. Models ▸ Implied Bunching ▸ Contracts to Reduce MH

Pure Equity Contract Gives Smaller Gains



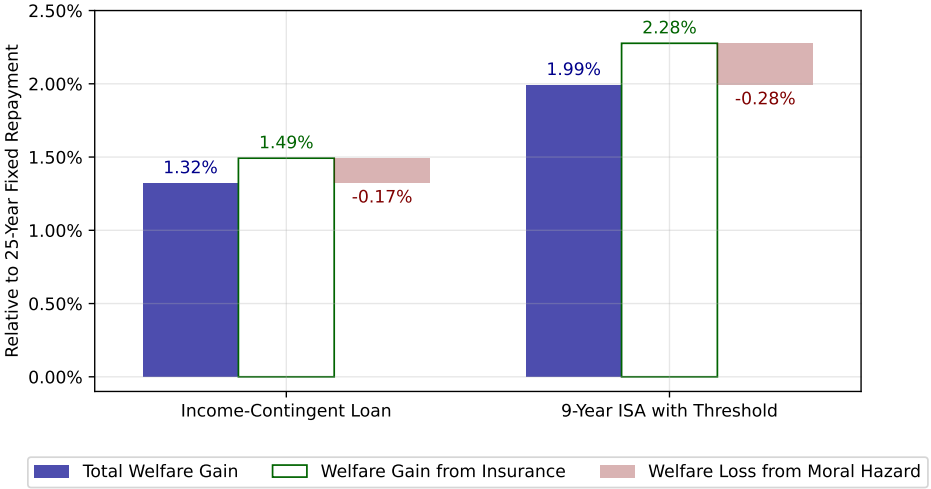
- Losses to transferring payments from (low-income) young $\rightarrow$ (high-income) old

Equity + Threshold Gives Larger But More Dispersed Gains



- **Benefit** of ISA: uncapped payments from high-income $\Rightarrow$ **70%** higher threshold

Equity + Threshold Gives Larger But More Dispersed Gains



- **Cost** of ISA: gains more dispersed ⇒ likely to cause **ex-ante** responses ▸ Distribution

Outline

Summary of Results

1. **Empirics**: borrowers adjust labor supply to $\downarrow$ income-contingent repayments
   - Larger responses in occupations with more hourly flexibility
   - Responses increase with debt balances and proxies for liquidity constraints

2. **Structural estimation**: responses imply relatively inelastic labor supply
   - Model replicates evidence with Frisch elasticity of **0.11** & adjustment frictions

3. **Welfare**: gains to increasing insurance with income-contingent repayment
   - Fixed repayment $\rightarrow$ optimal income-contingent loan $\Rightarrow \uparrow$ **1.3%** lifetime consumption
   - Gains from optimal equity contract larger, but much more dispersed
   - Moral hazard reduces optimal amount of insurance, but welfare cost small

Summary of Results

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Takeaway: Income-contingent repayment creates moral hazard that changes optimal contract, but too small to justify fixed repayment

- **Remaining questions**:
  - Effects of fixed vs. income-contingent repayment on borrowing behavior?
  - Can income-contingent loans be privately-provided and welfare-improving?
  - Can income-contingent repayment used for other forms of consumer credit?
- **Broader implications**: tradeoffs in other state-contingent liabilities
  - HHs: government-provided shared-appreciation mortgages (UK, Canada)
  - Firms: revenue-based financing

THANK YOU!

APPENDIX

START OF APPENDIX

Summary of Financing Options to Potential Borrowers

1. HECS-HELP
   - Loans to students approved for CSP-place at public undergraduate institution
   - Covers most undergraduate degrees
2. FEE-HELP
   - Loans to students at non-CSPs that are FEE-HELP approved
   - Covers private undergraduate (uncommon) and post-graduate degrees
3. Private loans from universities or banks
   - Common option for international students, not used by domestic students
4. Pay tuition in full up-front
   - Around 10% of HELP-eligible students do this
   - Mostly borrowers with family support (Norton 2018)

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Variable Definitions

- HELP Income = Taxable Income + Fringe Benefits + Foreign Employment Income + Investment or Property Losses + Employer Super Contributions
- Labor Income = Salary/Wages + Allowances & Tips + Self-Employment Income
- Capital Income = Interest and Dividend Income + Annuity Income + Capital Gains + Rental Income + Managed Trust Income
- Net Deductions = Labor Income + Capital Income - HELP Income

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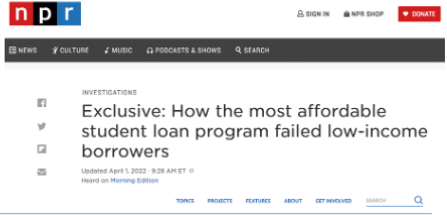
United States:



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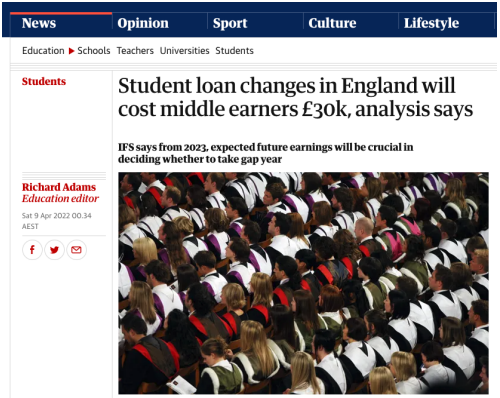
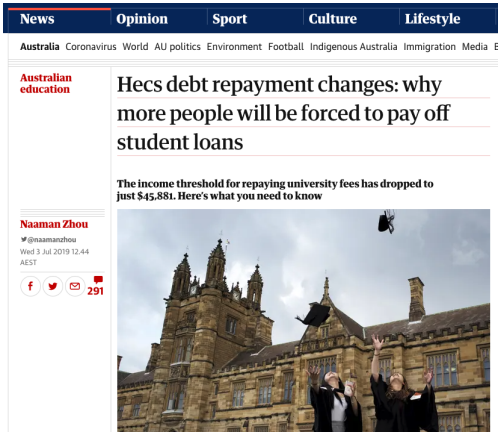
Worldwide Interest in Income-Contingent Repayment

United Kingdom:



Australia:



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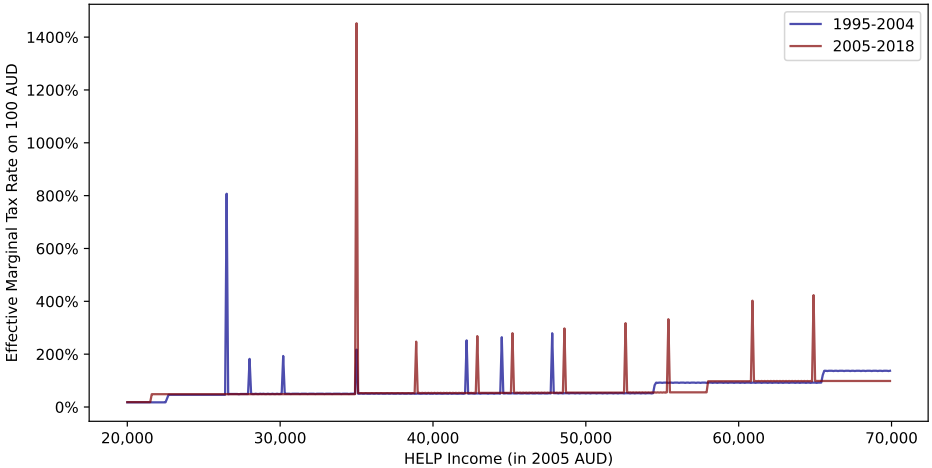
Marginal Repayment Rates on 100 AUD



