

INSURANCE VERSUS MORAL HAZARD IN INCOME-CONTINGENT STUDENT LOAN REPAYMENT

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MIT Sloan

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Disclaimer: The results of these studies are based, in part, on Australian Business Registrar (ABR) data supplied by the Registrar to the ABS under A New Tax System (Australian Business Number) Act 1999 and tax data supplied by the ATO to the ABS under the Taxation Administration Act 1953. These require that such data is only used for the purpose of carrying out functions of the ABS. No individual information collected under the Census and Statistics Act 1905 is provided back to the Registrar or ATO for administrative or regulatory purposes. Any discussion of data limitations or weaknesses is in the context of using the data for statistical purposes, and is not related to the ability of the data to support the ABR or ATO's core operational requirements. Legislative requirements to ensure privacy and secrecy of these data have been followed. Source data are de-identified and so data about specific individuals or firms has not been viewed in conducting this analysis. In accordance with the Census and Statistics Act 1905, results have been treated where necessary to ensure that they are not likely to enable identification of a particular person or organisation.

GOVERNMENT-FINANCED HIGHER EDUCATION

- Governments often provide subsidized financing for higher education
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- Share of earnings
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Debt:

- ✓ Insurance
- ✗ Disincentivize labor supply
- ✓ Encourage risk-taking
- ✗ Incentivize over-borrowing
- ✗ Adverse selection

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This Paper: Insurance vs. Moral Hazard		

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

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 preference parameters
 - **Normative**: characterize optimal amount of income-contingent repayment

SUMMARY OF RESULTS

- ① **Empirics:** borrowers adjust labor supply to ↓ 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 are small quantitatively
 - Model replicates evidence with Frisch elasticity of **0.11** & adjustment frictions
- ③ **Welfare:** gains to increasing insurance with income-contingent repayment
 - Fixed repayment → optimal income-contingent loan ⇒ ↑ **1.3%** lifetime consumption
 - Gains from optimal equity contract larger, but much more dispersed
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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
- **Insurance benefits of income-contingent loans** 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 household debt overhang** Shiller 2004, Caplin et al. 2007, Mian-Sufi 2014, Greenwald et al. 2018, Ganong-Noel 2020, Campbell et al. 2021
- ④ **Bunching in response to taxes to identify 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
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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**:

$$\text{Repayment}_{it} = \text{HELP Rate}_t (\text{HELP Income}_{it}) \times \text{HELP Income}_{it}$$

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

- 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 govt contract in Australia + 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

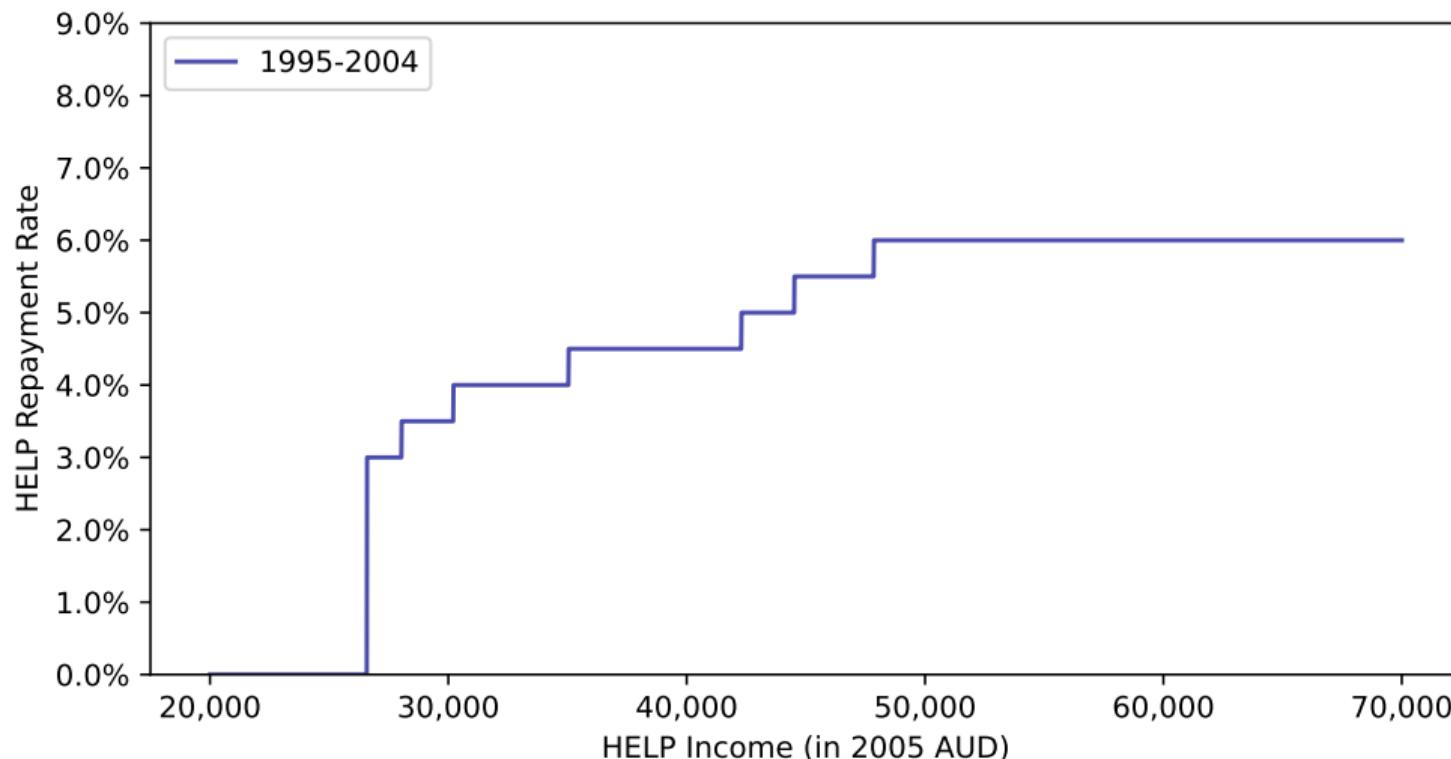
- ① Universe of individual tax returns from ATO (~ US Form 1040)
 - Income components to construct HELP Income and superannuation balances
- ② Administrative HELP data: debt balances, repayments, and flag for new debt
- ③ 2016 Household Census: self-reported hours and mortgage + rent payments
- ④ HILDA: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

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Sample: ~ 3 million **unique** debtholders between ages 20-64 from 1991-2018

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

IDENTIFYING VARIATION: DISCONTINUITIES IN REPAYMENT RATES



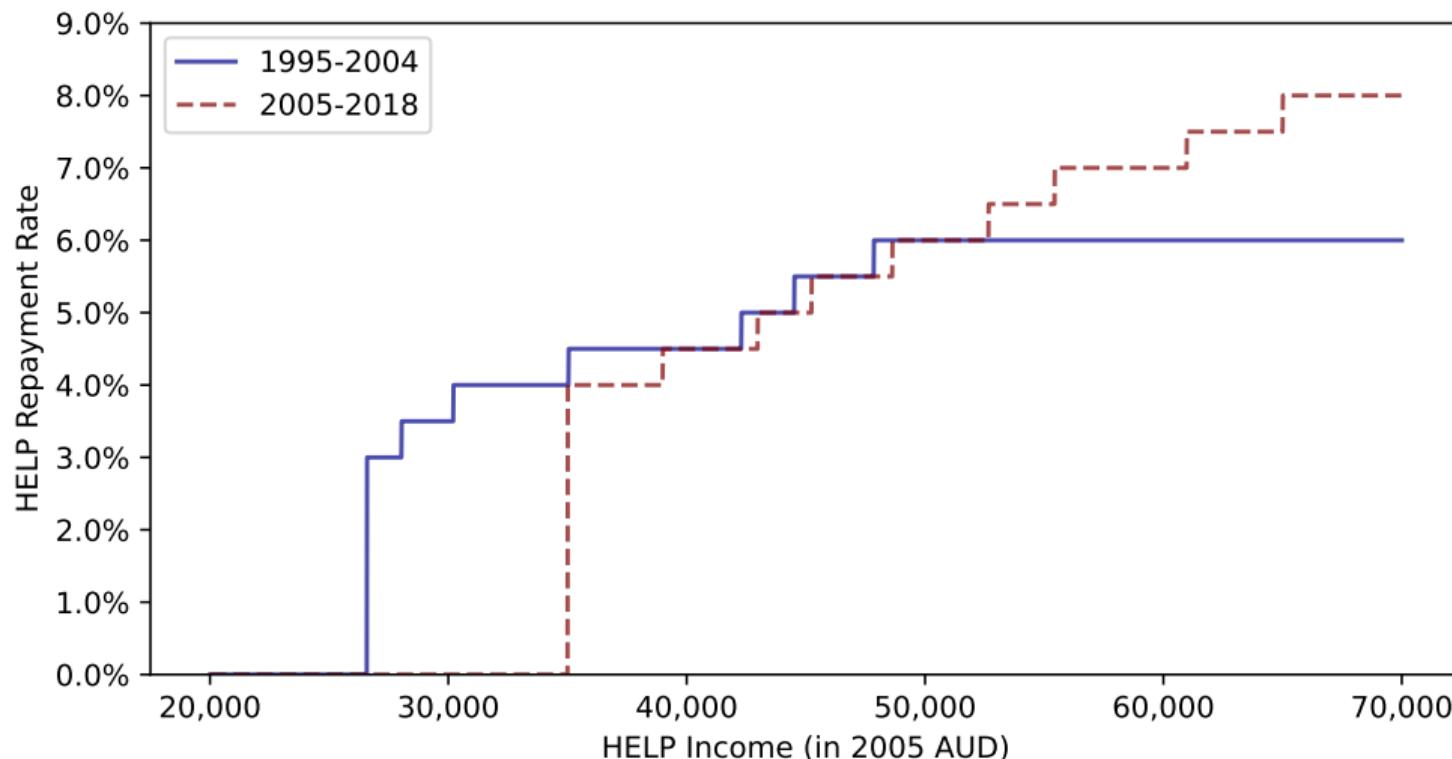
Note: Repayment schedule indexed to CPI, 1 AUD in 2005 ~ 1.2 USD in 2020

► Marginal Rates

► News

► Treatment

IDENTIFYING VARIATION: POLICY CHANGE TO REPAYMENT RATES



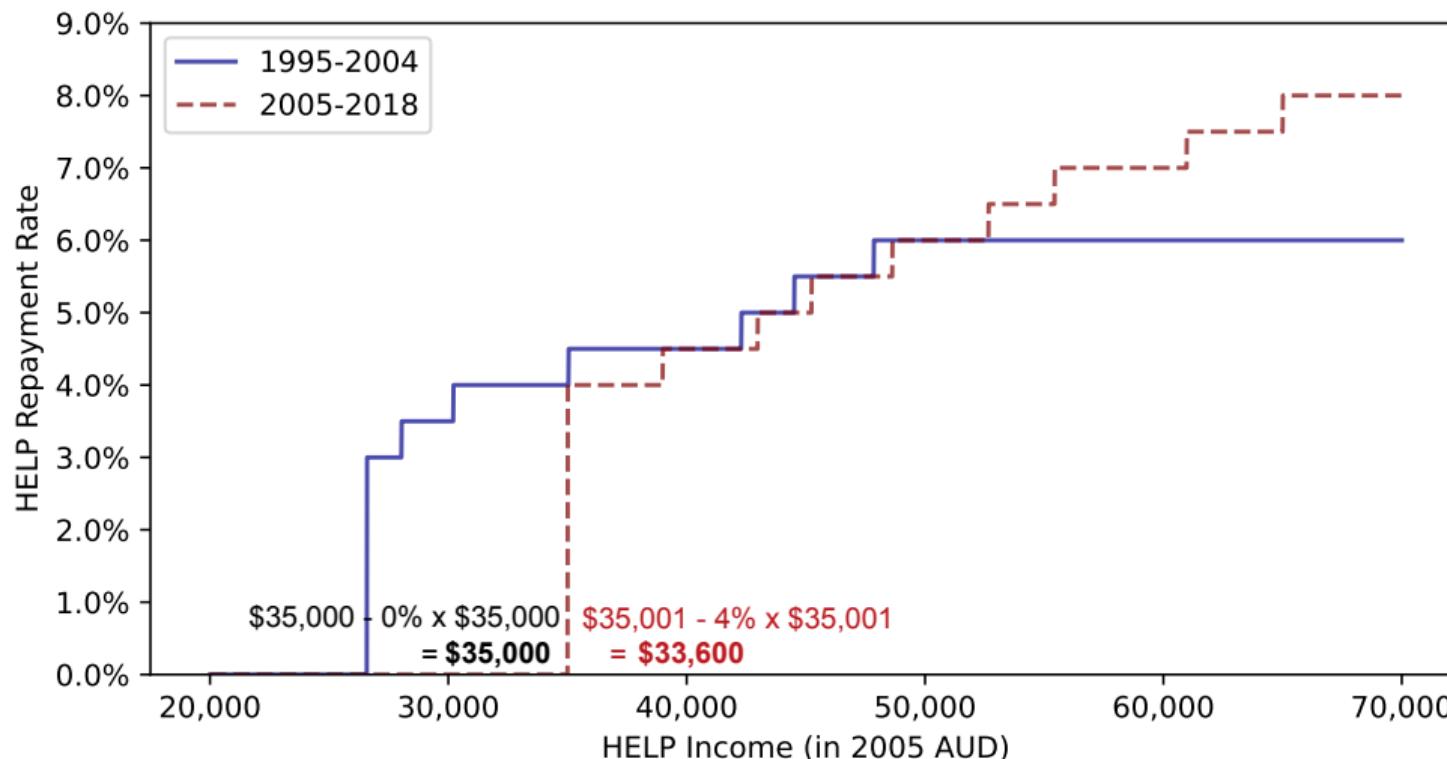
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REPAYMENT THRESHOLD INCREASES AVERAGE REPAYMENT RATE



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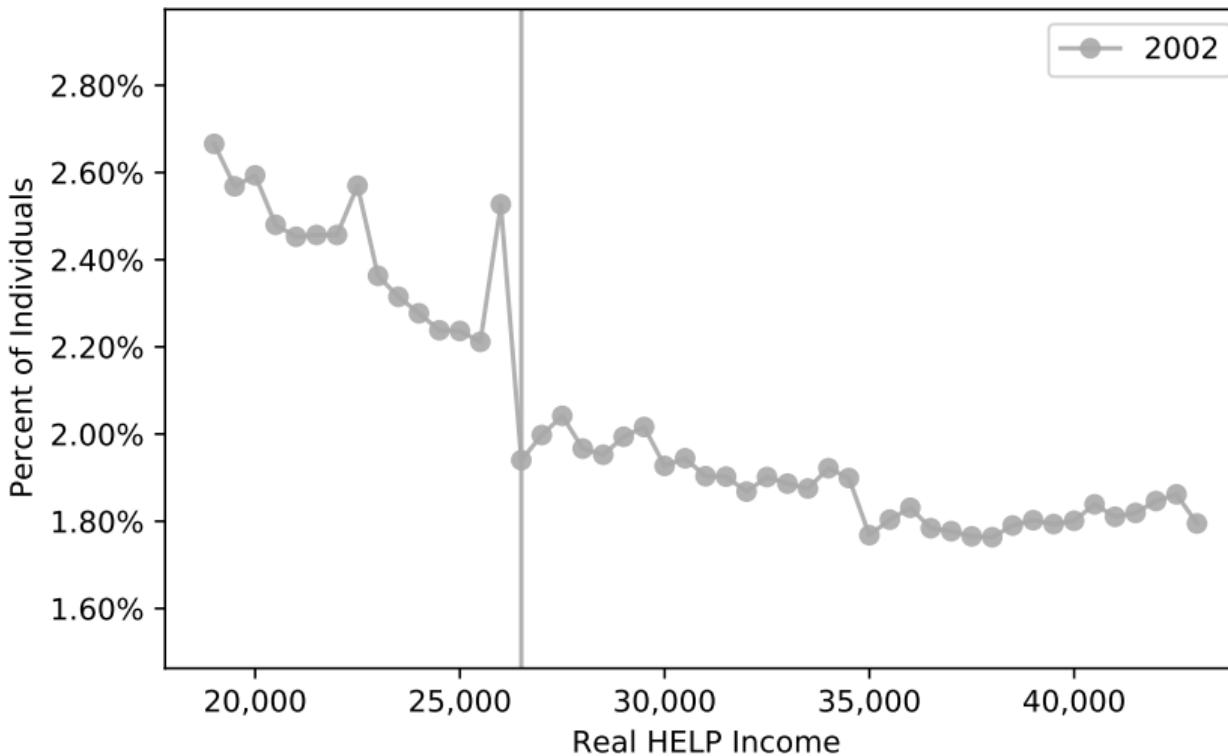
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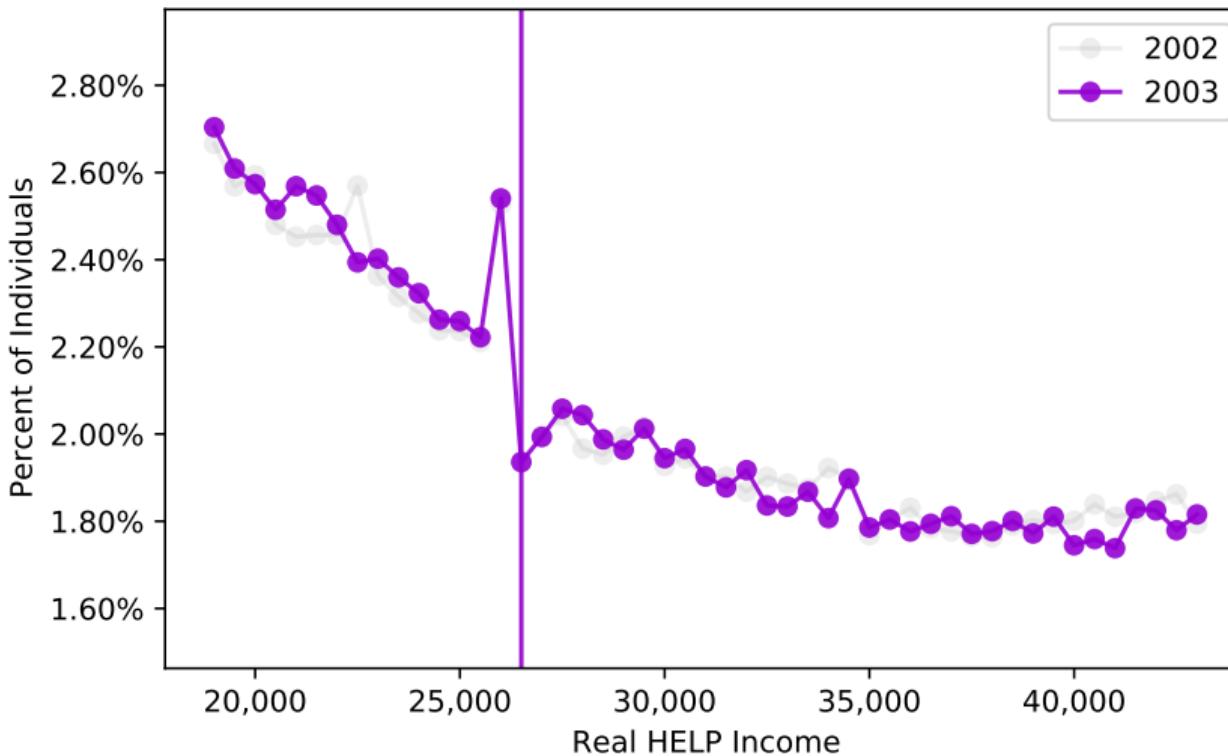
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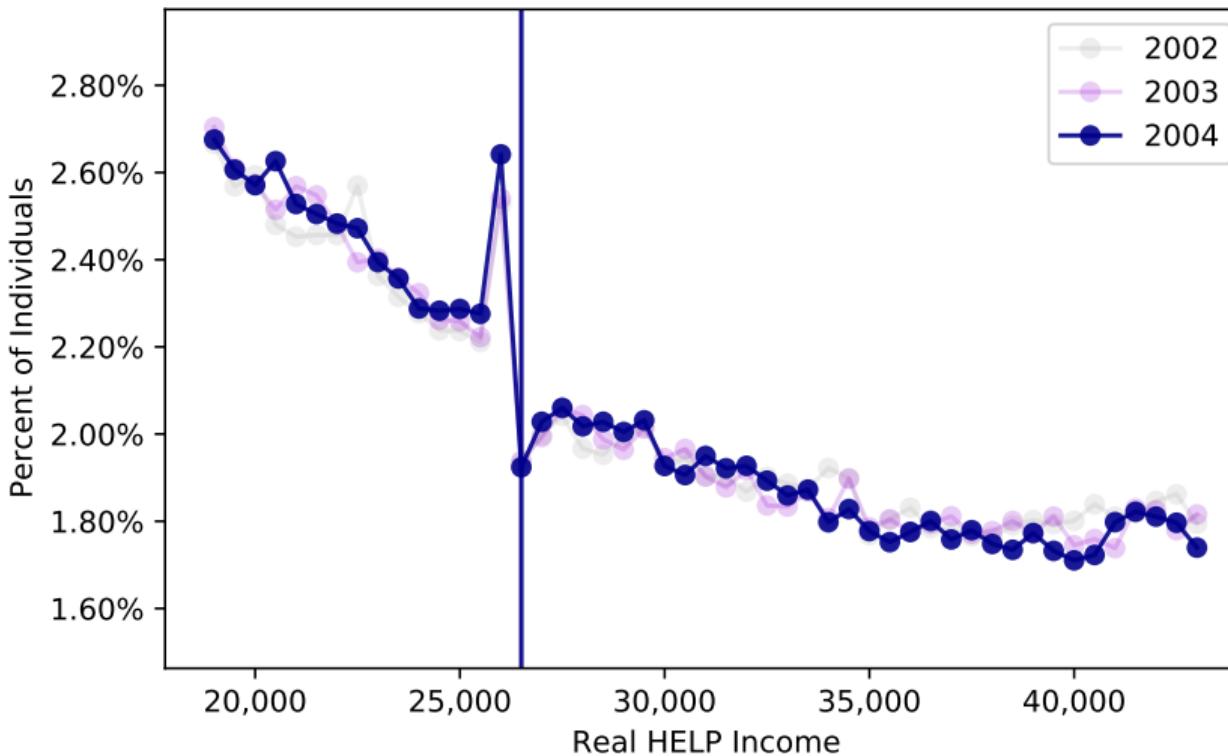
BORROWERS ADJUST INCOME TO REDUCE REPAYMENTS



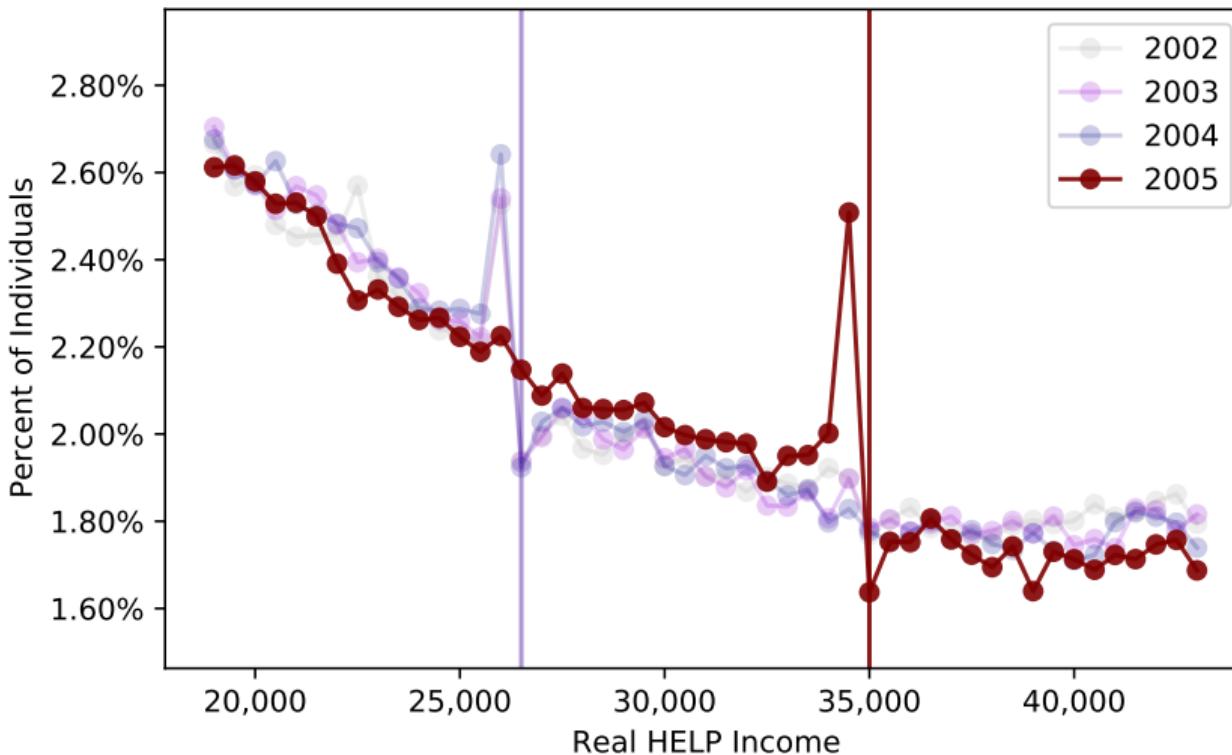
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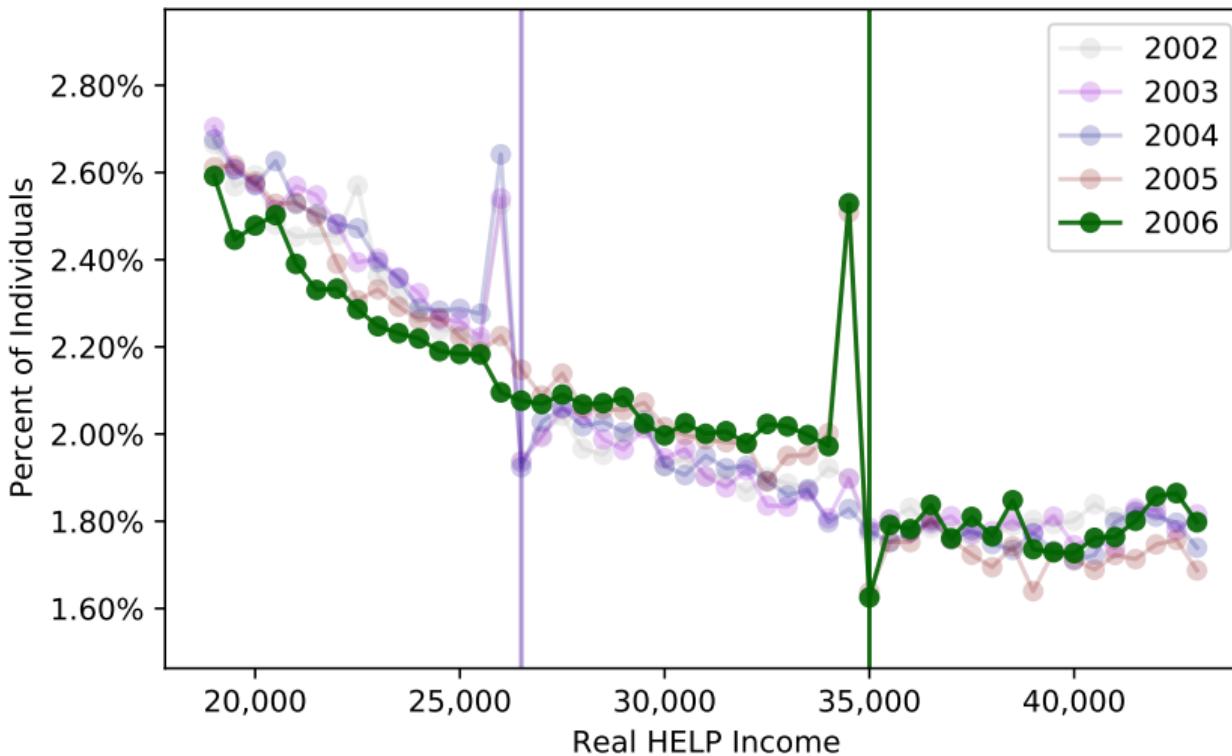
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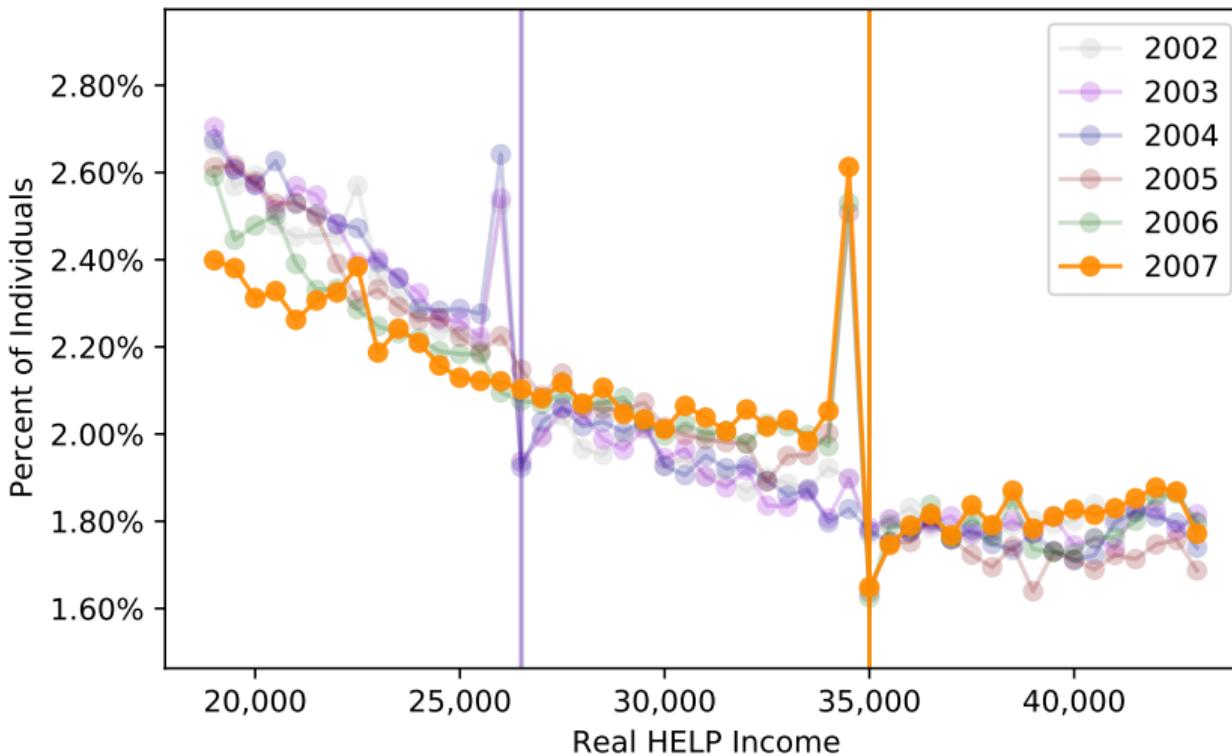
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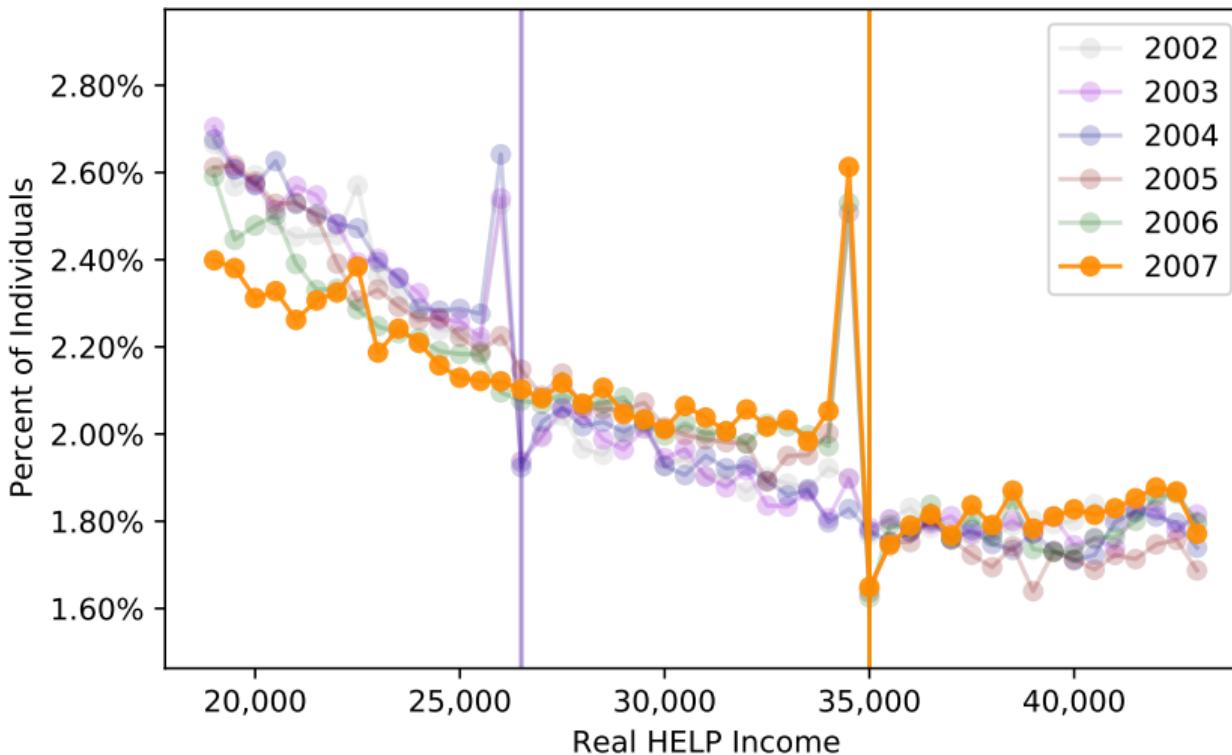
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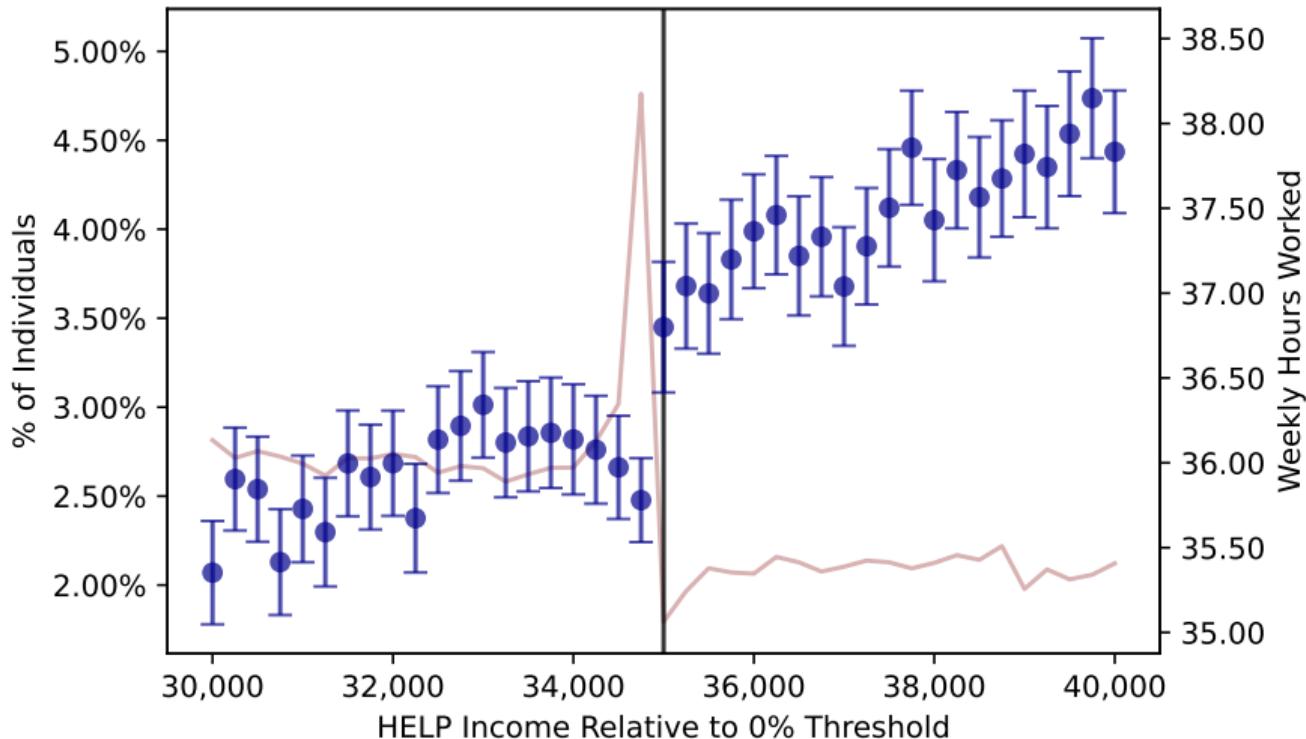