Note: marginal rates include income taxes and basic Medicare levy, assuming taxable income = HELP income

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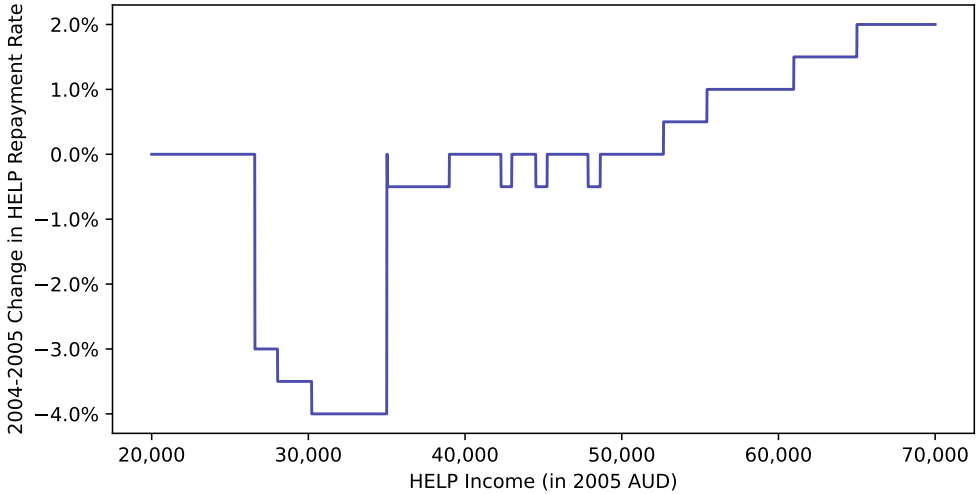
Change in Repayment Rates Due to Policy Change



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FINANCIAL REVIEW

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Politics

Print article

Ease HECS burden on students, say universities

Kate Marshall

Jan 9, 2003 – 11.00am

Save Share

Australian students owing more than $9 billion of debts to the federal government should be spared financial heartache under a proposal to lift the income threshold for repayments, the Australian Vice-Chancellors Committee said yesterday.

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Summary Statistics

	Sample of Individuals		
	Non-Debtholders (1)	Debtholders (2)	26-Year-Old Debtholders (3)
Demographics			
Age	41.1	29.5	26
Female	0.46	0.60	0.57
Wage-Earner	0.85	0.91	0.93
Income Totals			
Taxable Income	37,695	27,796	32,929
HELP Income	38,756	28,586	33,721
Income Components			
Salary & Wages	32,415	26,068	32,091
Labor Income	35,480	27,136	32,999
Interest & Dividend Income	726	242	224
Capital Income	1,221	324	184
Net Deductions	-1,548	-1,099	-554
HELP Variables			
HELP Debt	·	10,830	13,156
HELP Payment	·	991	1,305
HELP Income $<$ 0% Threshold	0.50	0.65	0.51
HELP Income $<$ 2004 0% Threshold	0.37	0.51	0.35
HELP Income $<$ 2005 0% Threshold	0.52	0.67	0.55
Number of Observations	247,118,713	27,316,037	1,701,464

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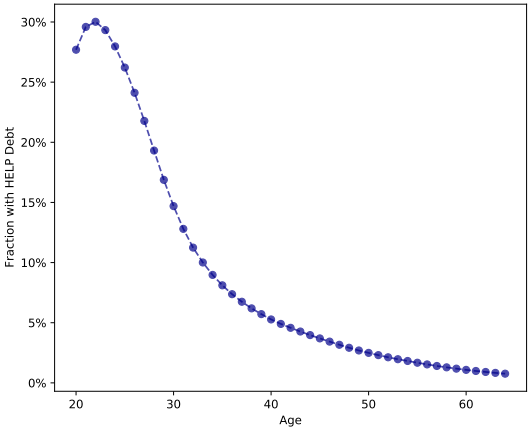
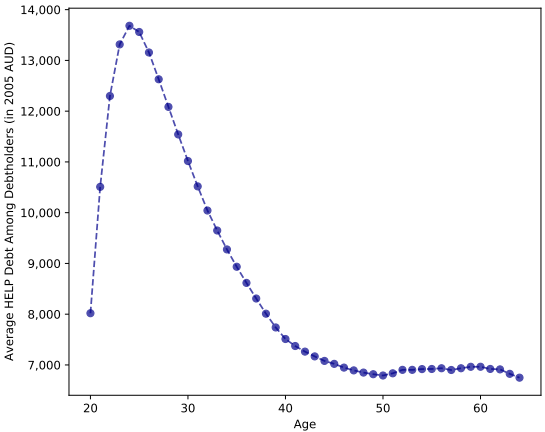
Debt Balances by Age





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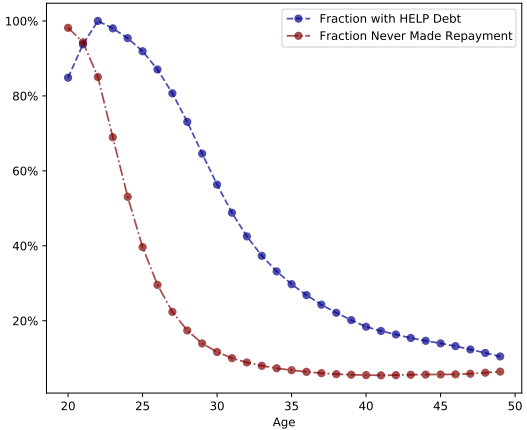
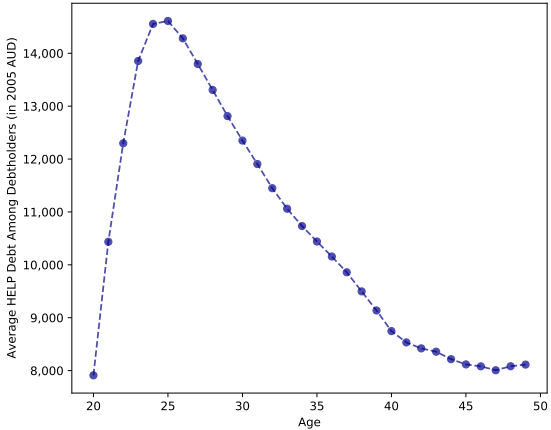
Debt Balances by Age: Individuals with Positive Debt at Age 22





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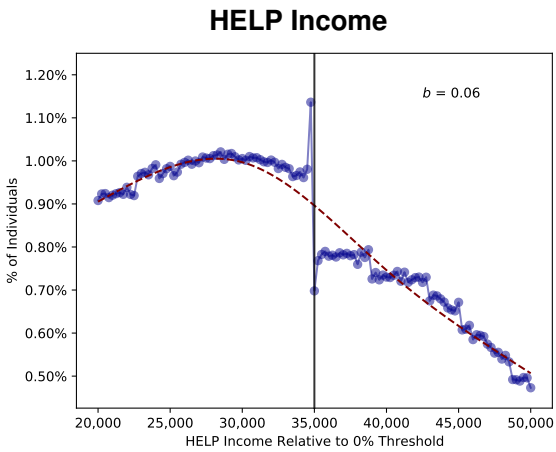
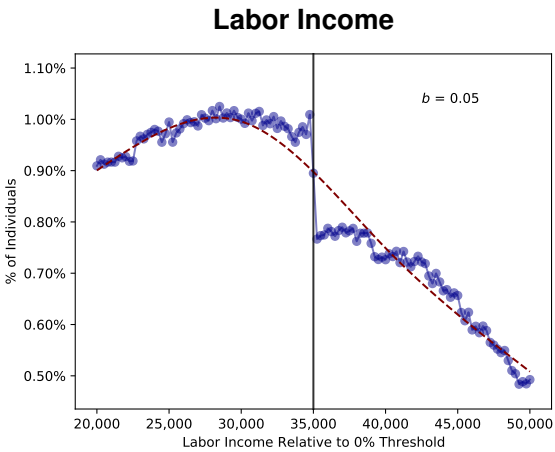
83% of Bunching in HELP Income Present in Labor Income





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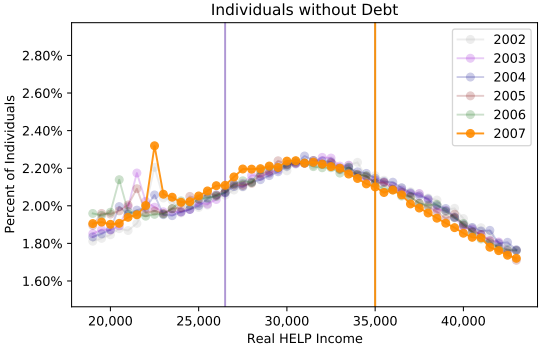
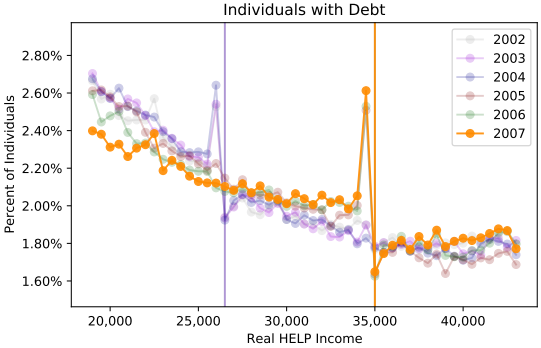
No Bunching at Repayment Threshold for Non-Debtholders





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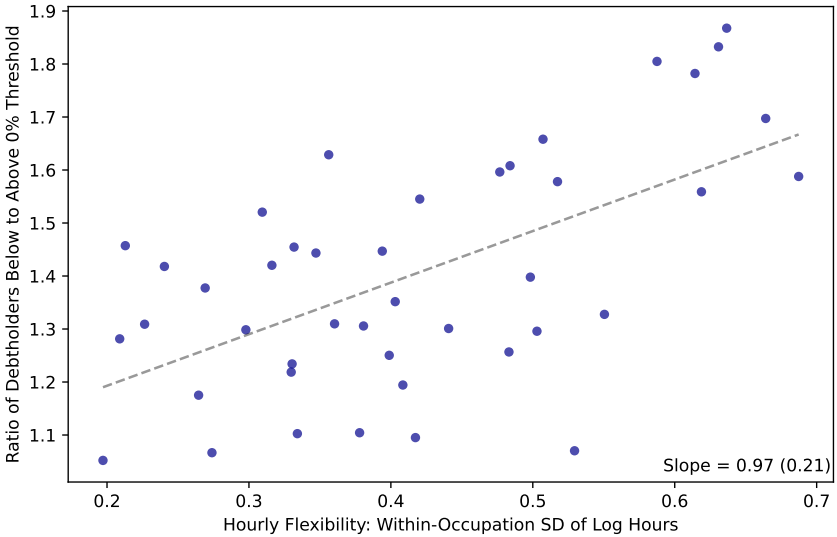
Alternative Measure of Hourly Flexibility



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- Bunching statistic calculated as in prior literature (Chetty et al. 2011, Kleven-Waseem 2013)
  1. Fit 5-piece spline leaving out [\$32,500, \$35,000 + X] $\Rightarrow$ **counterfactual density**
  2. Iterate and choose X so that counterfactual density integrates to 1
  3. $$b = \frac{\text{observed mass in [\$32,500, \$35,000]}}{\text{counterfactual mass in [\$32,500, \$35,000]}} - 1$$

- $b = 0.1 \Rightarrow$ 10% more people below threshold than would be absent discontinuity
  - Note: normalization makes b comparable across distributions of different shapes

- **Sample:** All debtholders age 20 to 64 pooled across 2005 to 2018
  - Income deflated to 2005 so 0% threshold constant in real terms at **\$35,000**

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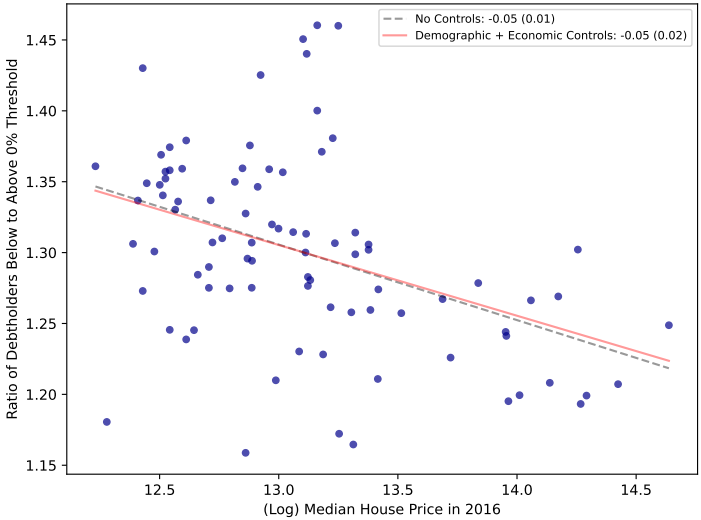
Less Bunching in Regions with More Housing Wealth



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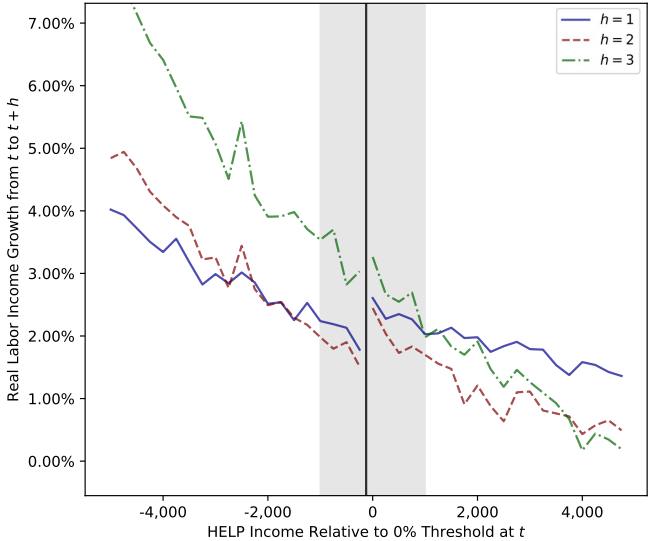
Limited Evidence of Dynamic Cost to Bunching