- Bunching present in labor income but not for non-debtholders

Labor

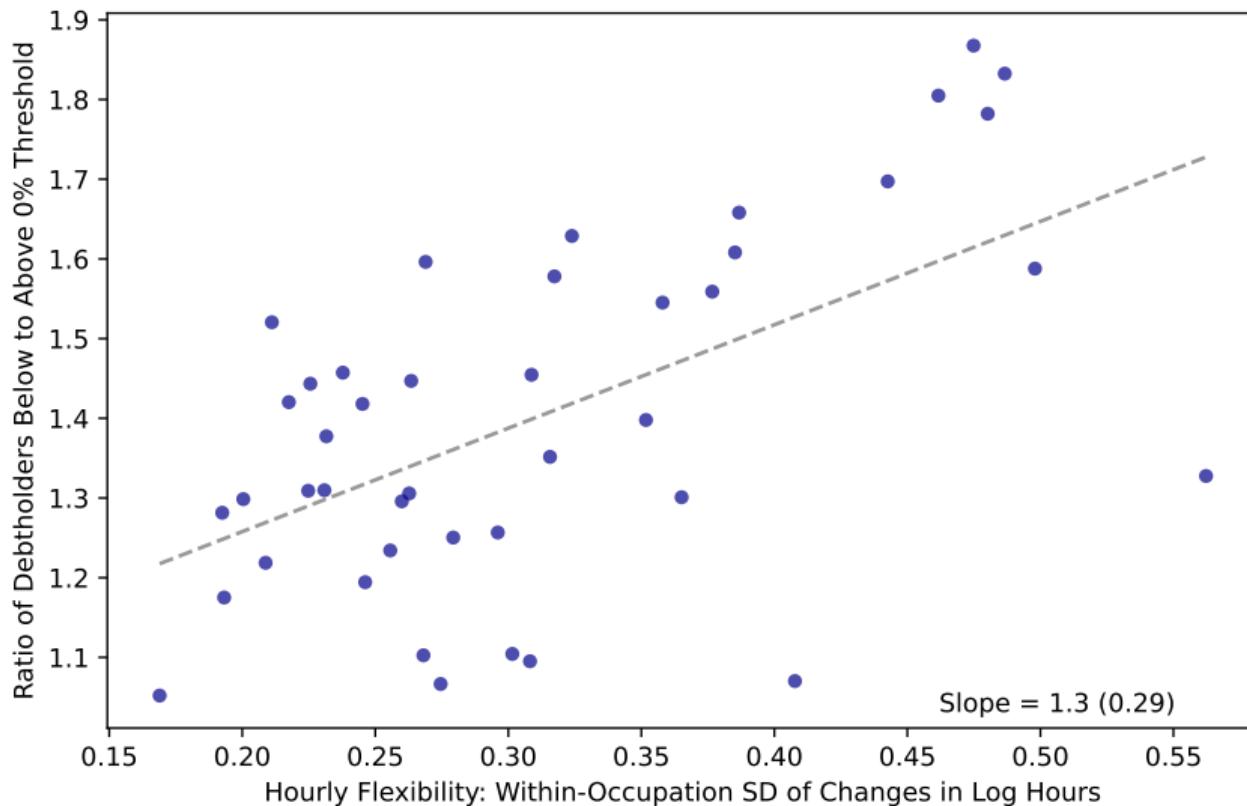
Non-Debt

BORROWERS BELOW REPAYMENT THRESHOLD WORK FEWER HOURS



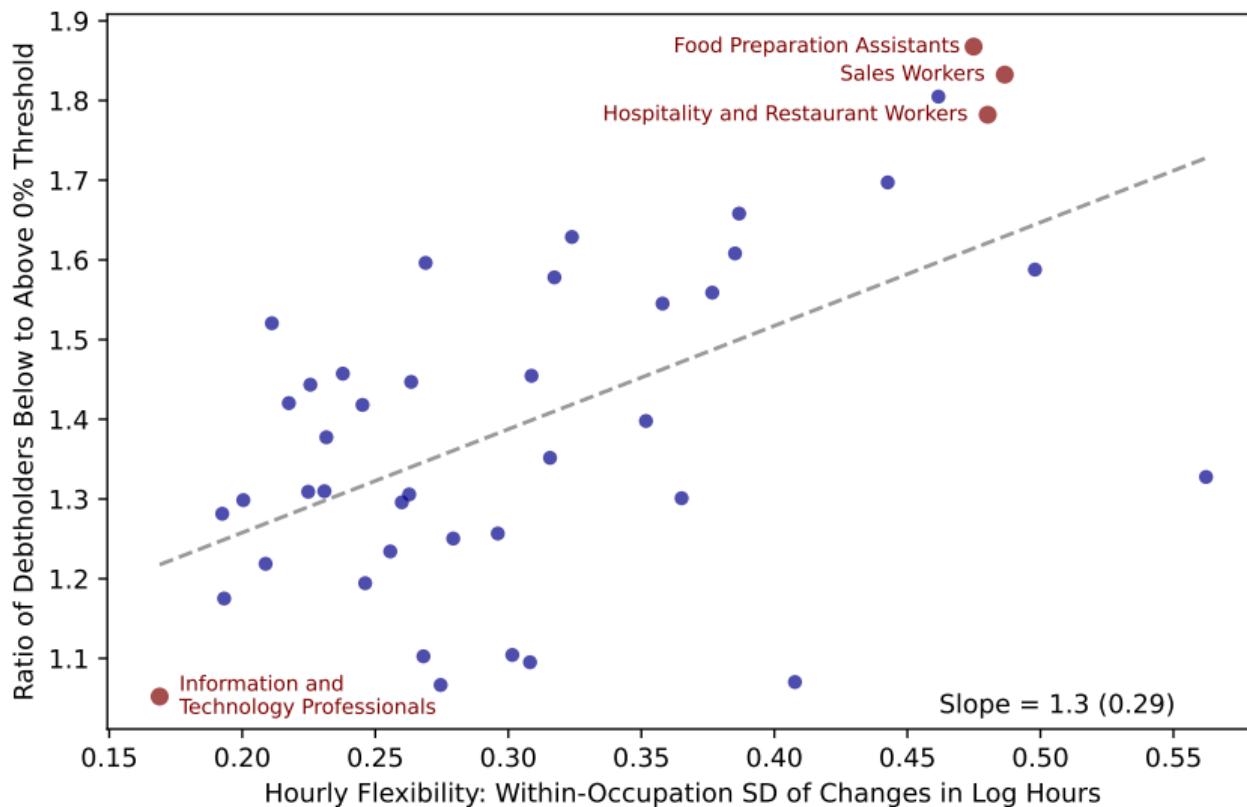
- In 2016, reduction is around **1** hour/week = 2.6% of standard workweek

MORE BUNCHING IN OCCUPATIONS WITH GREATER HOURLY FLEXIBILITY



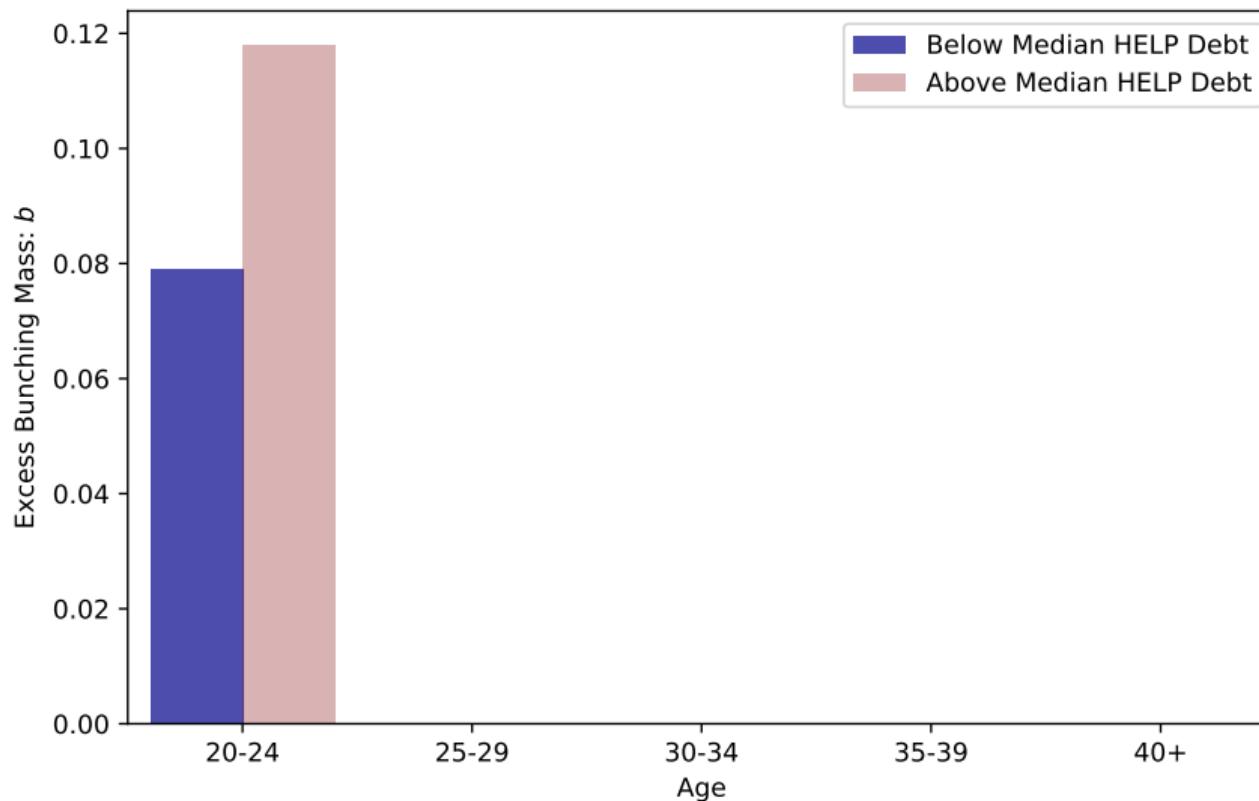
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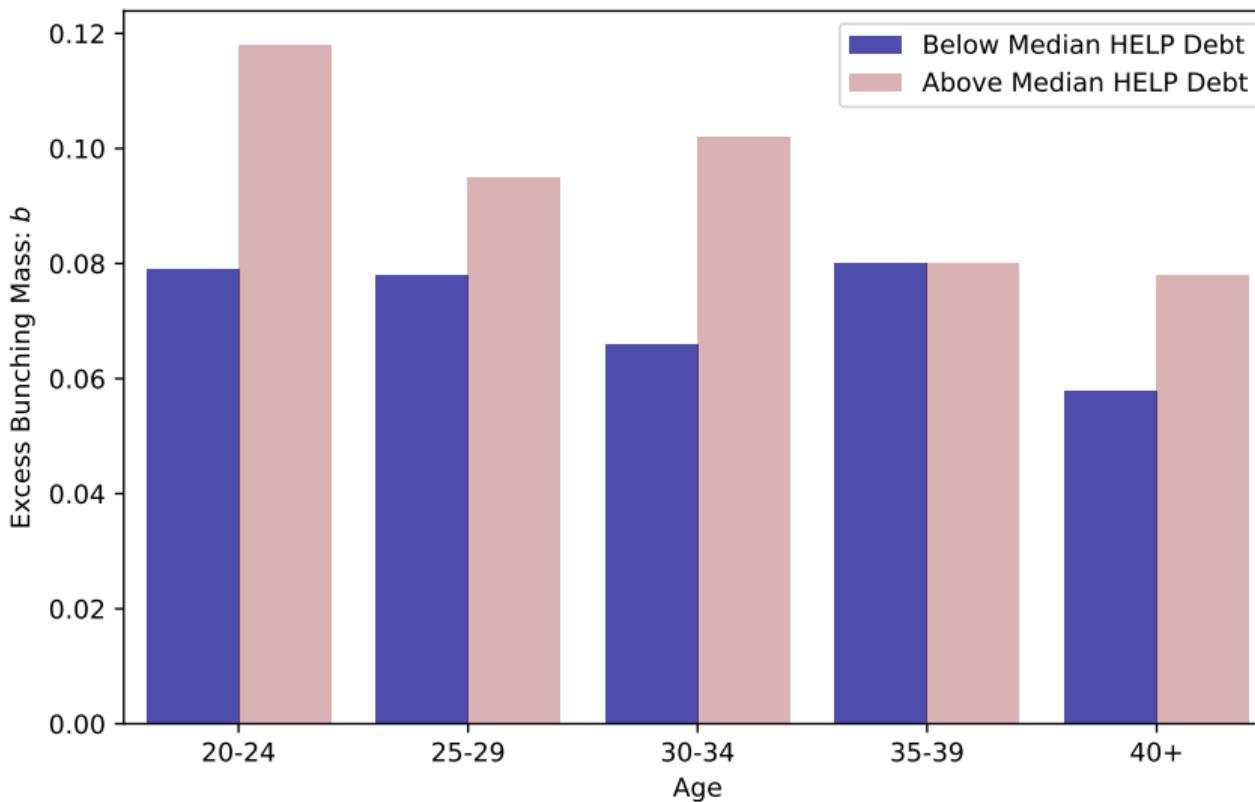
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BUNCHING INCREASES WITH DEBT



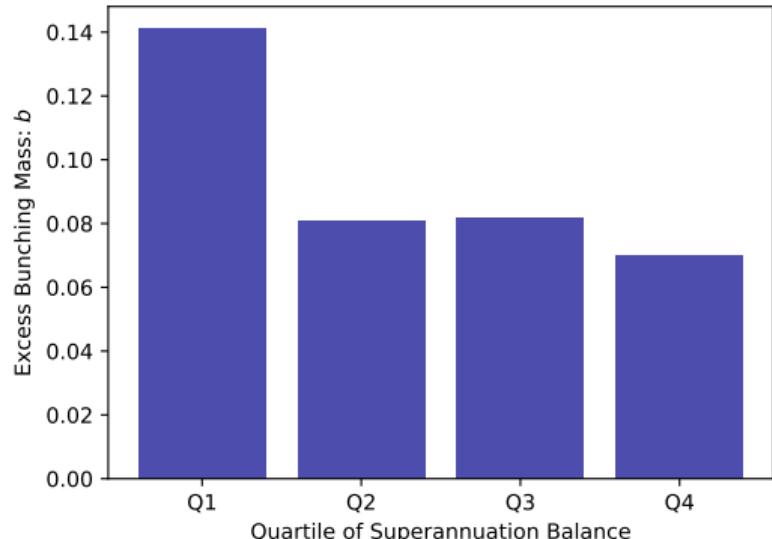
▶ *b* Details

BUNCHING INCREASES WITH DEBT AND DECREASES WITH AGE



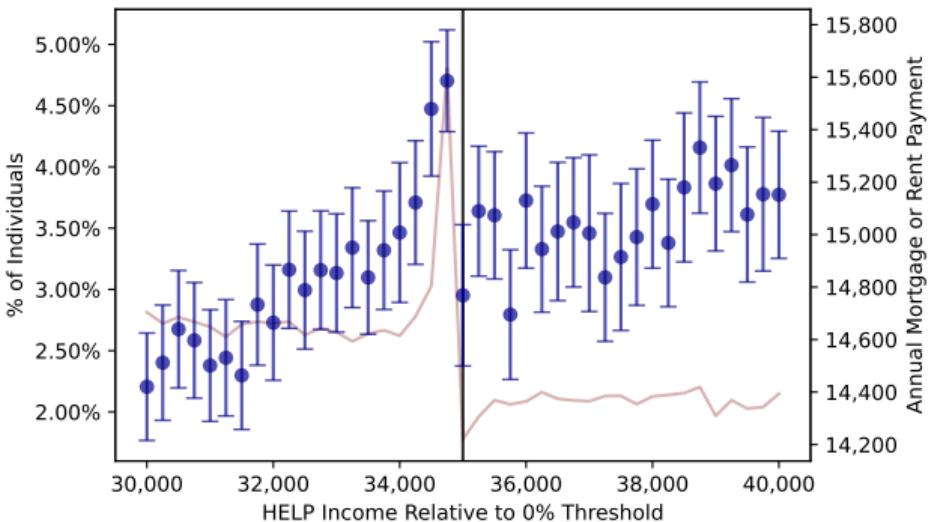
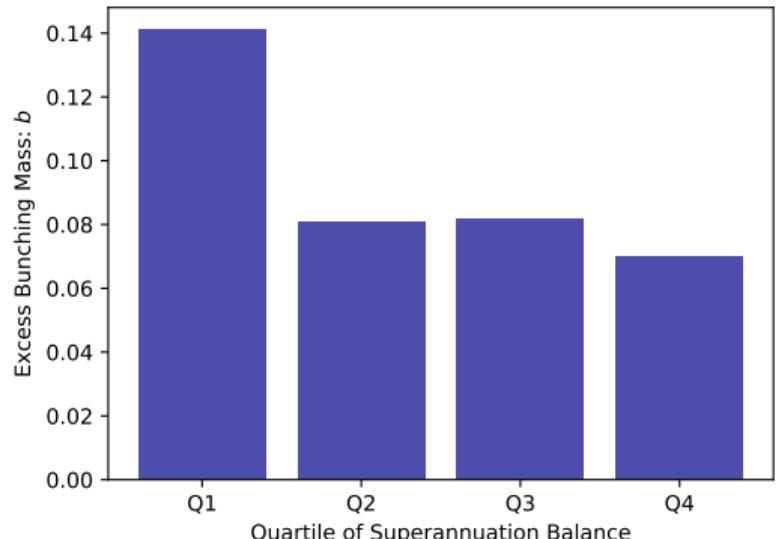
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BUNCHING INCREASES WITH PROXIES FOR LIQUIDITY-CONSTRAINTS



► House Prices ► Wage Growth

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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?

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MODEL DESCRIPTION

Life cycle model with debt + incomplete markets + endogenous labor supply
 ⇒ demand for insurance ⇒ moral hazard

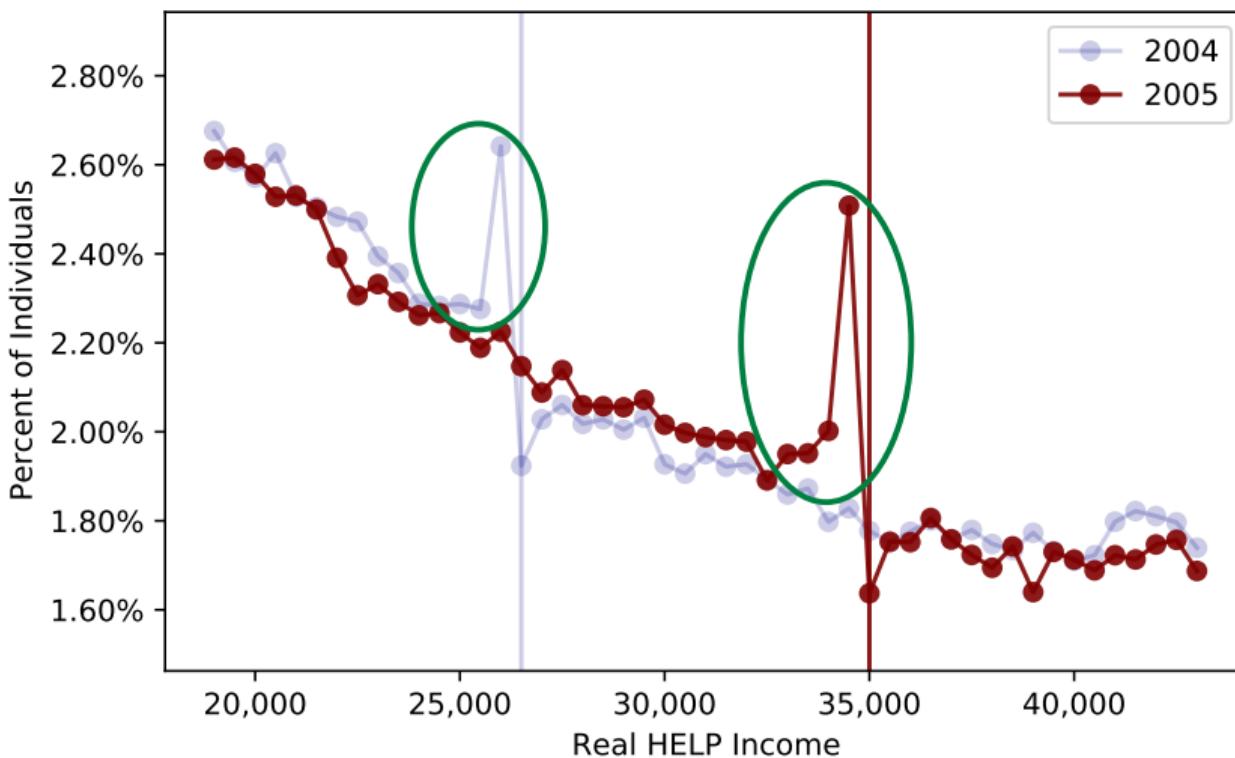
Life cycle model with debt + incomplete markets + endogenous labor supply

- 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

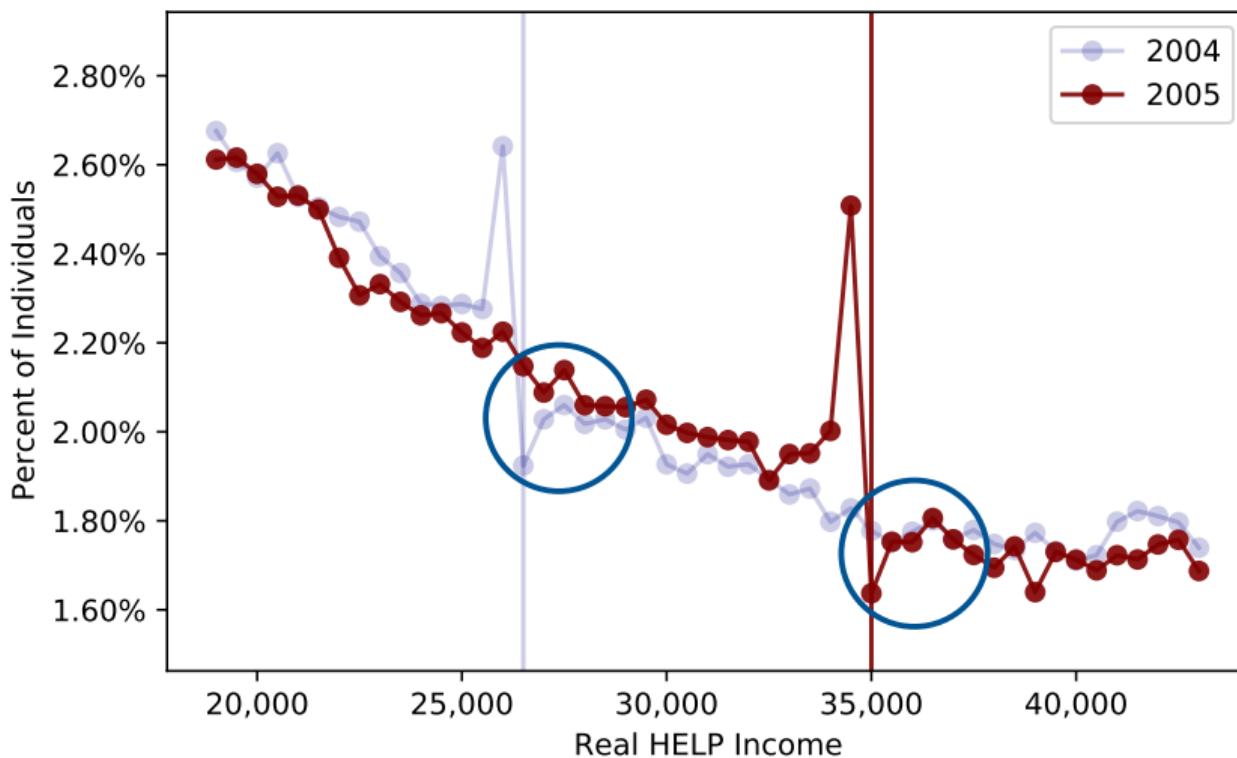
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- After age 64, individuals retire and choose consumption c_a
- **Government**
 - Revenues: progressive income taxes, debt repayments
 - Expenses: means-tested unemployment benefits & retirement pension, initial debt