Elasticity of Moments with Respect to Parameters

	ϕ	f	λ
Mass Below 2004 Threshold	0.08	-0.16	0.21
Mass Above 2004 Threshold	-0.03	0.09	-0.13
Mass Below 2005 Threshold	0.12	-0.16	0.28
Mass Above 2005 Threshold	-0.04	0.09	-0.19
Ratio 2005 0%	0.22	-0.34	0.64
Ratio 2005 0.5%	0.13	-0.12	0.16
Ratio 2005 0%, Q1 Debt	0.22	-0.34	0.37
Ratio 2005 0%, Q4 Debt	0.20	-0.33	0.82

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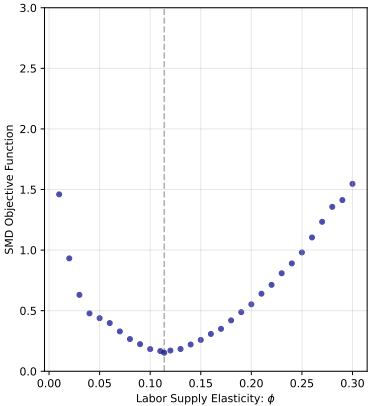
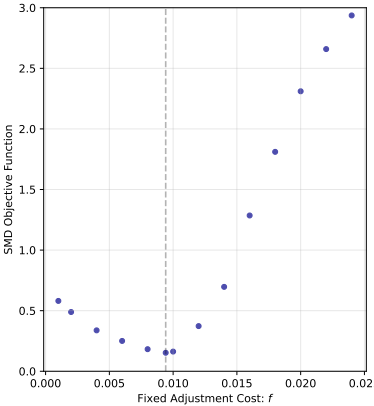
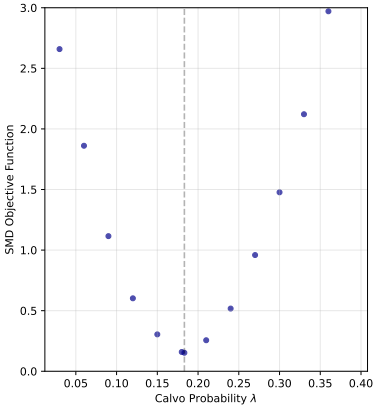
SMM Objective is Smooth in Labor Supply Parameters







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$$\text{Parameters} = \Big(\underbrace{\phi \quad f \quad \lambda \quad \kappa \quad \beta}_{\text{preferences}} \quad \underbrace{\delta_0 \quad \delta_1 \quad \delta_2 \quad \delta_0^E \quad \delta_1^E}_{\text{wage profile}} \quad \underbrace{\rho \quad \sigma_\nu \quad \sigma_\epsilon \quad \sigma_i}_{\text{wage risk}} \Big)$$

- Age profiles of salary & wages $\Rightarrow$ wage profile parameters
- Moments in Guvenen et al. 2022 $\Rightarrow$ wage risk parameters
- Average capital income at ages 40-44 $\Rightarrow \beta$
- Average labor supply $\Rightarrow \kappa$

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Full Estimation Results

Parameter		Estimation (1)	(2)	(3)	(4)	(5)
Labor supply elasticity	ϕ	0.114	0.005	0.188	0.053	0.082
		(.004)	(.000)	(.003)	(.002)	(.002)
Fixed adjustment cost	f	\$377	\$0	\$2278	\$0	\$762
		(\$13)	.	(\$21)	.	(\$10)
Calvo parameter	λ	0.183	1	1	0.147	0.346
		(.003)	.	.	(.002)	(.009)
Labor supply scaling parameter	κ	0.560	0.030	0.059	0.510	1.242
		(.007)	(.003)	(.014)	(.012)	(.116)
Time discount factor	β	0.973	0.996	0.972	0.944	0.951
		(.001)	(.000)	(.001)	(.001)	(.001)
Wage profile parameters	δ_0	8.922	9.862	8.680	9.389	9.197
		(.009)	(.002)	(.006)	(.007)	(.007)
	δ_1	0.073	0.111	0.073	0.063	0.070
		(.000)	(.000)	(.000)	(.000)	(.000)
	δ_2	−0.001	−0.002	−0.001	−0.001	−0.001
		(.000)	(.000)	(.000)	(.000)	(.000)
	δ_0^E	−0.487	−0.294	−0.450	−0.530	−0.480
		(.002)	(.000)	(.001)	(.002)	(.002)
	δ_1^E	0.020	0.032	0.018	0.021	0.018
		(.000)	(.000)	(.000)	(.000)	(.000)
Persistence of permanent shock	ρ	0.930	0.914	0.943	0.922	0.889
		(.000)	(.000)	(.000)	(.000)	(.000)
Standard deviation of permanent shock	σ_ν	0.236	0.076	0.196	0.268	0.288
		(.000)	(.000)	(.000)	(.000)	(.000)
Standard deviation of transitory shock	σ_ϵ	0.130	0.504	0.168	0.077	0.064
		(.000)	(.000)	(.000)	(.002)	(.002)
Standard deviation of individual FE	σ_i	0.599	0.101	0.541	0.654	0.625
		(.003)	(.001)	(.003)	(.003)	(.003)
Learning-by-doing parameter	α	0	0	0	0	0.24

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Model Fit: Other Target Moments

Estimation Target	Data	Model
Average Labor Income	42639.373	45581.953
Cross-Sectional Variance of Log Labor Income at Age 22	0.453	0.462
Cross-Sectional Variance of Log Labor Income at Age 32	0.555	0.491
Cross-Sectional Variance of Log Labor Income at Age 42	0.577	0.525
Cross-Sectional Variance of Log Labor Income at Age 52	0.539	0.580
Cross-Sectional Variance of Log Labor Income at Age 62	0.608	0.657
Linear Age Profile Term	0.077	0.080
Quadratic Age Profile Term	−0.001	−0.001
Education Income Premium Constant	−0.574	−0.554
Education Income Premium Slope	0.023	0.023
10th Percentile of 1-Year Labor Income Growth	−0.387	−0.392
10th Percentile of 5-Year Labor Income Growth	−0.667	−0.705
90th Percentile of 1-Year Labor Income Growth	0.415	0.393
90th Percentile of 5-Year Labor Income Growth	0.698	0.710
Average Labor Supply	1.000	0.963
Average Capital Income between Ages 40 and 44	1338.846	1332.459

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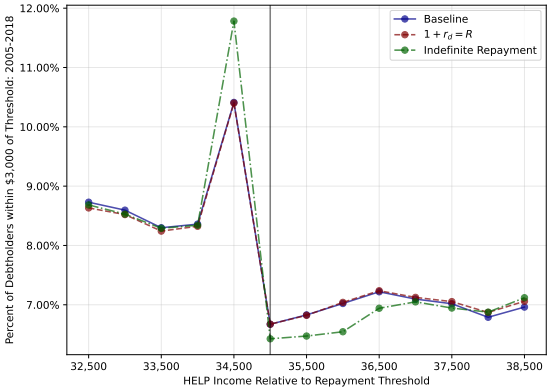
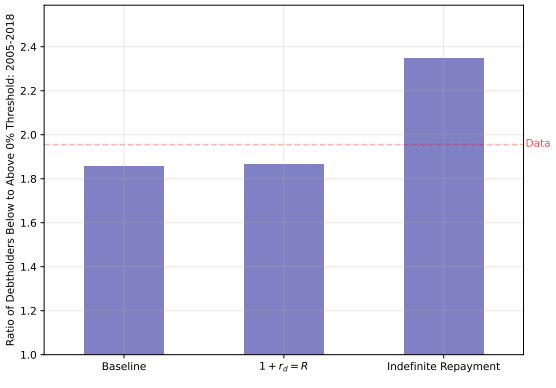
Dynamics: Anticipation of Repayment Reduces Responses





- Model: no repayment limit $\Rightarrow \uparrow$ PDV of repayment reduction $\Rightarrow$ bunching $\uparrow$ **70%**
- Data: bunching in top quartile of debt = **1.6**$\times$ bottom quartile

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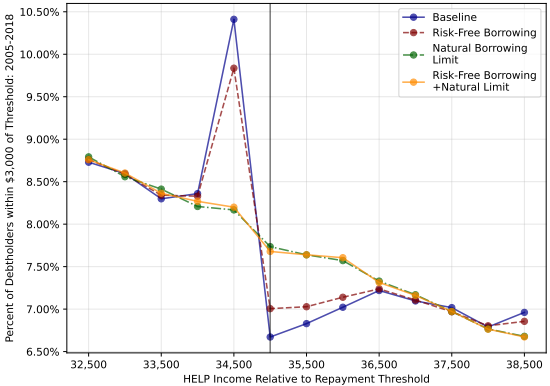
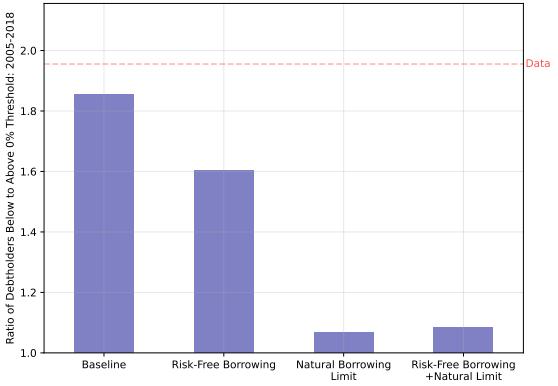
Liquidity: Incomplete Markets Amplify Responses





- Model: complete markets $\Rightarrow \downarrow$ value of repayment reduction $\Rightarrow$ bunching $\downarrow$ **90%**
- Data: bunching $\downarrow$ in wealth and $\uparrow$ in liquidity demands

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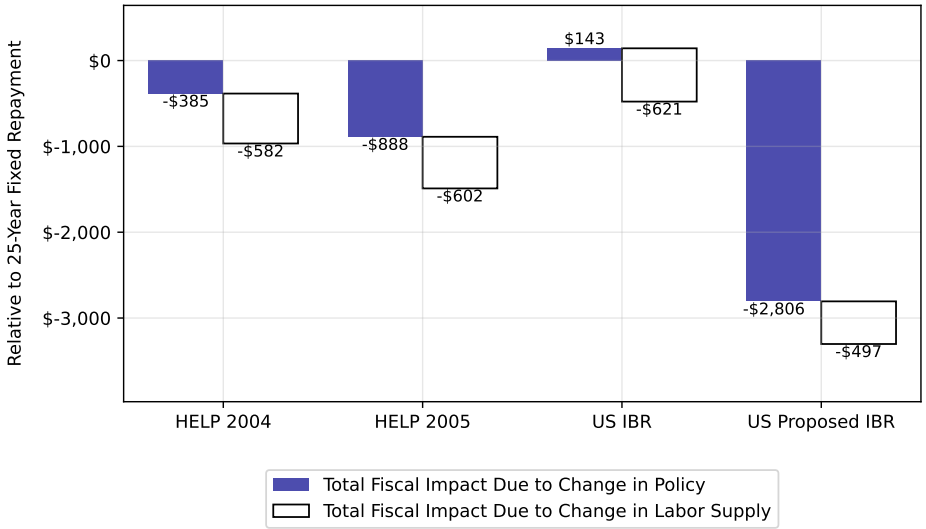
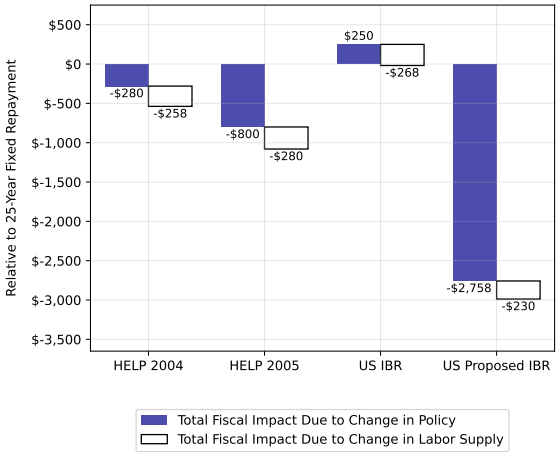
Decomposition of Fiscal Impact: Endogenous Labor Supply



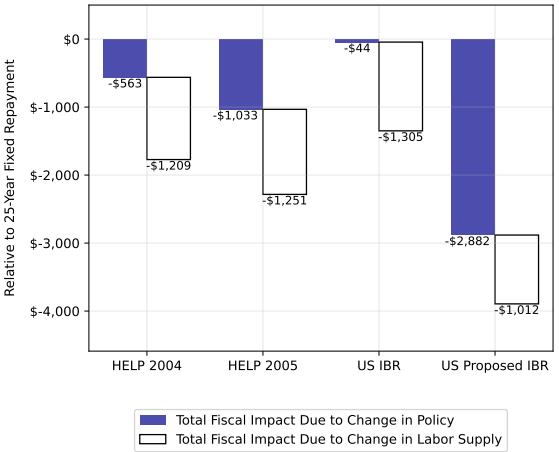
Vary ϕ Back

Decomposition of Fiscal Impact: Alternative ϕ

$\phi = \mathbf{0.052}$



$\phi = \mathbf{0.21}$



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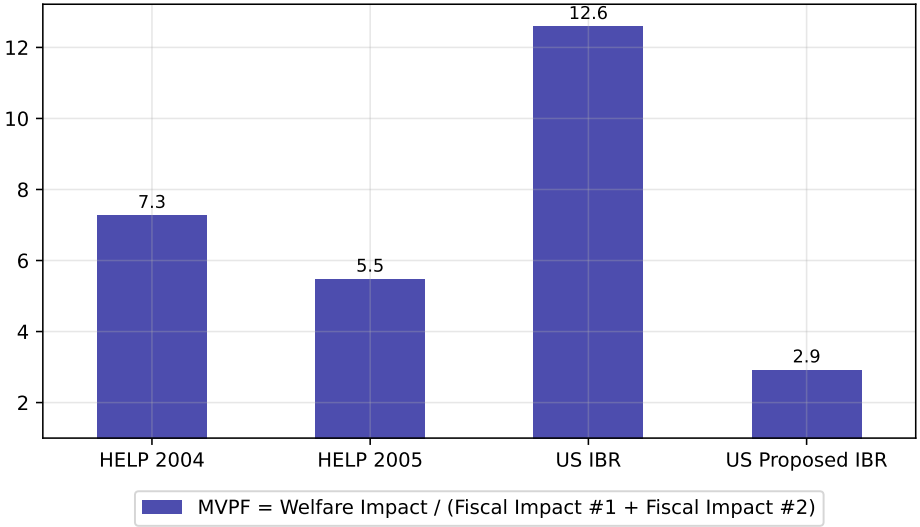
Marginal Value of Public Funds