BUNCHING CONSISTENT WITH POSITIVE LABOR SUPPLY ELASTICITY



MASS ABOVE THRESHOLD INCONSISTENT WITH FRICTIONLESS MODEL



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

- 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 $\ell_a = \ell_{a-1}$
 - 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 $\ell_a \neq \ell_{a-1}$
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LABOR SUPPLY OPTIMIZATION FRICTIONS

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

OPTIMIZATION PROBLEM OF INDIVIDUALS HIT BY CALVO SHOCK

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

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

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

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

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

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$$\mathbf{s}_a = (a \quad t \quad A_a \quad D_a \quad \theta_a \quad \epsilon_a \quad \ell_{a-1} \quad \omega_a)$$

OPTIMIZATION PROBLEM OF INDIVIDUALS HIT BY CALVO SHOCK

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

$$y_a = \ell_a w_a, \quad \log w_a = \textcolor{blue}{g}_a + \theta_a + \epsilon_a$$

$$\mathbf{s}_a = (\textcolor{blue}{a} \quad \textcolor{blue}{t} \quad A_a \quad D_a \quad \theta_a \quad \epsilon_a \quad \ell_{a-1} \quad \omega_a)$$

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

OPTIMIZATION PROBLEM OF INDIVIDUALS HIT BY CALVO SHOCK

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

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$$\mathbf{s}_a = (a \quad t \quad A_a \quad D_a \quad \theta_a \quad \epsilon_a \quad \ell_{a-1} \quad \omega_a)$$

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

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

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- ϵ_a = transitory shock $\sim N(0, \sigma_\epsilon^2)$ Extension: learning-by-doing

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$$\mathbf{s}_a = (a \quad t \quad A_a \quad D_a \quad \theta_a \quad \epsilon_a \quad \ell_{a-1} \quad \omega_a)$$

- 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

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$$\mathbf{s}_a = (a \quad t \quad A_a \quad D_a \quad \theta_a \quad \epsilon_a \quad \ell_{a-1} \quad \omega_a)$$

- 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

- **Interest rates and borrowing:**
 - Interest rate = 1.84%, borrowing rate = CC rate, debt interest rate = 0%
 - Borrowing limit = average CC limit 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:** $\gamma = \frac{1}{\sigma} = 2.23$ (Choukhmane-de Silva 2023)
 - Welfare analysis: consider alternative values + preference for early resolution

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 - Welfare analysis: consider alternative values + preference for early resolution
- **Learning-by-doing extension:** $\alpha = 0.24$ (median value from Best-Kleven 2013)

SECOND-STAGE SIMULATED METHOD OF MOMENTS

$$\text{Parameters} = \begin{pmatrix} & \\ & \\ & \end{pmatrix}$$

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

SECOND-STAGE SIMULATED METHOD OF MOMENTS: IDENTIFICATION

$$\text{Parameters} = \left(\begin{array}{c} \overbrace{\phi \ f \ \lambda}^{\text{labor supply}} \\ \end{array} \right)$$

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

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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

SECOND-STAGE SIMULATED METHOD OF MOMENTS: IDENTIFICATION

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

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 - **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
	ρ	0.930
Persistence 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

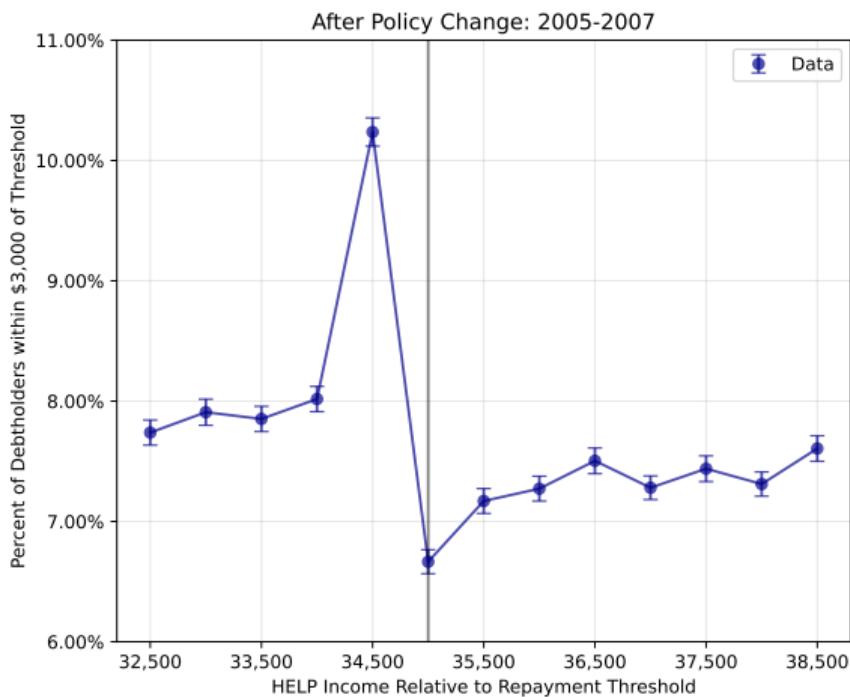
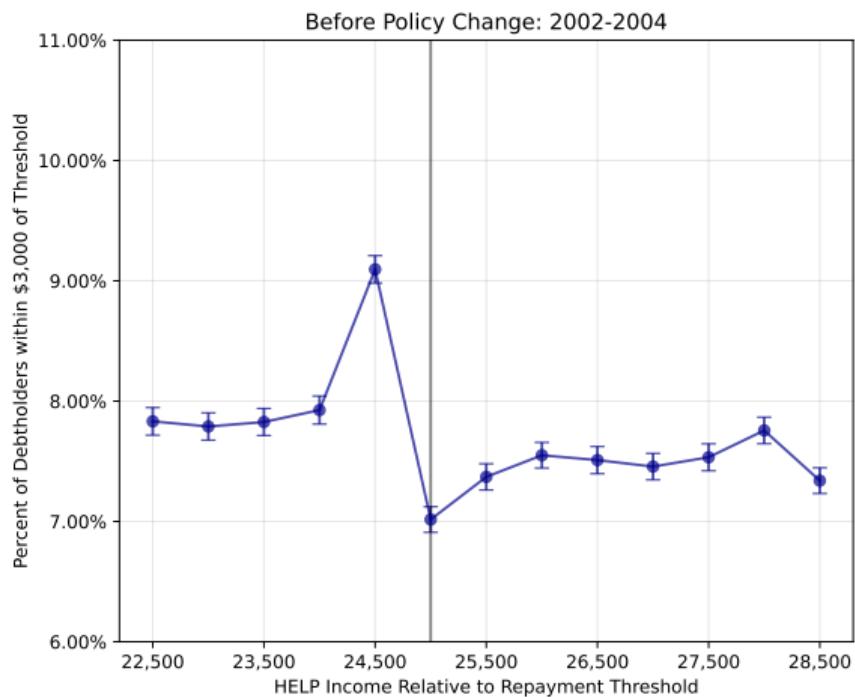
▶ Full

PARAMETER ESTIMATES

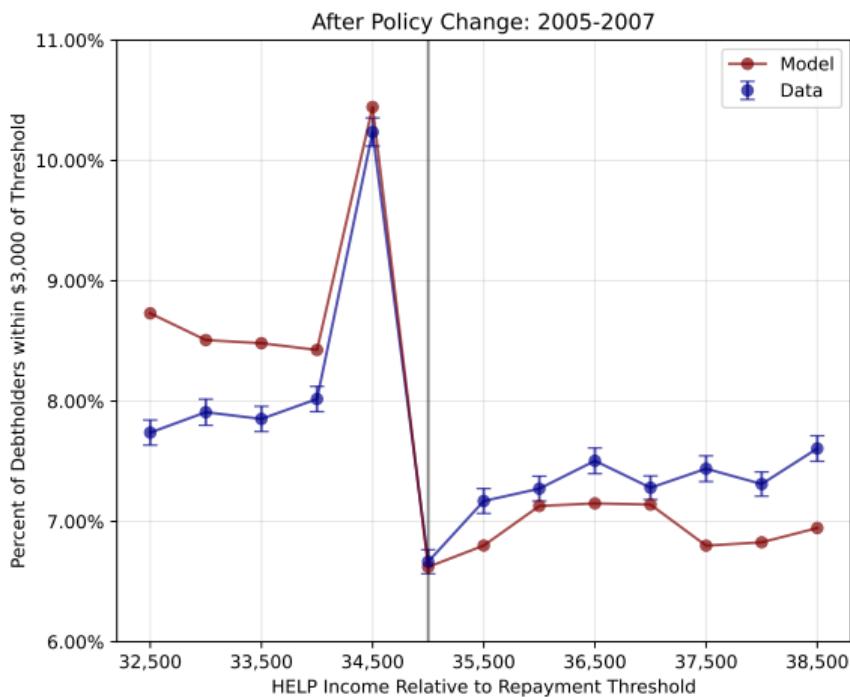
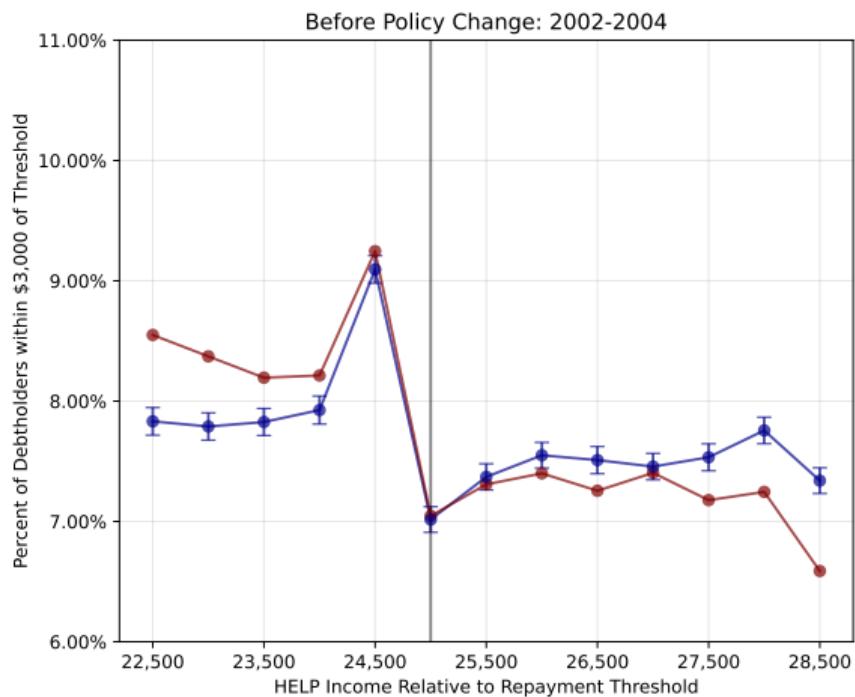
Parameter		Estimation		
		Baseline	No Frictions	LBD
Labor supply elasticity	ϕ	0.114	0.005	0.082
Fixed adjustment cost	f	\$377	.	\$762
Calvo parameter	λ	0.183	.	0.346
Labor supply scaling parameter	κ	0.560	0.030	1.242
Time discount factor	β	0.973	0.996	0.951
Wage profile parameters	δ_0	8.922	9.862	9.197
	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

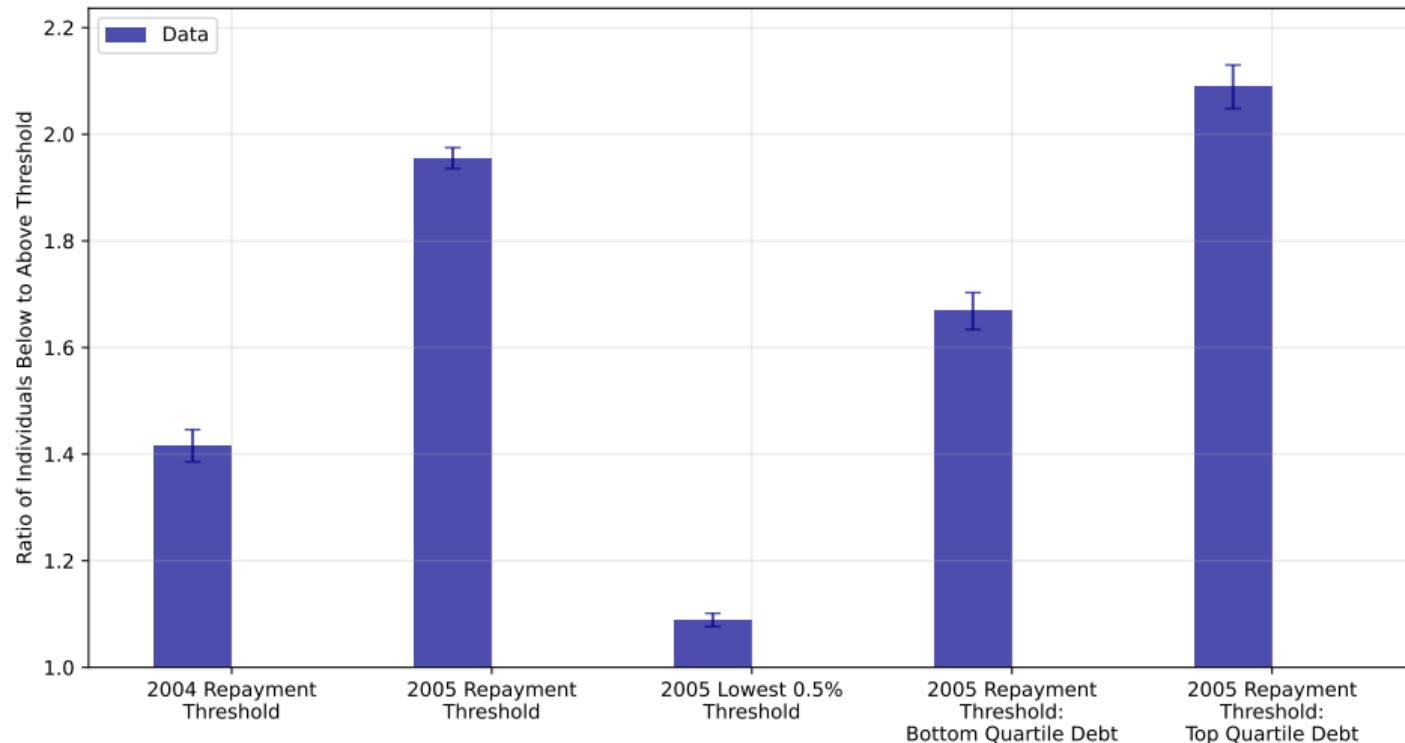
MODEL FIT: BUNCHING BEFORE AND AFTER POLICY CHANGE



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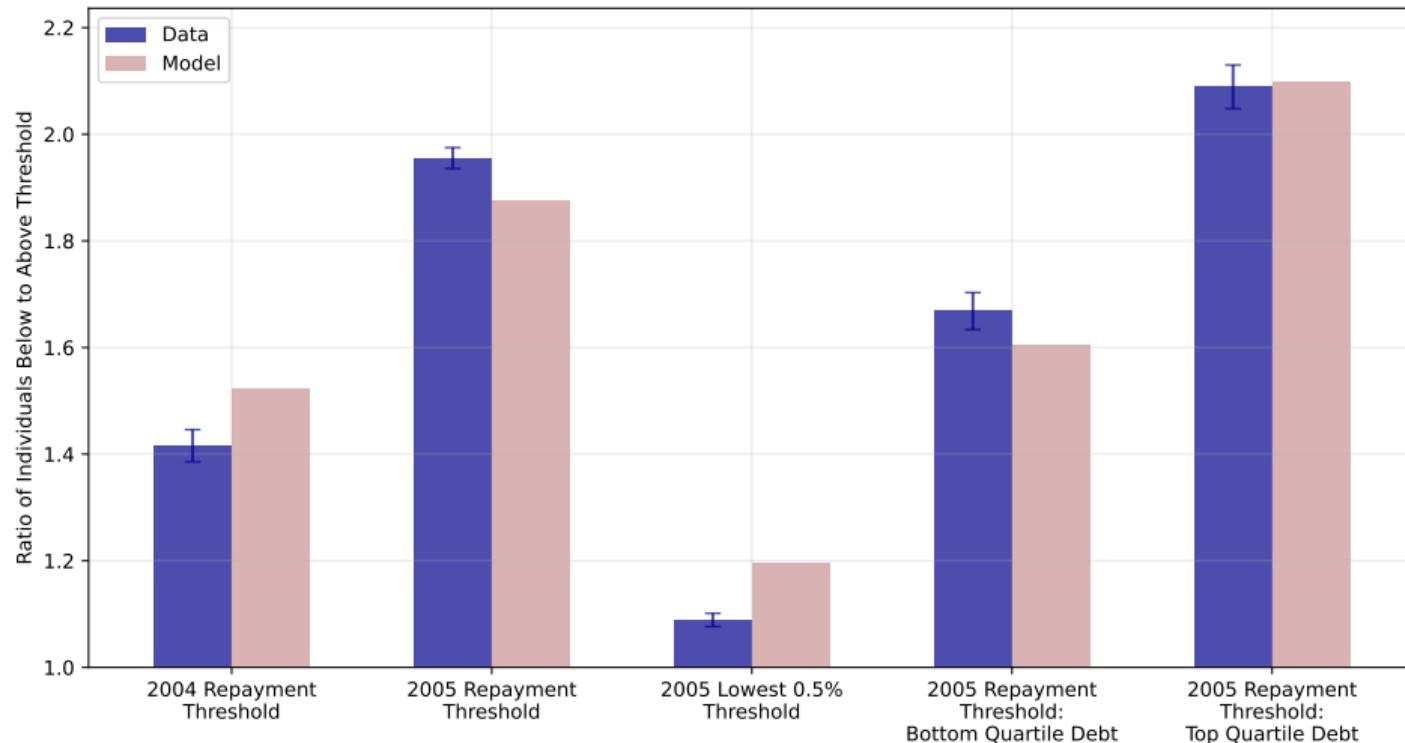


MODEL FIT: BUNCHING HETEROGENEITY



► Other Moments ► Dynamics ► Liquidity

MODEL FIT: BUNCHING HETEROGENEITY



► Other Moments

► Dynamics

► Liquidity

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

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

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- **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)

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- **Step 2: Optimal** income-contingent contracts vs. fixed repayment (budget-neutral)
- Note: consider effect of forgiveness in Step 2