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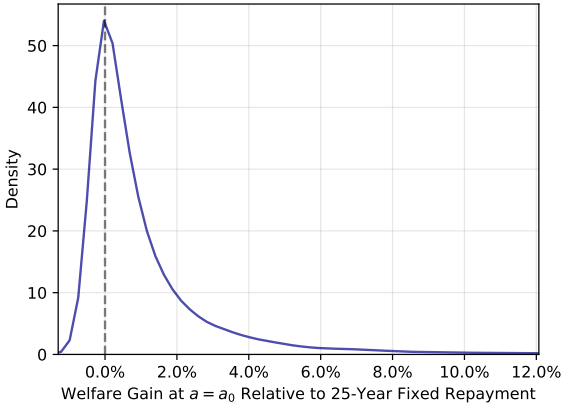
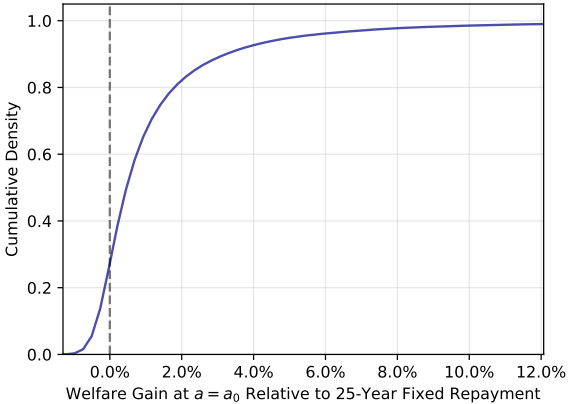
Distribution of Initial Welfare Gains: ICL

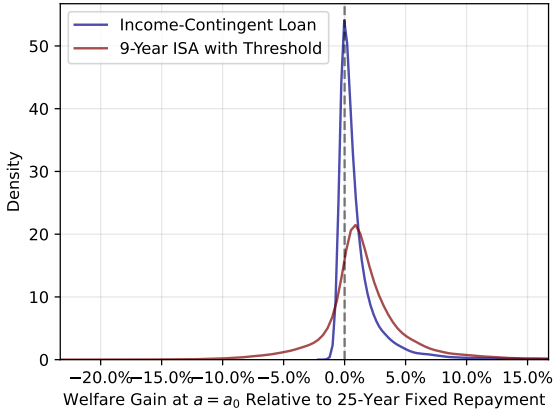


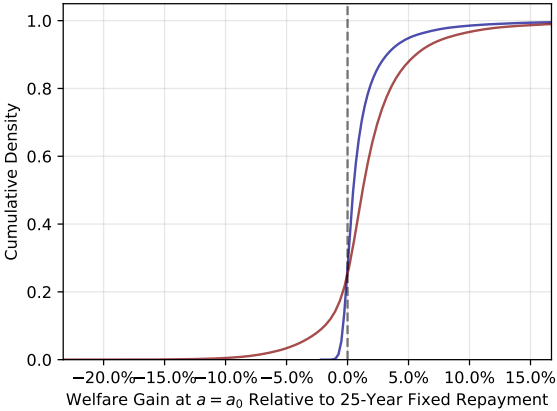


- Only **1.2%** of borrowers have welfare loss above 0.5%

▸ Heterogeneity by States ▸ Losers ▸ Age ◂ Back

Distribution of Initial Welfare Gains: ISA

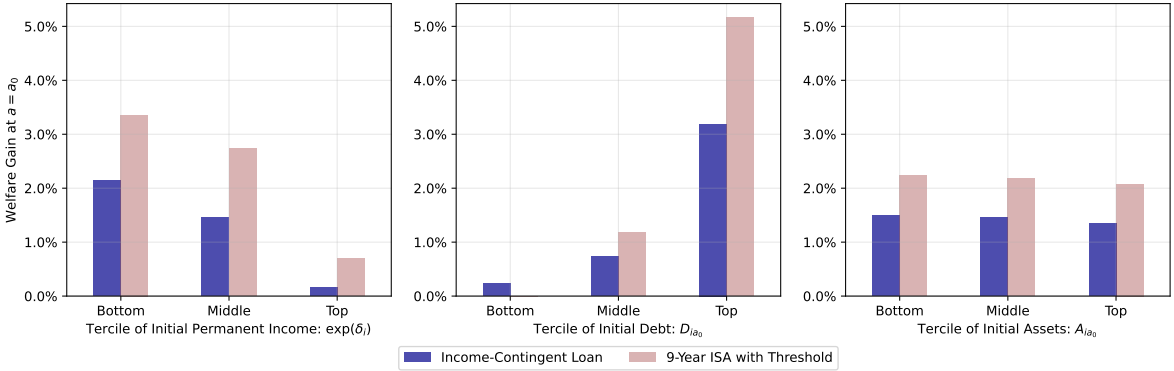




- **18%** of borrowers have welfare loss above 0.5% for ISA vs. **1.2%** for ICL

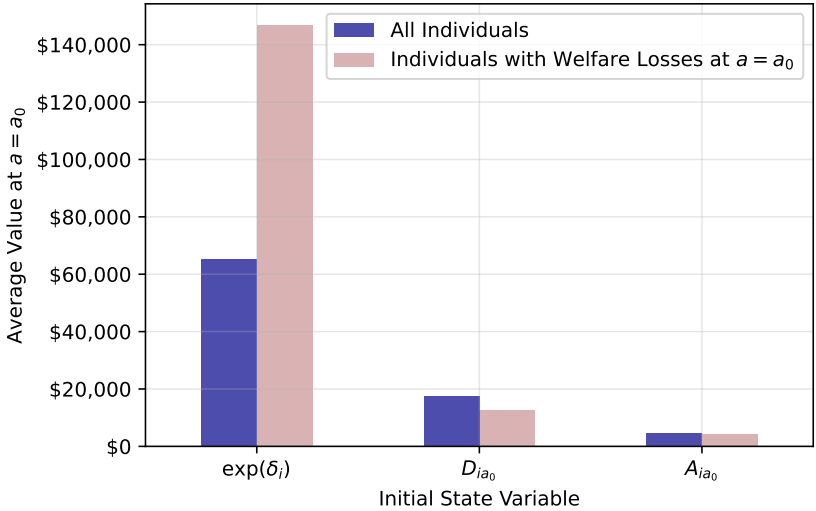
▸ Heterogeneity by States ◂ Back

Heterogeneity in Welfare Gains across Initial States



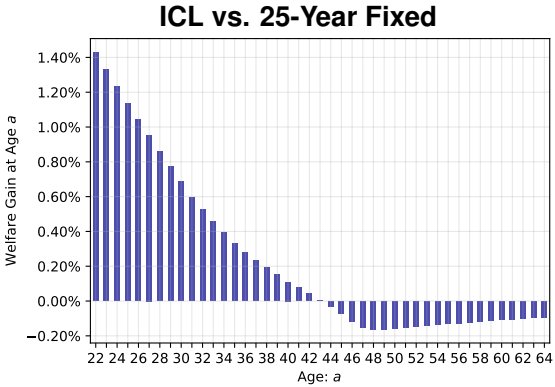
▸ Losers ICL ▸ Age ▸ Initial CEQ ◂ ICL ◂ ISA

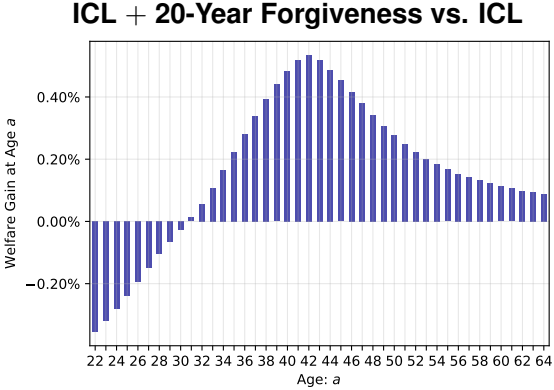
Individuals with Initial Welfare Losses: ICL



Age ICL ISA

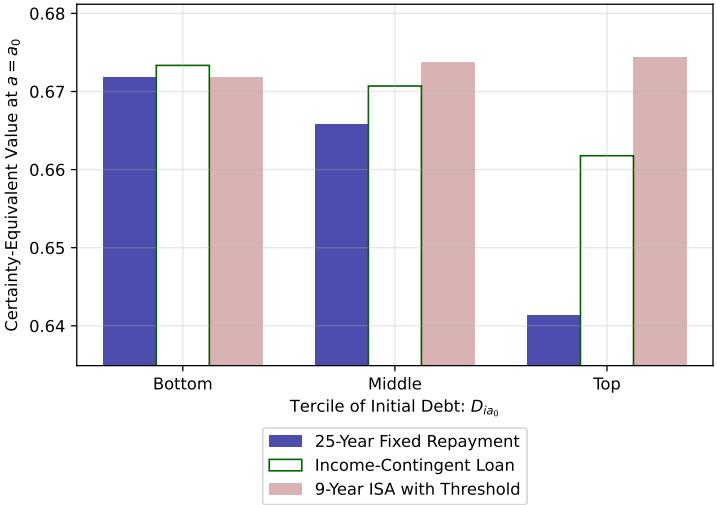
Welfare Gains by Age





◂ ICL ◂ ISA

Certainty-Equivalents across Initial Debt



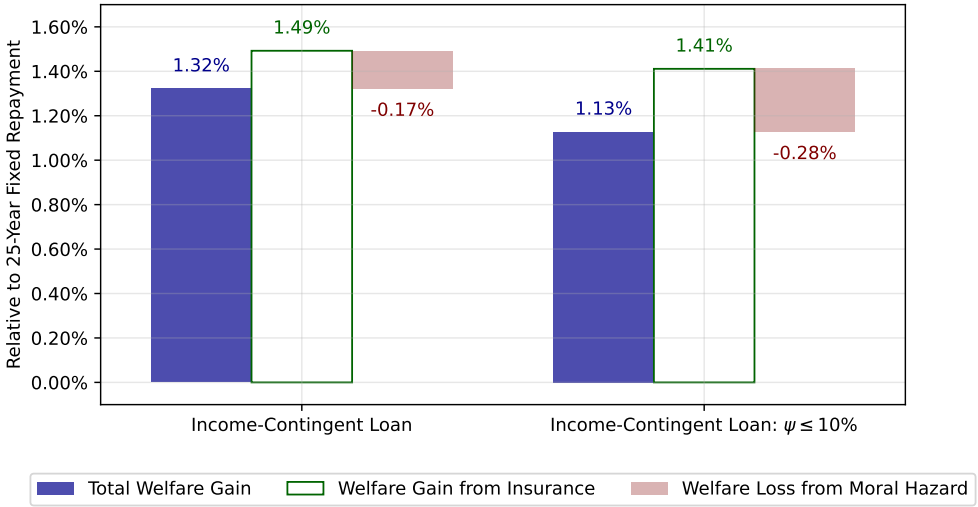
◂ ICL ◂ ISA

Welfare Gains from Income-Contingent Loans: Alt. Models

	Deviation from Baseline	Welfare Gain	= Insurance	+ Moral Hazard	ψ^*	K^*
(1)	RRA = 7.5	3.52%	4.00%	−0.48%	50%	$27,607
(2)	EIS = 1.5	0.57%	0.7%	−0.13%	42%	$30,905
(3)	RRA = 7.5, EIS = 1.5	1.87%	2.29%	−0.43%	49%	$28,641
(4)	No Ex-Post Uncertainty	0.58%	0.76%	−0.17%	27%	$18,098
(5)	No Uncertainty	−0.17%	0.15%	−0.32%	21%	$26,906
(6)	Occupation Heterogeneity	0.28%	0.33%	−0.05%	22%	$25,639
(7)	Learning-by-Doing	1.68%	·	·	35%	$36,615
(8)	Wealth Effects on Labor Supply	0.82%	1.05%	−0.23%	37%	$30,307
(9)	$\rho = 0.8$	0.90%	1.14%	−0.23%	42%	$34,244
(10)	$\rho = 0.99$	1.35%	1.63%	−0.28%	35%	$18,949
(11)	Non-Normal Permanent Shocks	1.14%	1.43%	−0.30%	28%	$26,933
(12)	$r_d = 2\%$	1.96%	2.14%	−0.18%	38%	$47,731
(13)	US Tax System	1.18%	1.36%	−0.19%	38%	$28,838
(14)	$\mathcal{R}_a = R$	1.06%	1.41%	−0.35%	29%	$22,696
(15)	$\mathcal{R}_a = R + 4\%$	1.60%	1.65%	−0.05%	46%	$34,441
	Baseline Model	**1.32%**	**1.47%**	**0.15%**	**33%**	**$27,147**

◂ ICL ◂ FP ◂ ISA

Constraining Repayment Rate Reduces Welfare Gains



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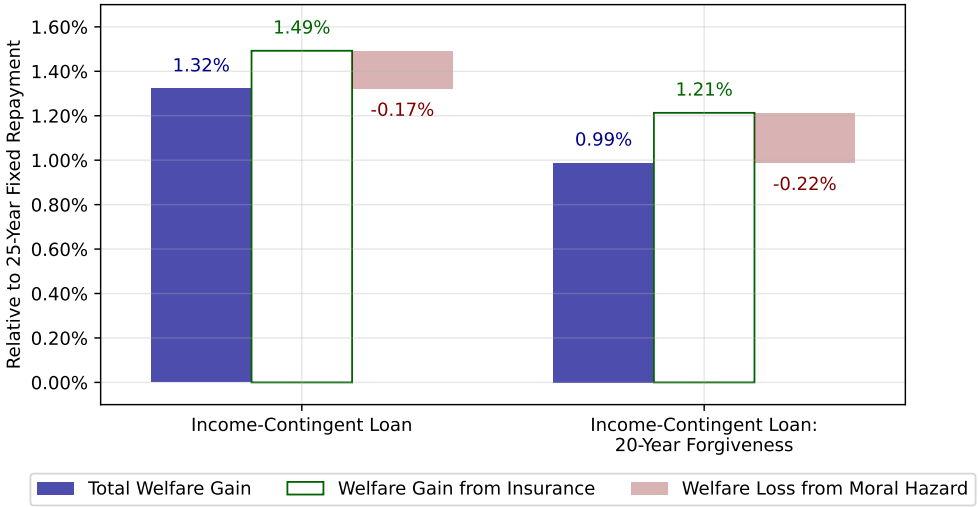
Forgiveness Reduces Welfare Gains