GOVERNMENT BUDGET = EXPECTED DISCOUNTED VALUE OF PAYMENTS

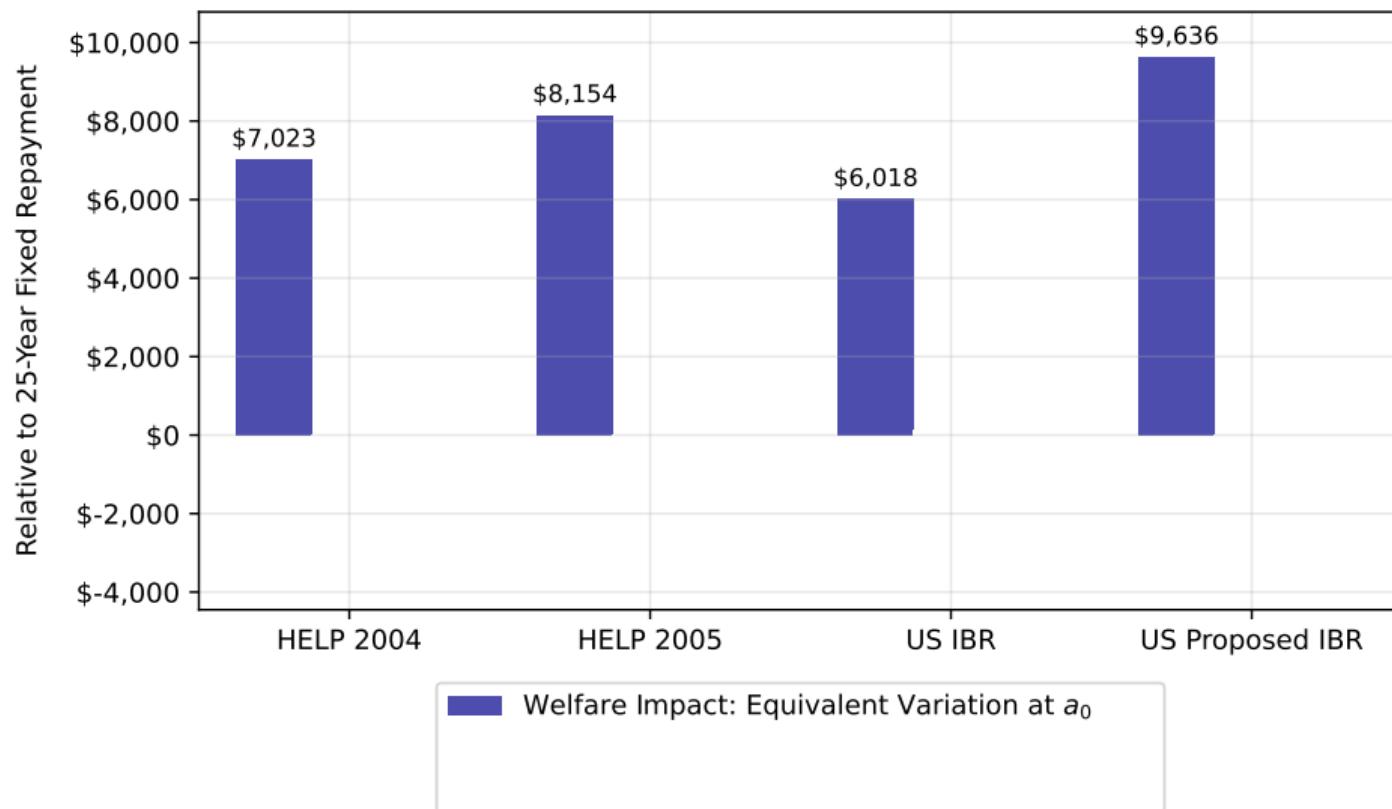
- **Government budget** defined as:

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

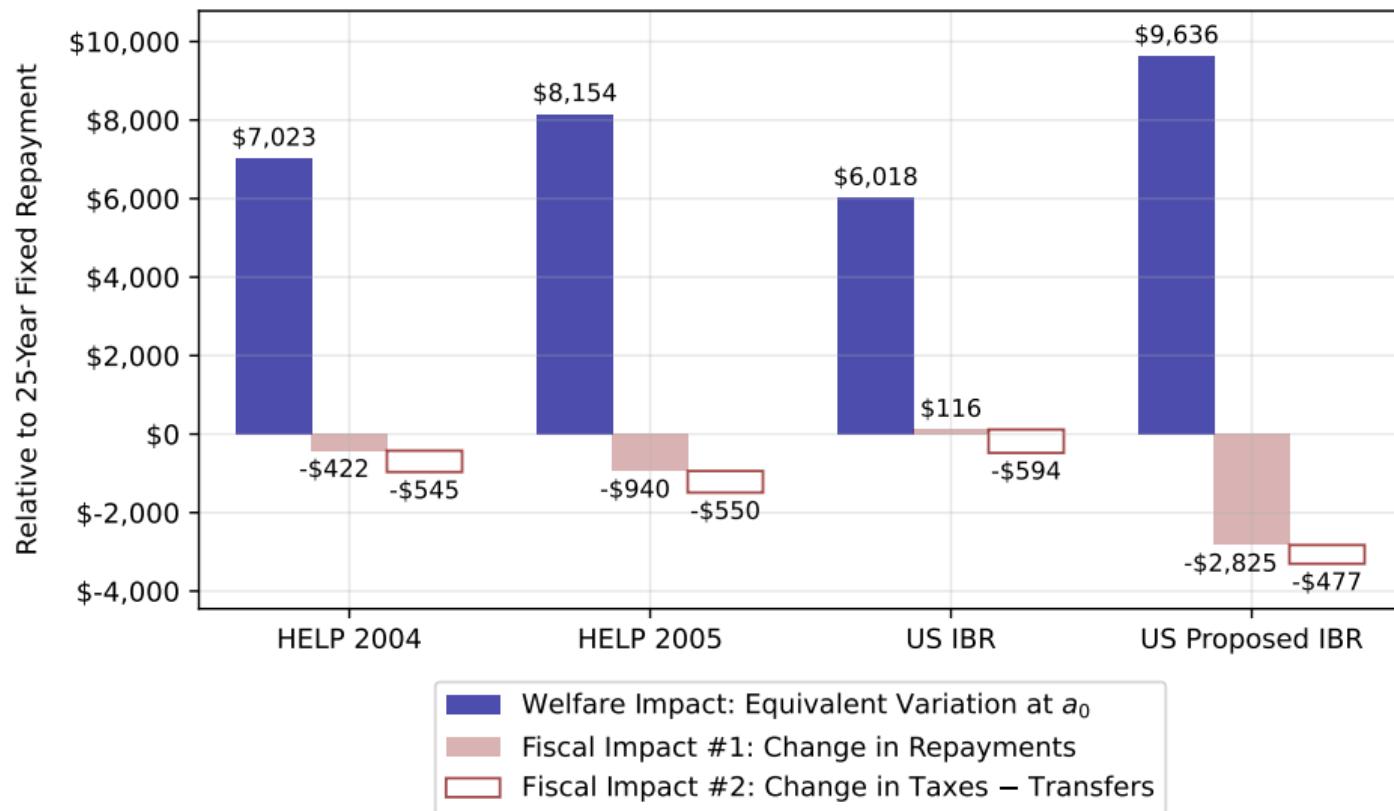
$$\mathcal{R}_a = \underbrace{\beta^{-(a-a_0)}}_{\text{individual time preference}} * \underbrace{\prod_{s=0}^{a-a_0} m_s}_{\text{mortality}}$$

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

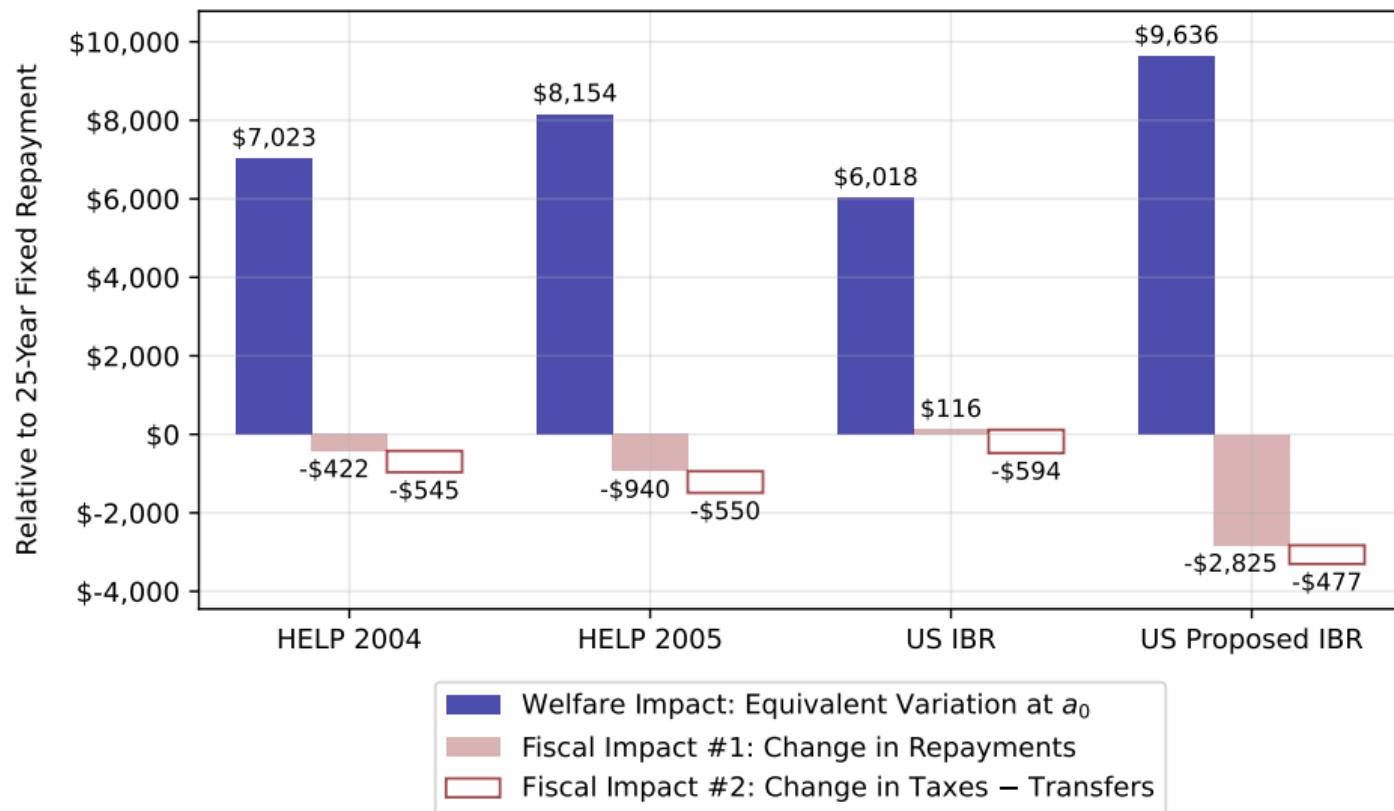
EXISTING INCOME-CONTINGENT LOANS VS. FIXED REPAYMENT



EXISTING INCOME-CONTINGENT LOANS VS. FIXED REPAYMENT



EXISTING INCOME-CONTINGENT LOANS VS. FIXED REPAYMENT



► Decomposition

► MVPF

CONSTRAINED-OPTIMAL INCOME-CONTINGENT LOANS

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

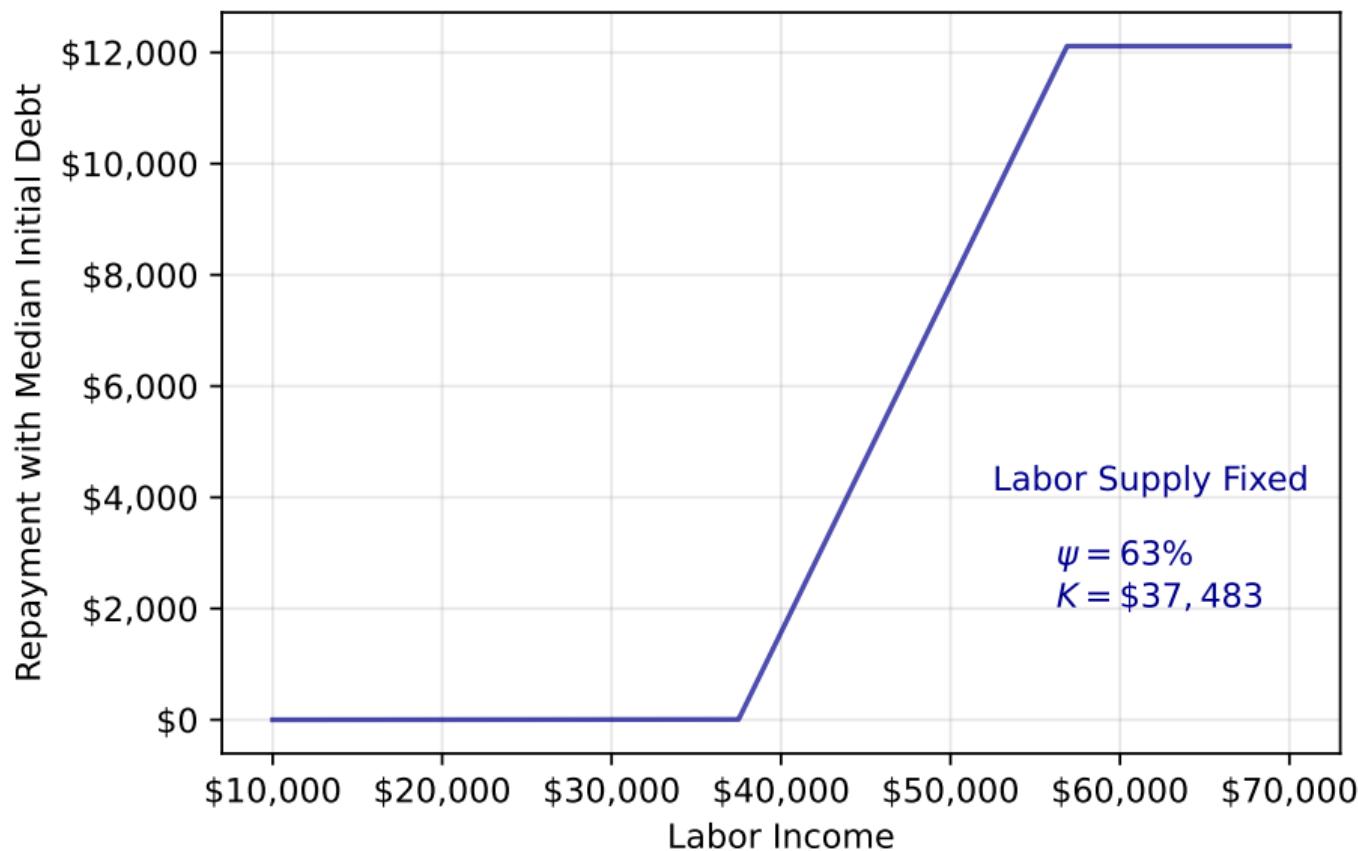
$$\max_{\psi, K} \mathbf{E}_0 \left(V_{a_0}^{1-\gamma} \right)^{\frac{1}{1-\gamma}}$$

subject to:

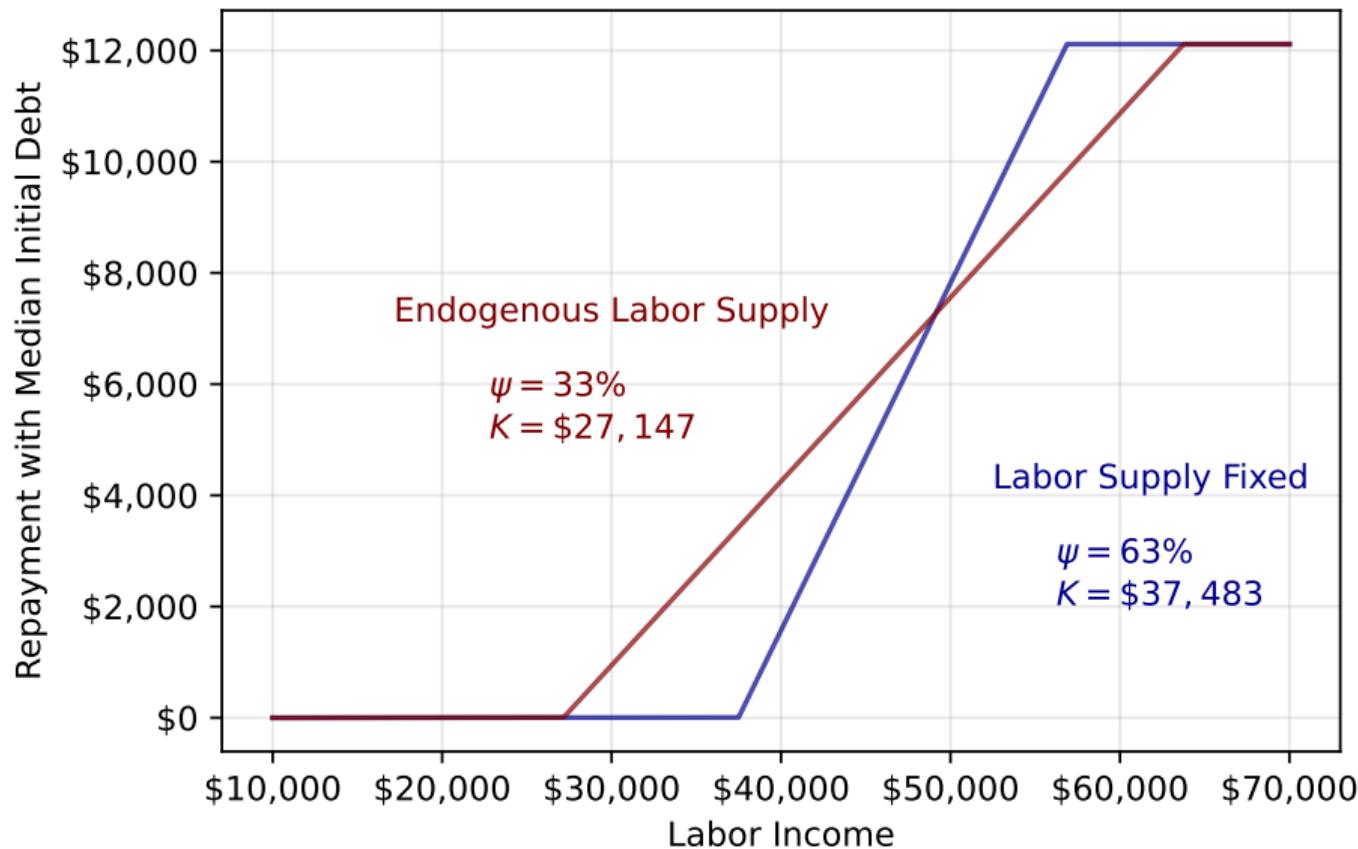
$$\mathbf{E}_0 \sum_{a=a_0}^{a_T} \frac{\text{Repayments}_a + \text{Taxes}_a - \text{Transfers}_a}{\mathcal{R}_a} \geq \mathcal{G}_{\text{25-Year Fixed}} \quad (1)$$

$$\text{Repayments}_a = \min \{ \psi * \max \{ y_a - K, 0 \}, D_a \} \quad (2)$$

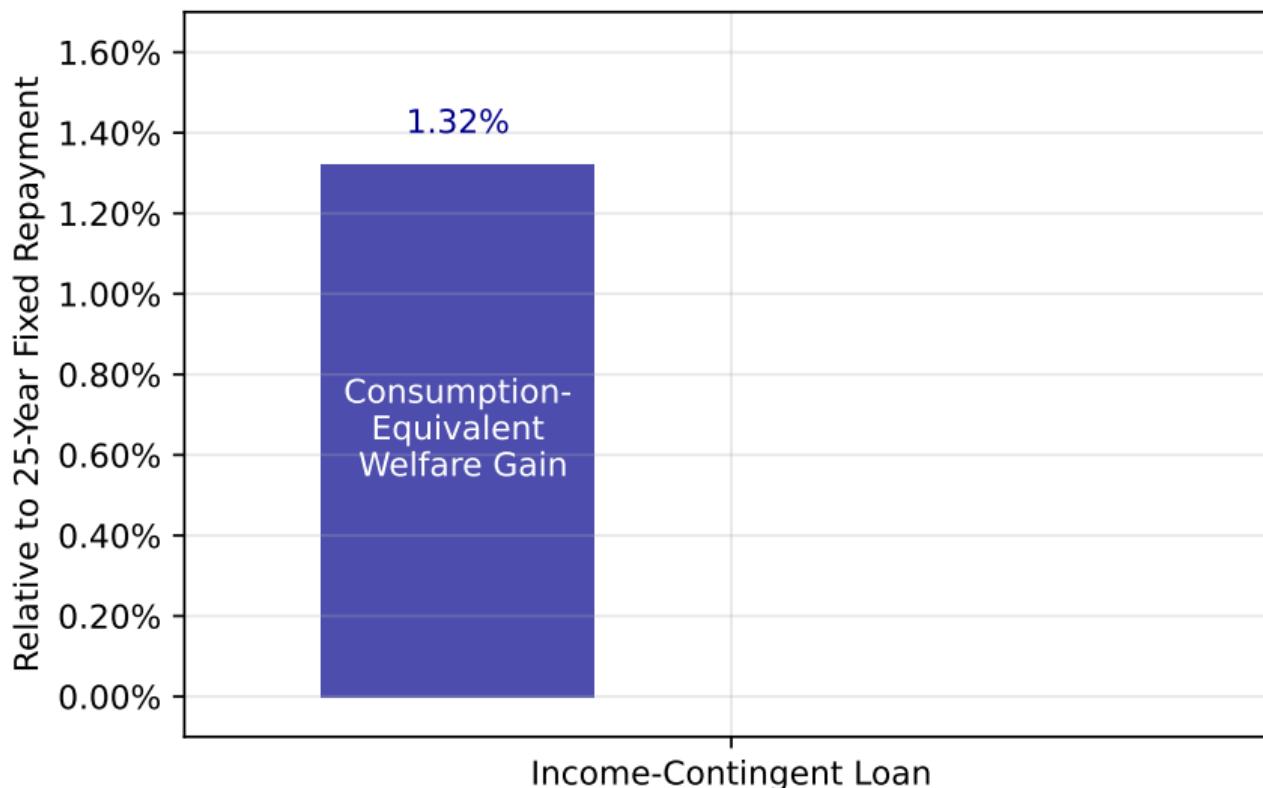
SOLUTION TO CONSTRAINED PLANNER'S PROBLEM



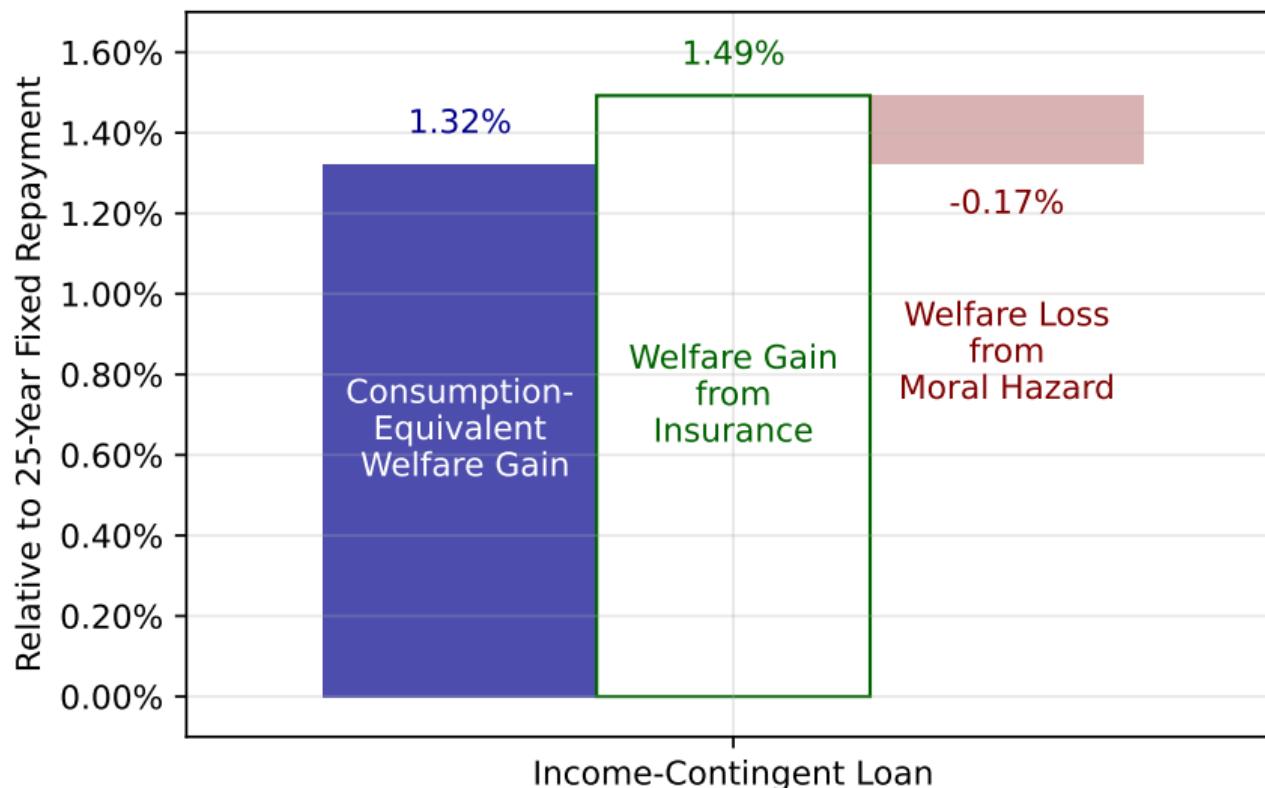
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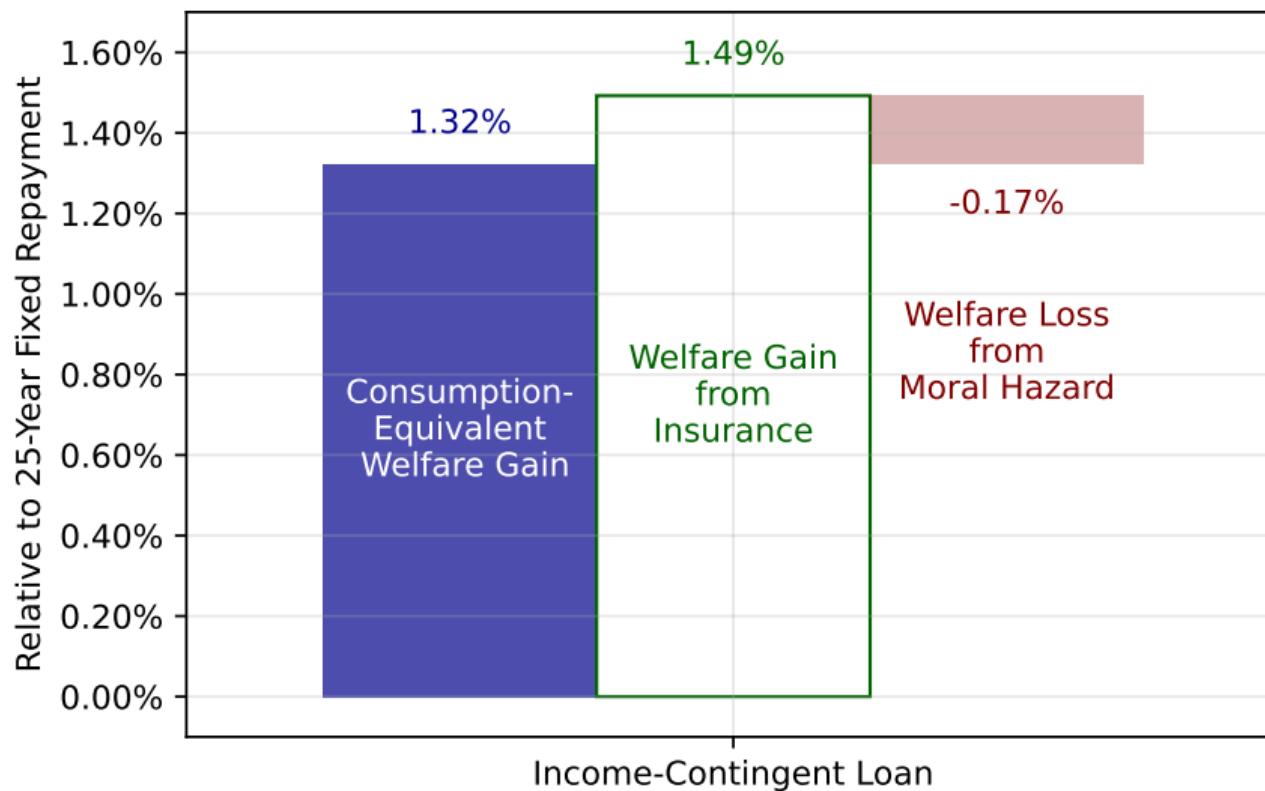
CONSTRAINED-OPTIMUM = 1.3% INCREASE IN LIFETIME CONSUMPTION



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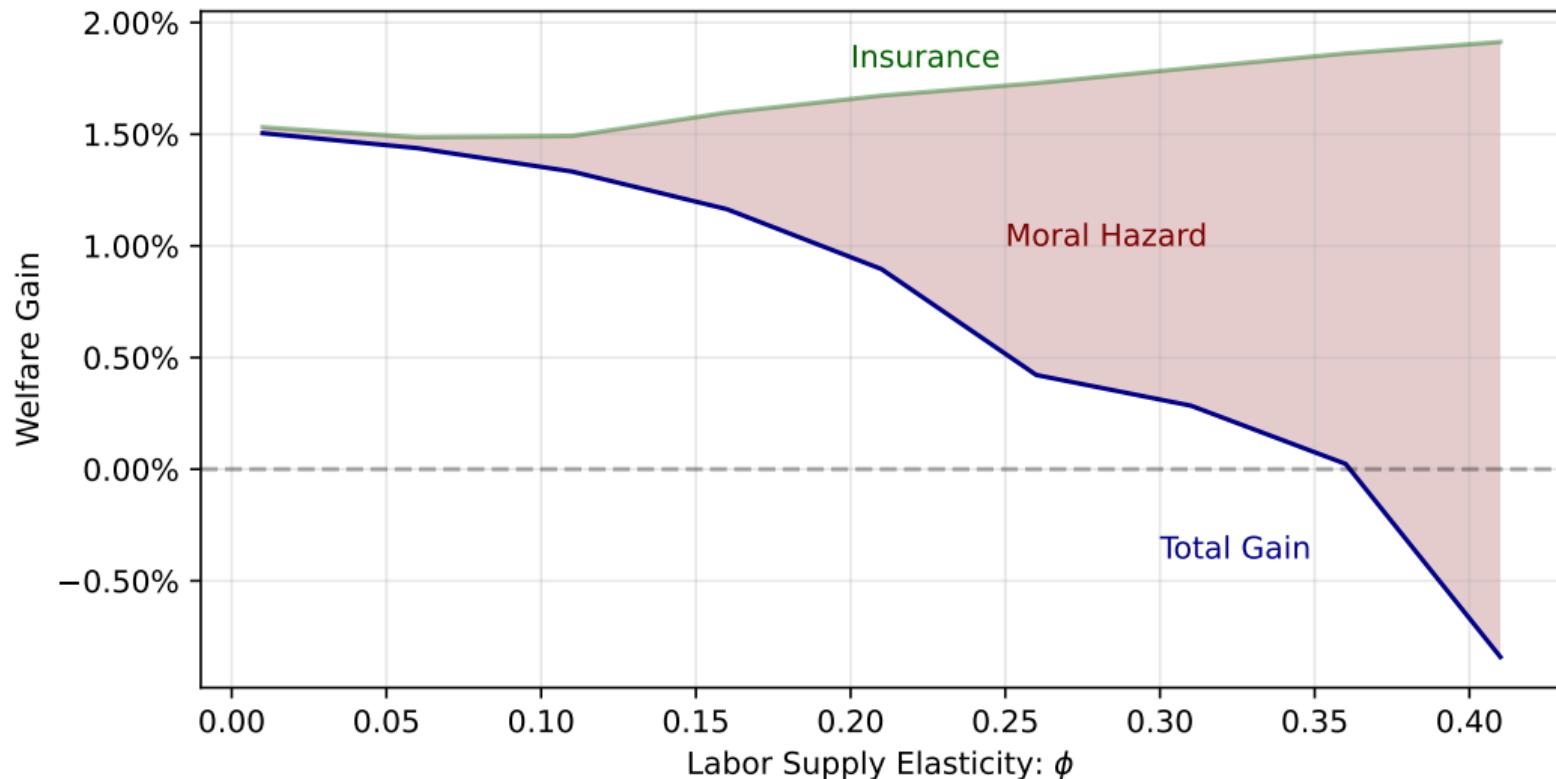


CONSTRAINED-OPTIMUM = 1.3% INCREASE IN LIFETIME CONSUMPTION



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

WELFARE GAIN IS POSITIVE AS LONG AS $\phi < 0.37$

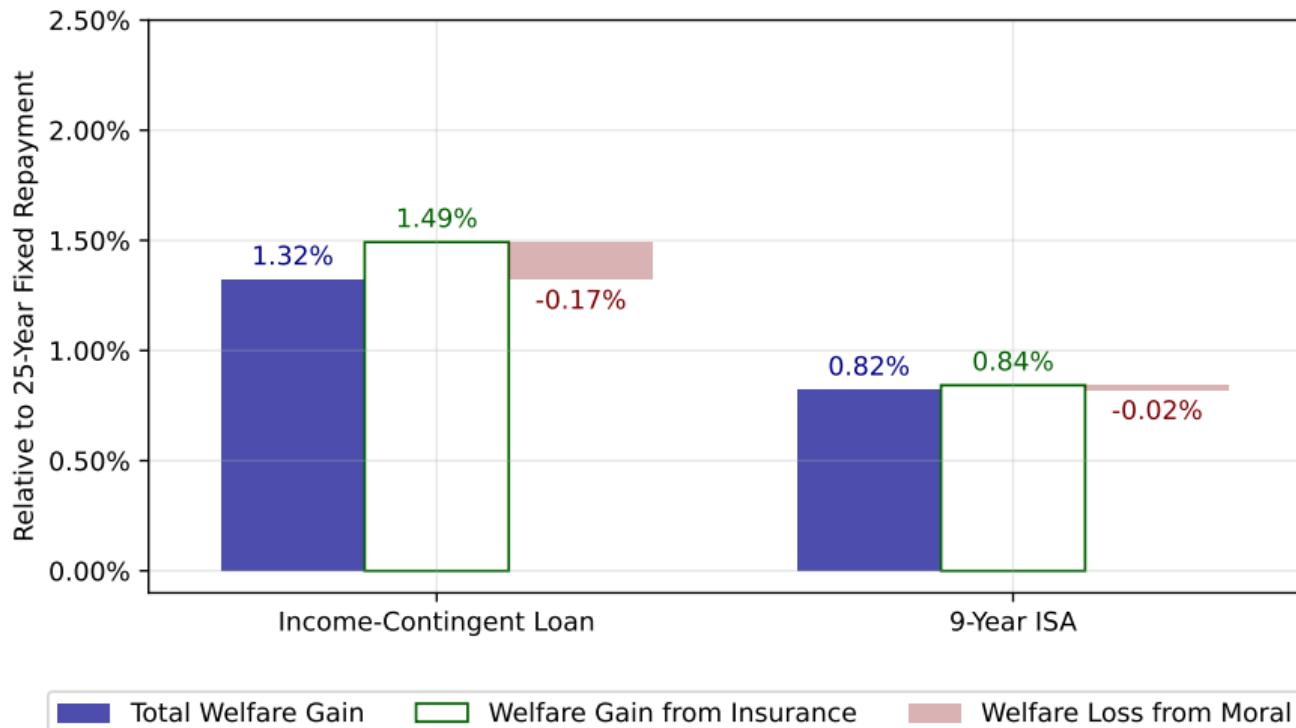


▶ Alt. Models

▶ Implied Bunching

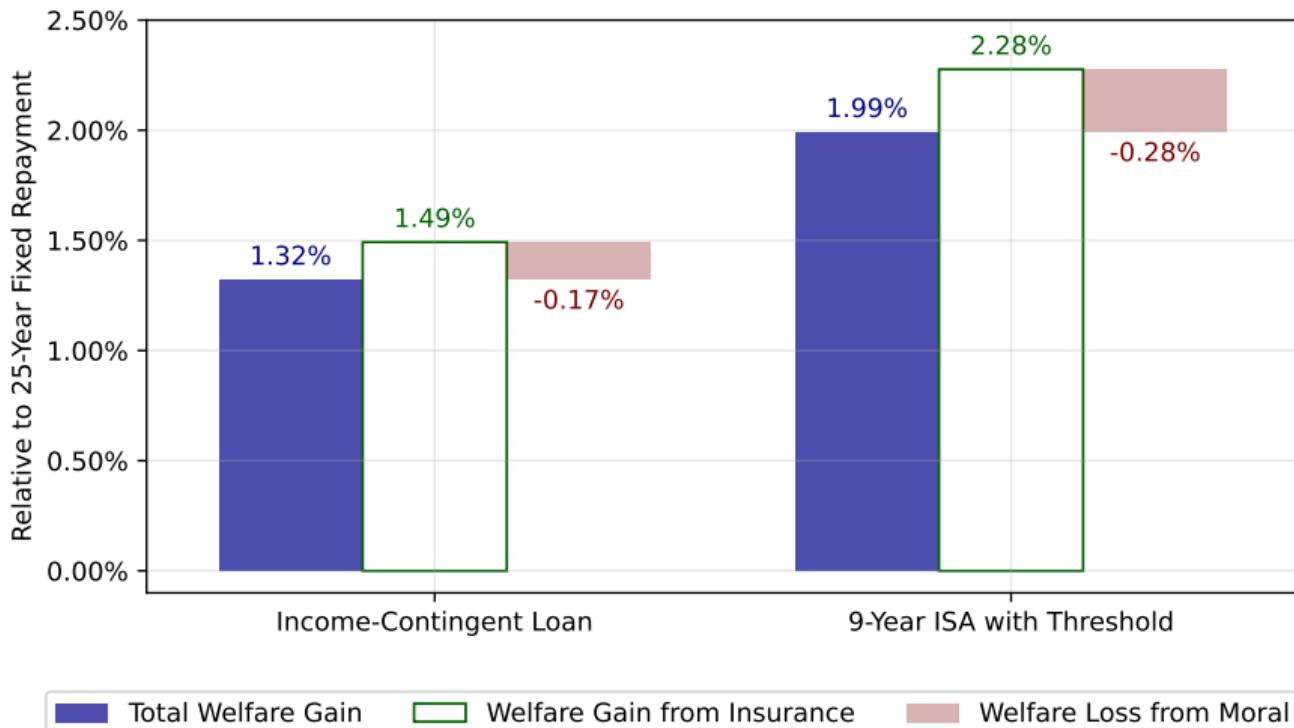
▶ Contracts to Reduce MH

PURE EQUITY CONTRACT GIVES SMALLER GAINS



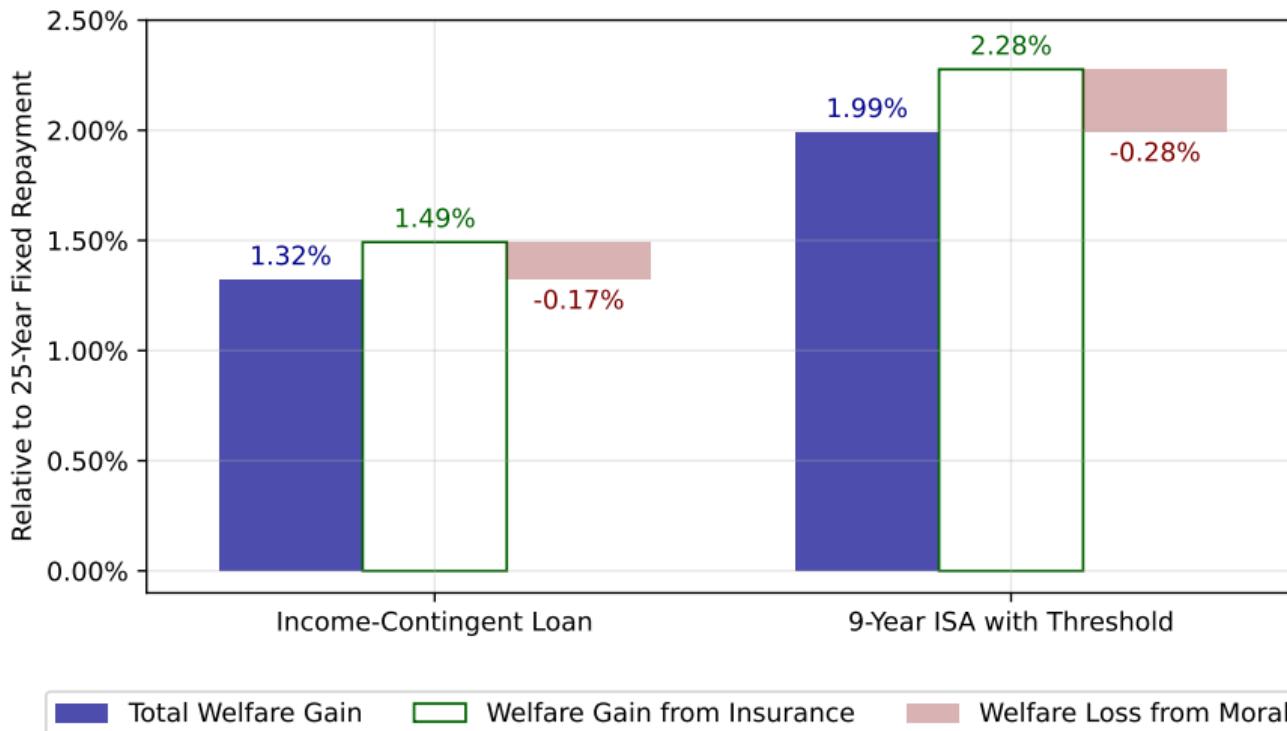
- Losses to transferring payments from (low-income) young → (high-income) old

EQUITY + THRESHOLD GIVES LARGER GAINS



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

EQUITY + THRESHOLD GIVES LARGER GAINS, BUT MORE DISPERSED



- **Cost** of ISA: gains more dispersed \Rightarrow likely to cause **ex-ante** responses

Distribution

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

SUMMARY OF RESULTS

- ① **Empirics:** borrowers adjust labor supply to ↓ 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 are small quantitatively
 - Model replicates evidence with Frisch elasticity of **0.11** & adjustment frictions
- ③ **Welfare:** gains to increasing insurance with income-contingent repayment
 - Fixed repayment → optimal income-contingent loan ⇒ ↑ **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

- US “student debt crisis”: **25%** of borrowers default within 5 years of graduation
 - Possible solution = put borrowers on income-contingent repayment (e.g., SAVE)
- **This paper:**
 - ① Ex-post moral hazard not a reason to avoid income-contingent repayment
 - ② Empirical evidence + model to calibrate effects of different contracts
- **Remaining questions:**
 - ① Should income-contingent repayment be mandated to remove selection?
 - ② Effect of income-contingent repayment on borrowing?