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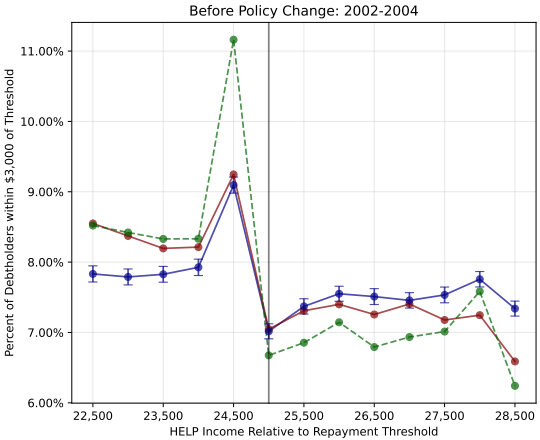
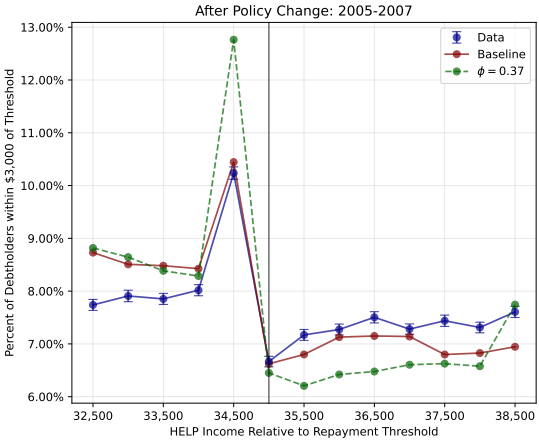
Fit of Model in which Fixed Repayment is Optimal

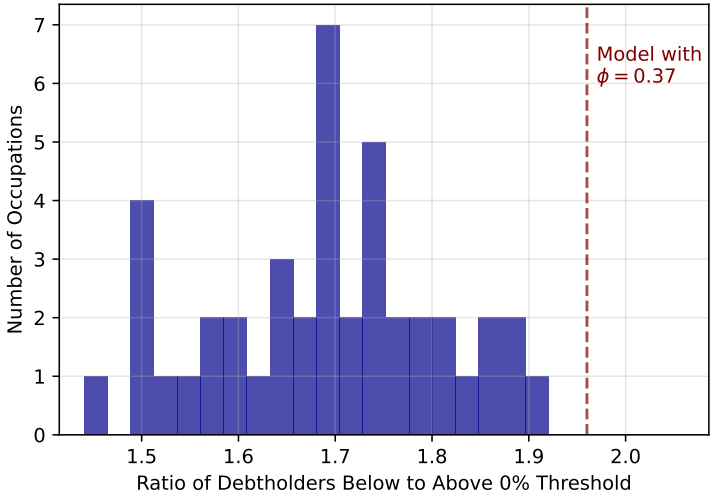




- Insurance gains $<$ moral hazard loss $\iff$ $\text{bunching}_{\text{model}} > \mathbf{1.7} \times \text{bunching}_{\text{data}}$

Occupations | Back

Bunching when Fixed Repayment is Optimal vs. Occupations



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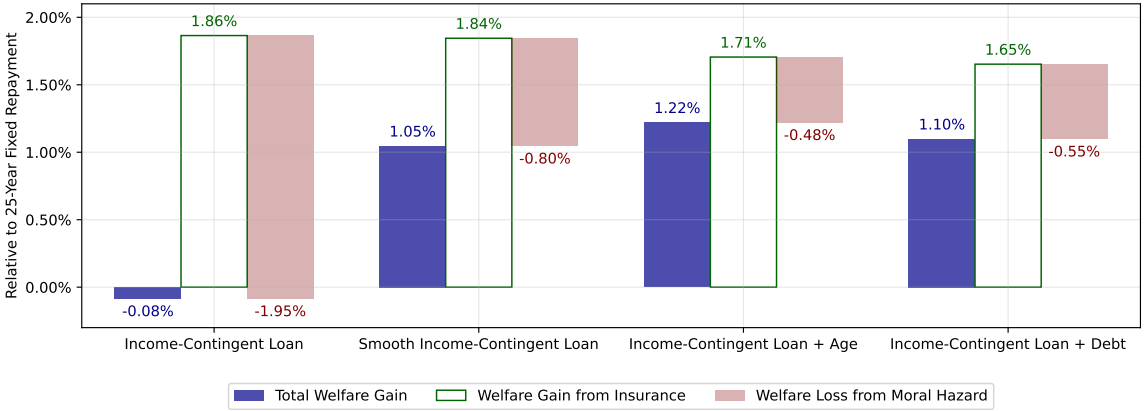
Alternative Contracts Reduce Welfare Cost of Moral Hazard



Contracts | Baseline ϕ | Back

Alternative Forms of Income-Contingent Loans: $\phi = 0.37$

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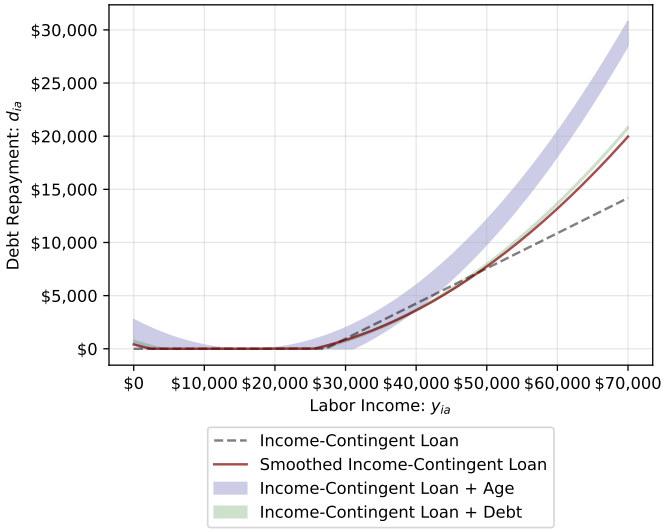
Alternative Forms of Income-Contingent Loans: Baseline ϕ



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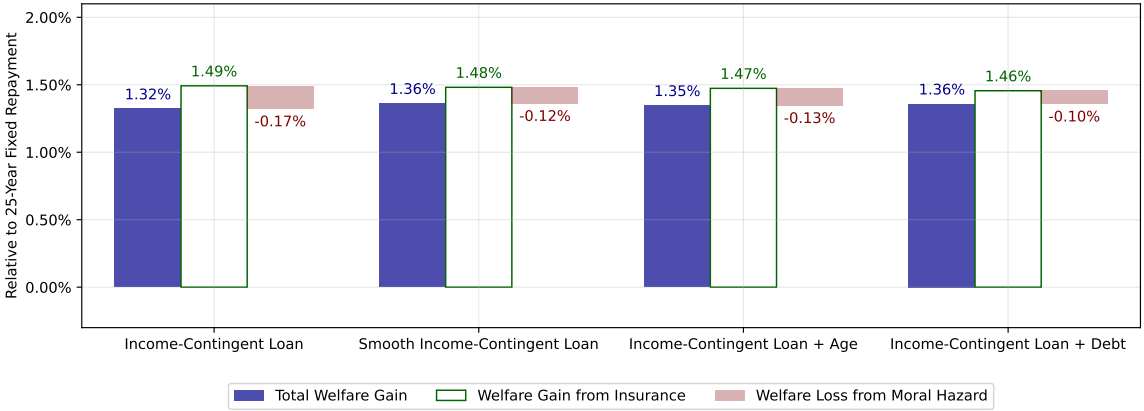
Reducing Welfare Cost of Moral Hazard: Baseline ϕ



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Physical vs. logical page numbers

- Windows: Ctrl + K, uncheck ”Use Logical Page Numbers”
- Mac: Cmd + K, uncheck ”Use Logical Page Numbers” (might have to toggle on/off if its off already)

Jump to page numbers

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- Mac: Cmd + Shift + N

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