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 - ② Effect of income-contingent repayment on borrowing?
- **Broader question:** Is state-contingent repayment useful for other 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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WORLDWIDE INTEREST IN INCOME-CONTINGENT REPAYMENT

United States:



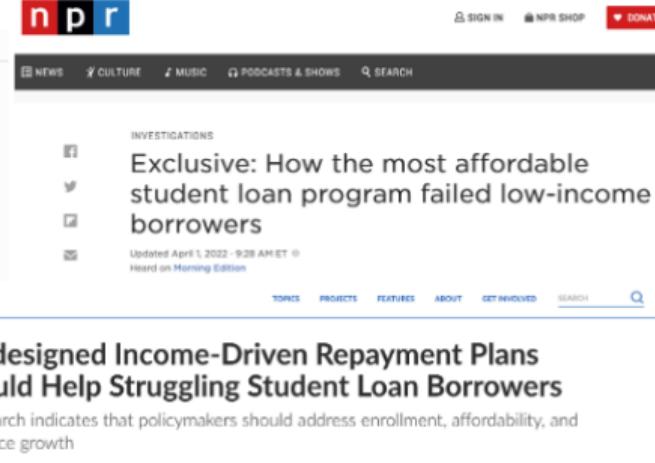
Forbes

PERSONAL FINANCE

Student Loan Forgiveness: 'We're Going To Win' Says Top Democrat, As Poll Shows Broad Support For Debt Cancellation

Student-loan payment plans that are based on income have failed borrowers — a new report revealed they're 'worse than we expected,' a top Democrat says

April 6, 2022 2:05 PM



npr

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INVESTIGATIONS

Exclusive: How the most affordable student loan program failed low-income borrowers

Updated April 1, 2022 · 9:28 AM ET
Heard on Morning Edition

TOPICS PROJECTS FEATURES ABOUT GET INVOLVED SEARCH

Redesigned Income-Driven Repayment Plans Could Help Struggling Student Loan Borrowers

Research indicates that policymakers should address enrollment, affordability, and balance growth

REPORT | February 8, 2022 | Read time: 63 min

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WORLDWIDE INTEREST IN INCOME-CONTINGENT REPAYMENT

United Kingdom:

News Opinion Sport Culture Lifestyle

Education ► Schools Teachers Universities Students

Students

Student loan changes in England will cost middle earners £30k, analysis says

IFS says from 2023, expected future earnings will be crucial in deciding whether to take gap year

Richard Adams
Education editor

Sat 9 Apr 2022 00.34
AEST

[f](#) [t](#) [e](#)



Australia:

News Opinion Sport Culture Lifestyle

Australia Coronavirus World AU politics Environment Football Indigenous Australia Immigration Media E

Australian education

Hecs debt repayment changes: why more people will be forced to pay off student loans

The income threshold for repaying university fees has dropped to just \$45,881. Here's what you need to know

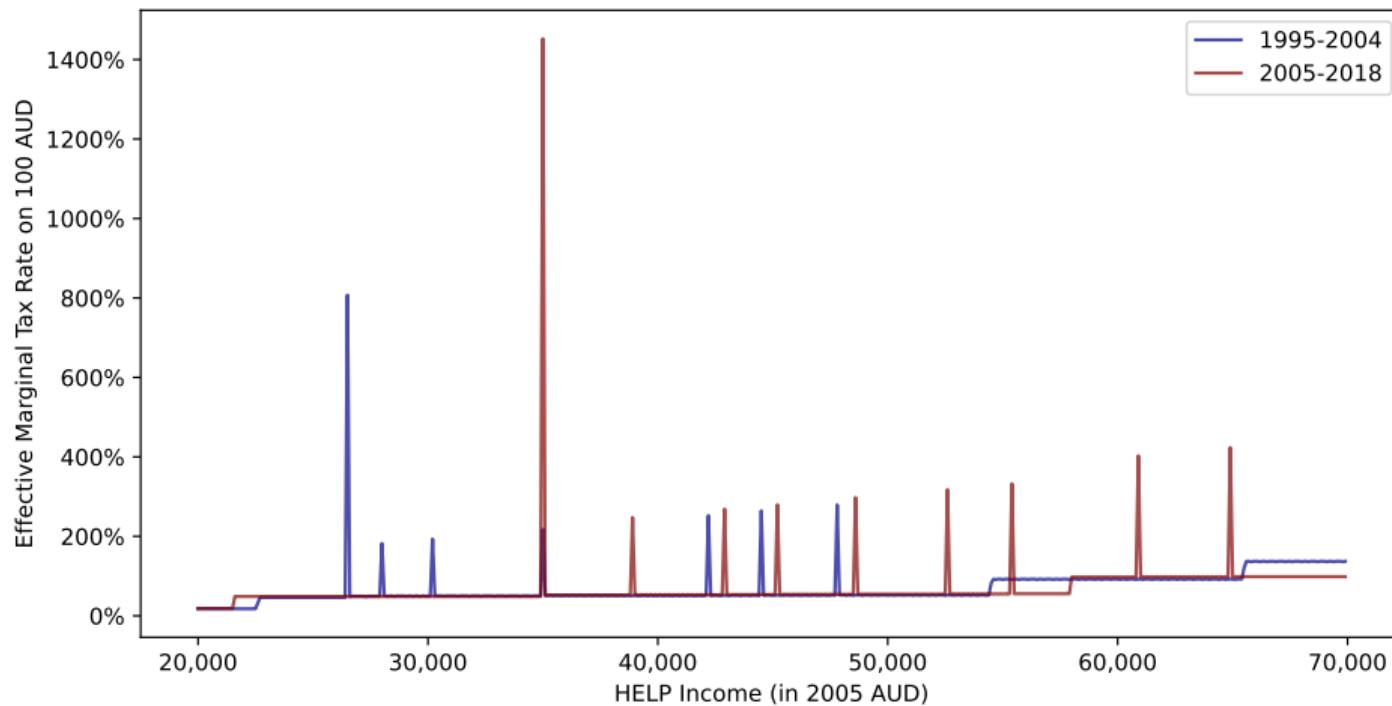
Naaman Zhou
@naamanzhou
Wed 3 Jul 2019 12.44
AEST

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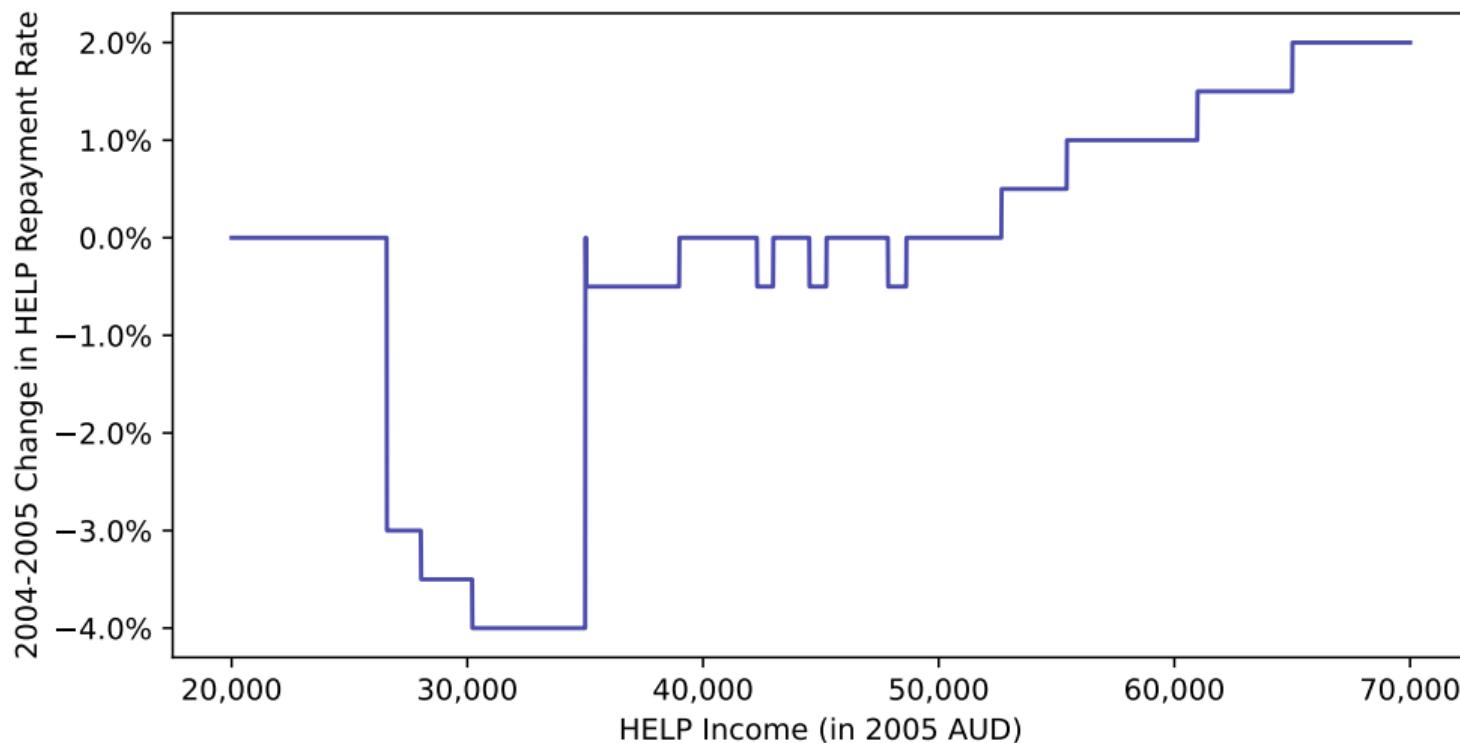
MARGINAL REPAYMENT RATES ON 100 AUD



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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Politics

Print article

Ease HECS burden on students, say universities

Kate Marshall

Jan 9, 2003 – 11.00am



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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.

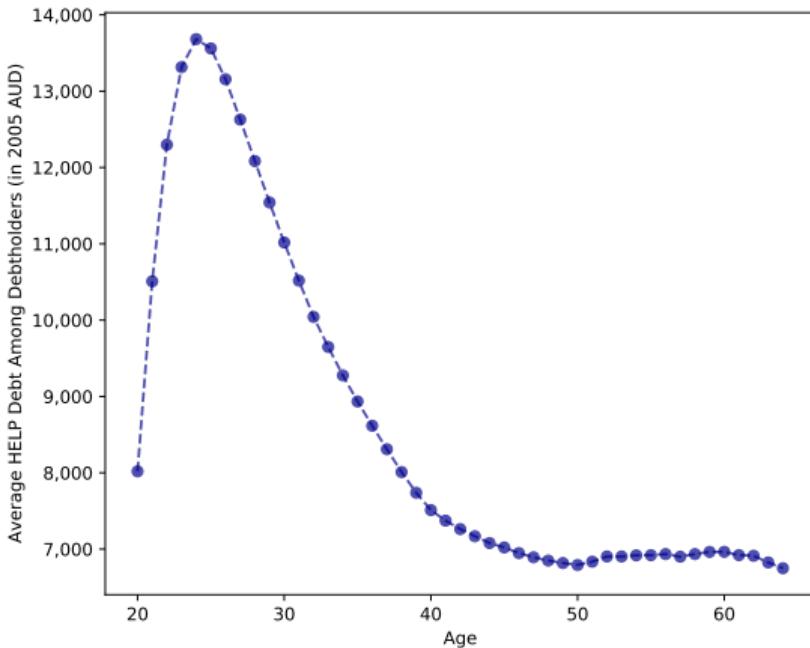
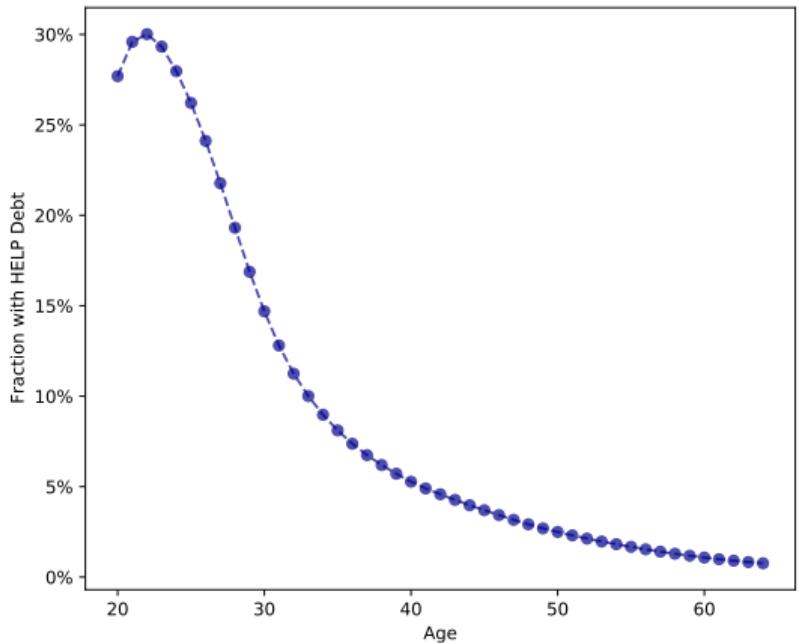
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SUMMARY STATISTICS

	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 < 2004 0% Threshold	0.50	0.65	0.51
HELP Income < 2005 0% Threshold	0.37	0.51	0.35
HELP Income < 2006 0% Threshold	0.52	0.67	0.55
Number of Observations	247,118,713	27,316,037	1,701,464

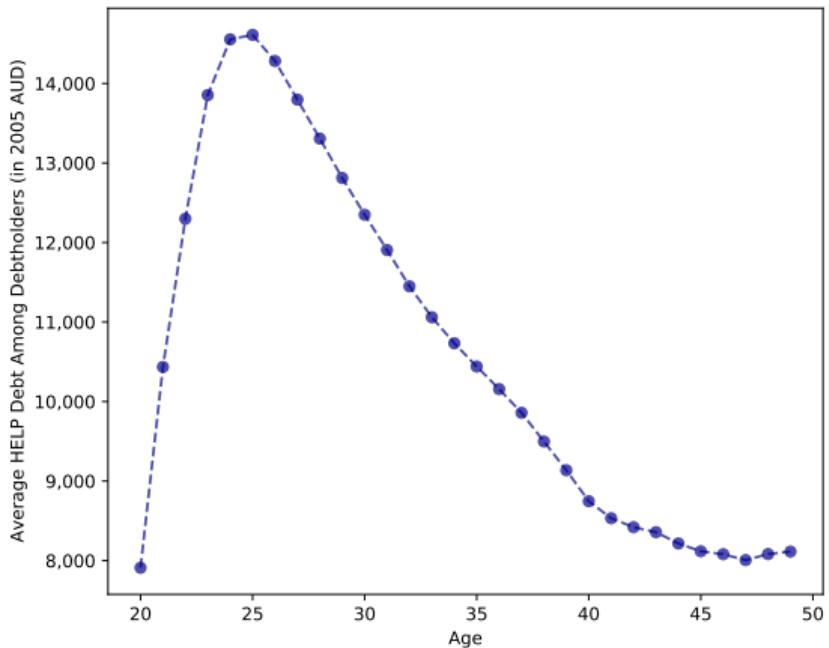
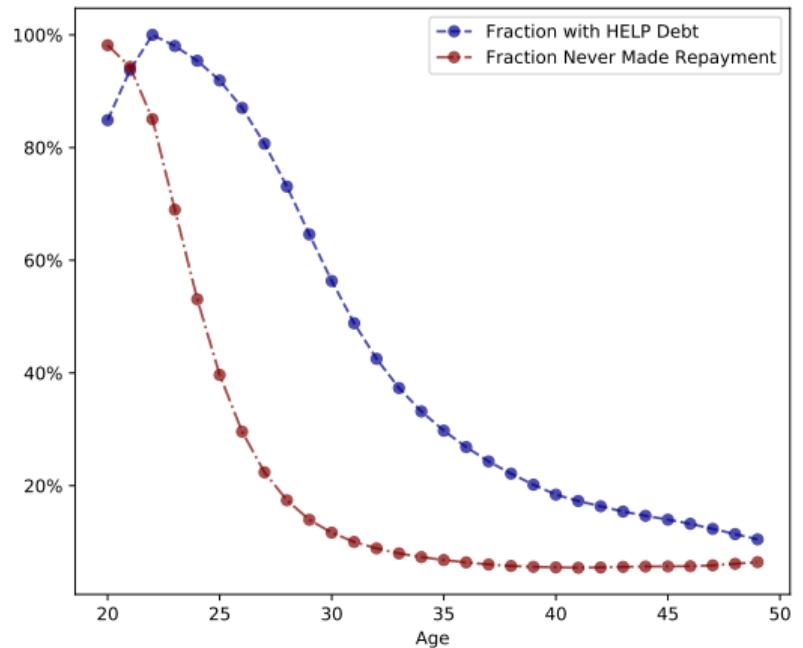
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DEBT BALANCES BY AGE



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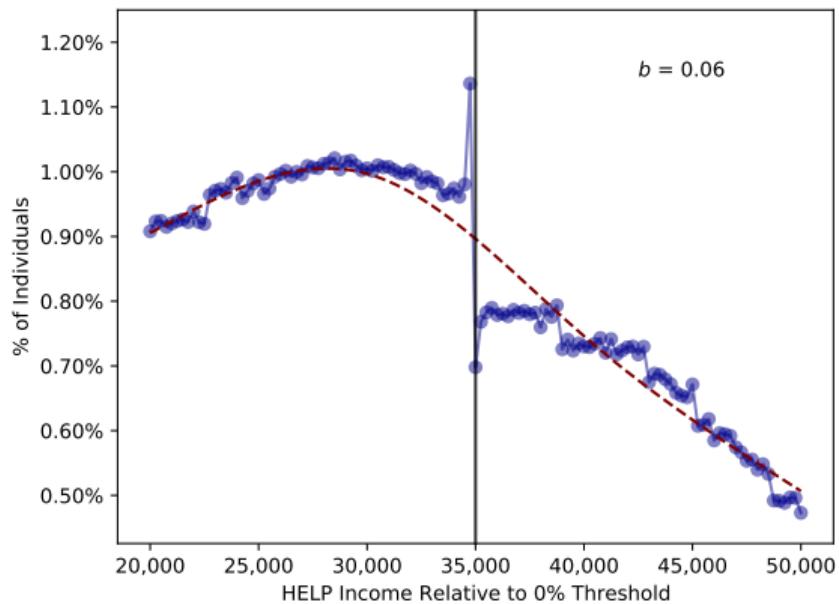
DEBT BALANCES BY AGE: INDIVIDUALS WITH POSITIVE DEBT AT AGE 22



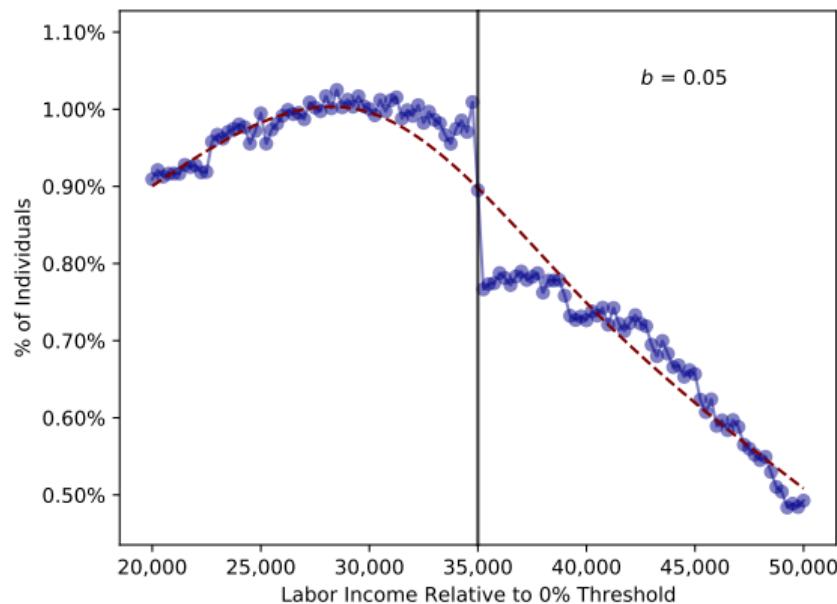
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83% OF BUNCHING IN HELP INCOME PRESENT IN LABOR INCOME

HELP Income

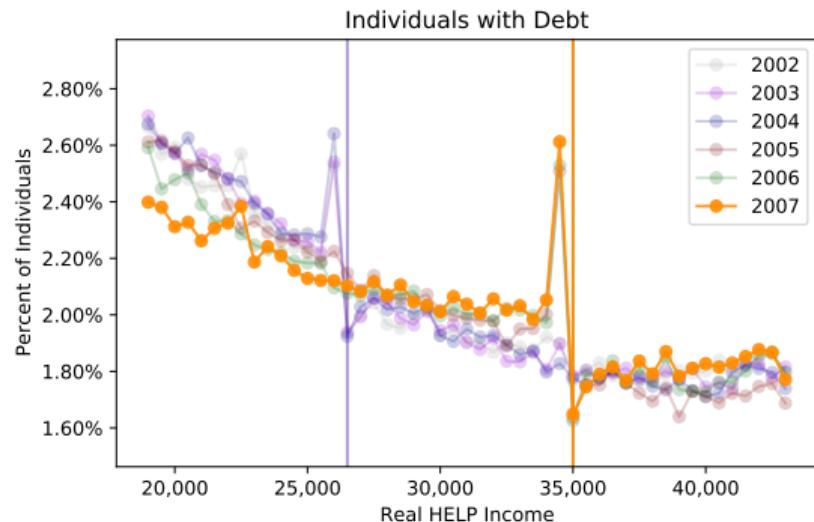
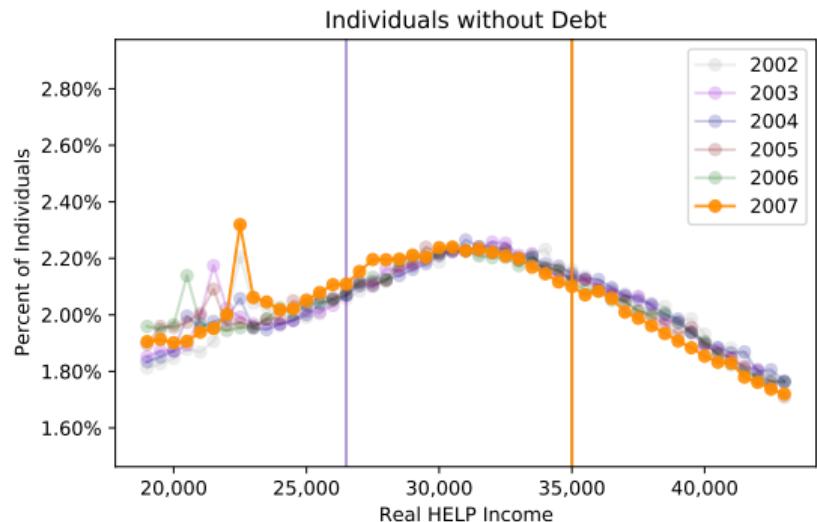


Labor Income



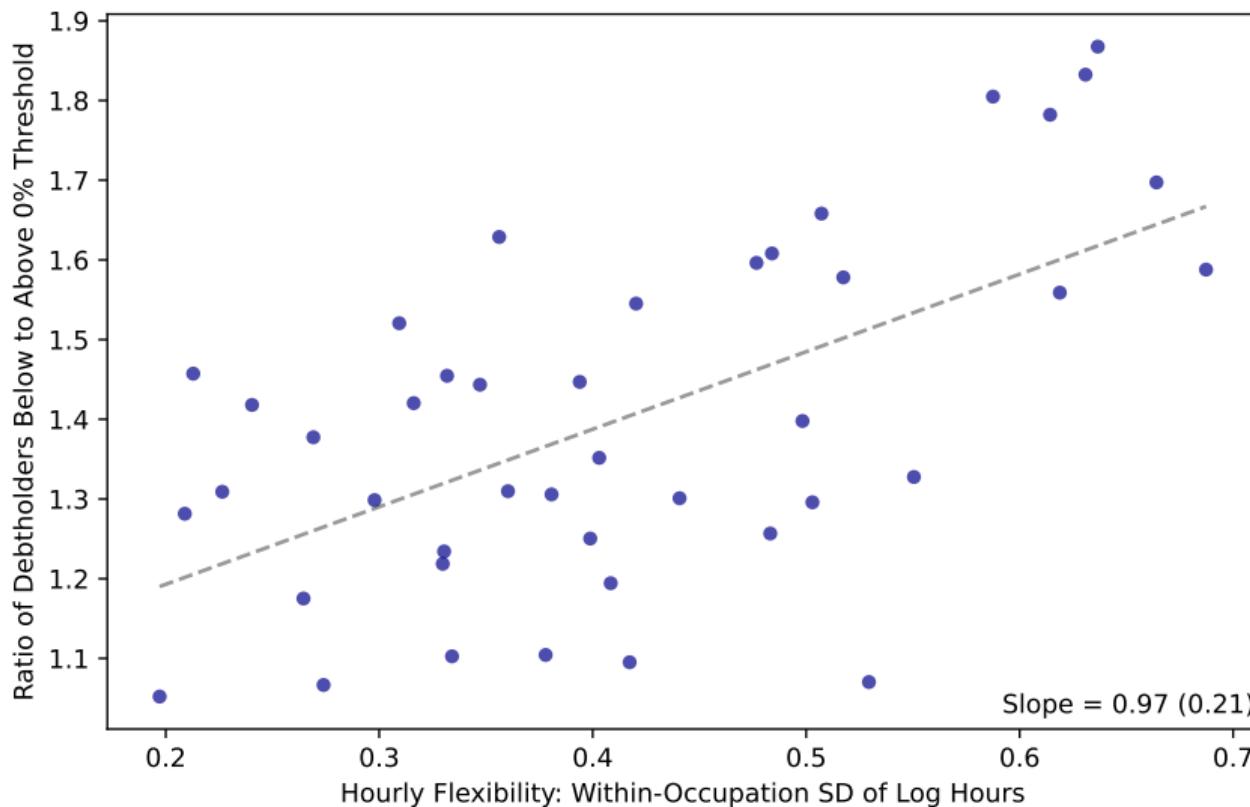
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No BUNCHING AT REPAYMENT THRESHOLD FOR NON-DEBTHOLDERS



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ALTERNATIVE MEASURE OF HOURLY FLEXIBILITY



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COMPUTATION OF BUNCHING STATISTIC

- Bunching statistic calculated as in prior literature (Chetty et al. 2011, Kleven-Waseem 2013)

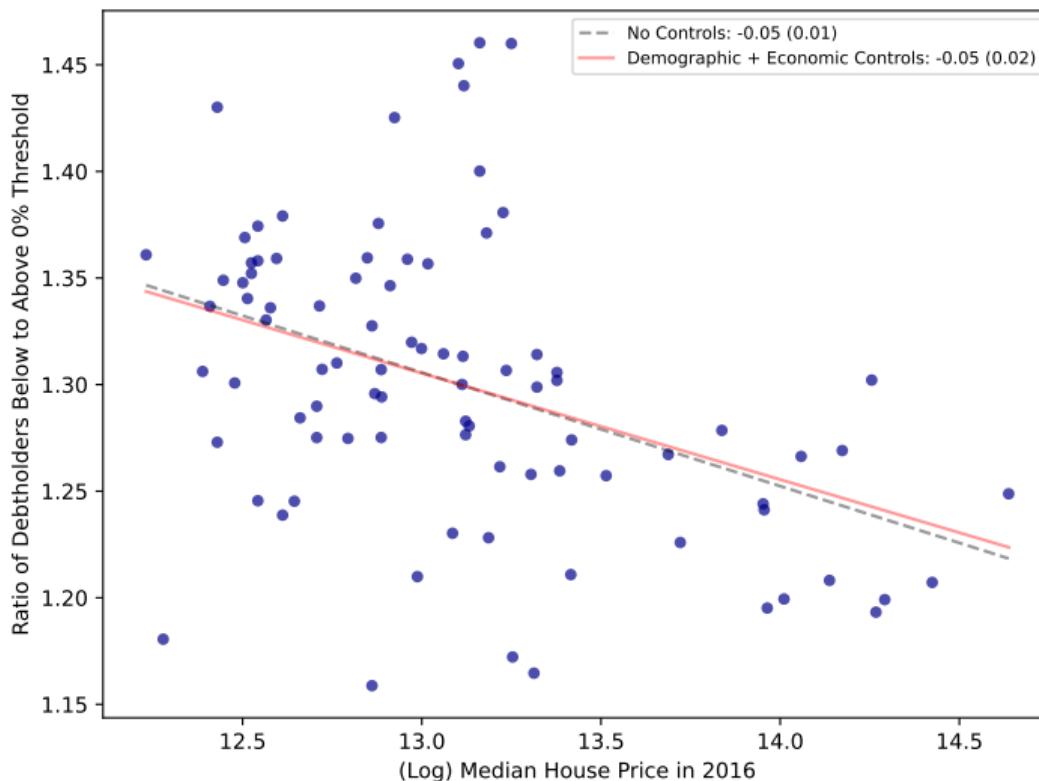
- Fit 5-piece spline leaving out $[\$32,500, \$35,000 + X]$ ⇒ **counterfactual density**
- Iterate and choose X so that counterfactual density integrates to 1
- 3

$$b = \frac{\text{observed mass in } [\$32,500, \$35,000]}{\text{counterfactual mass in } [\$32,500, \$35,000]} - 1$$

- $b = 0.1 \Rightarrow 10\%$ 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**

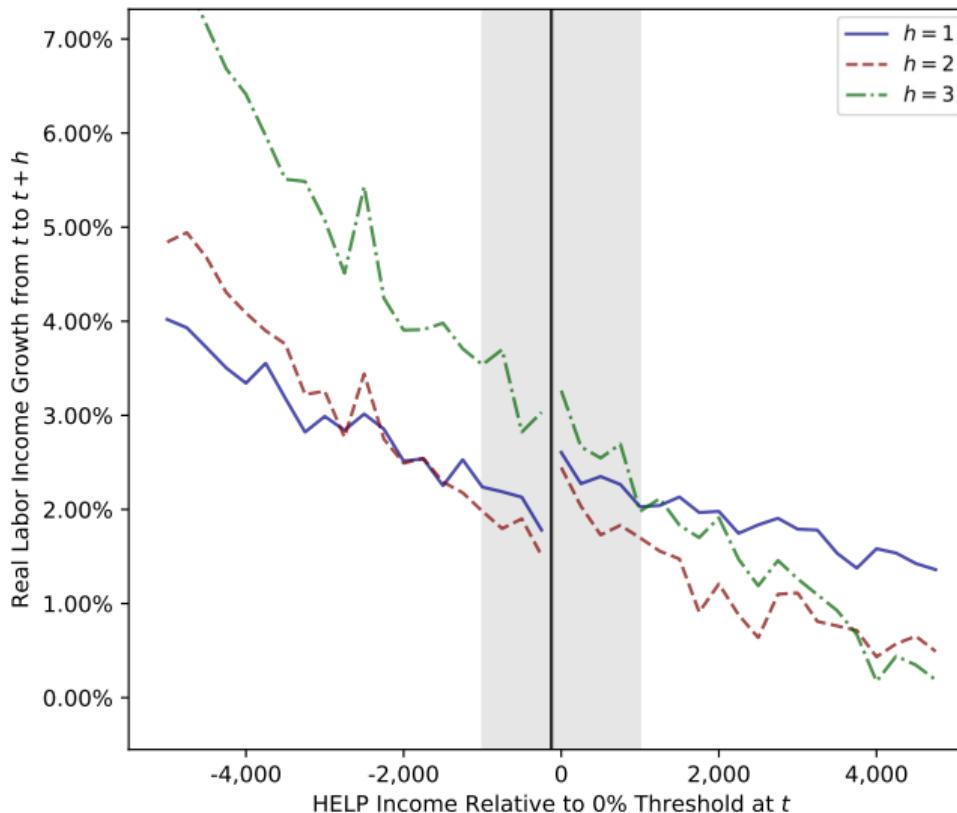
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LESS BUNCHING IN REGIONS WITH MORE HOUSING WEALTH



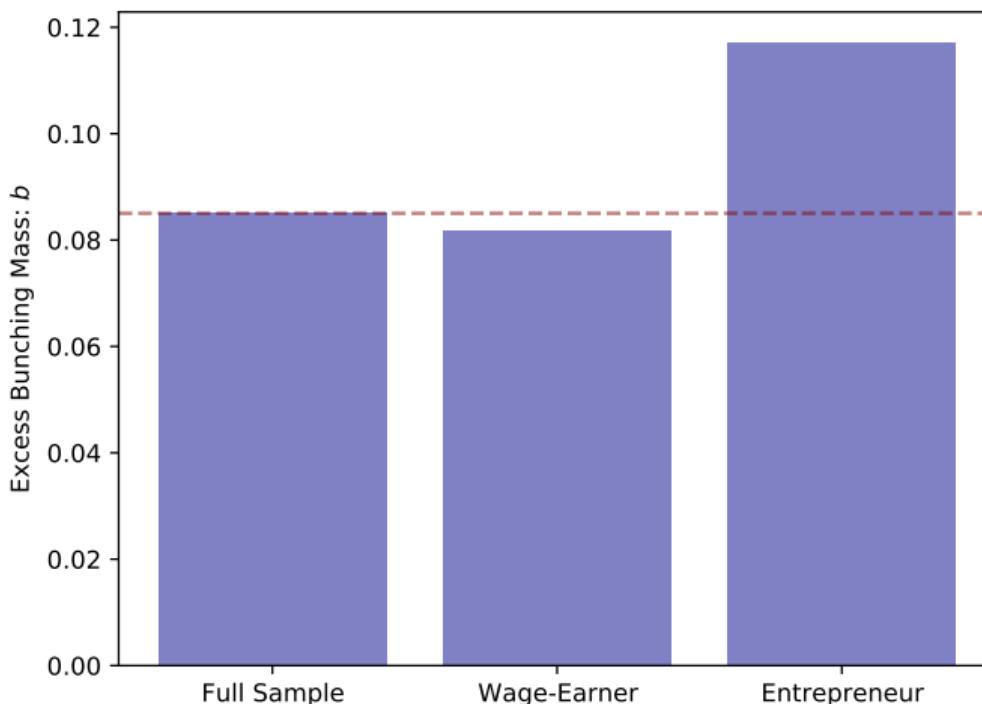
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LIMITED EVIDENCE OF DYNAMIC COST TO BUNCHING



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BUNCHING AMONG WAGE-EARNERS VS. ENTREPRENEURS



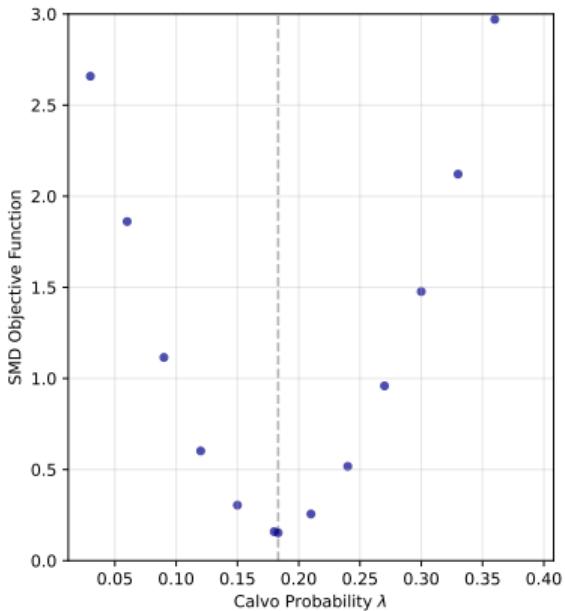
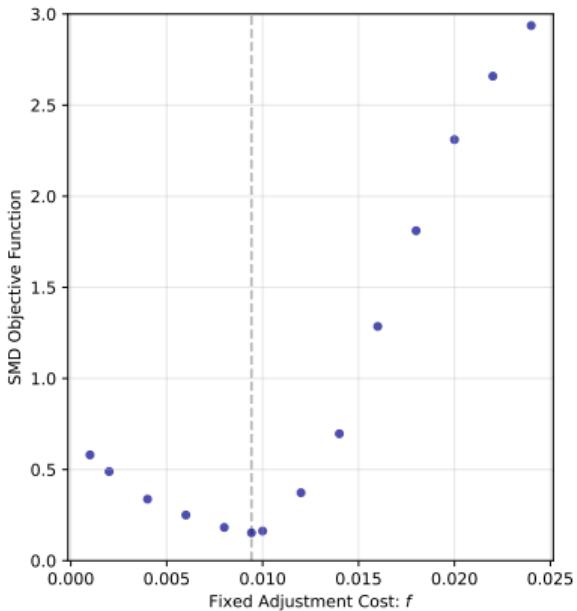
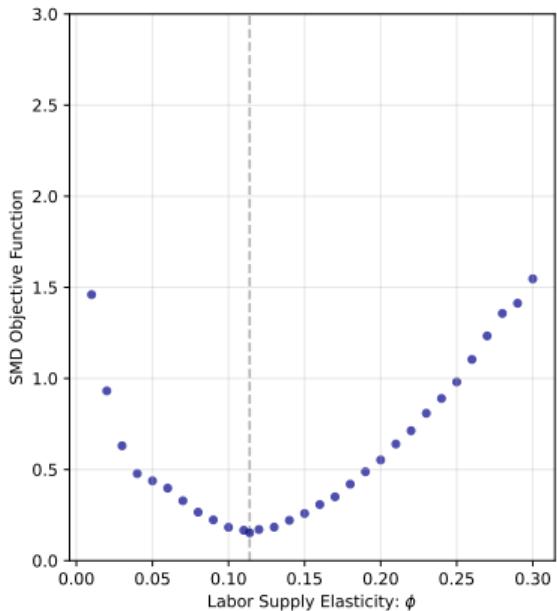
Note: Entrepreneur defined as having positive sole trader, partnership, or personal services income

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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SECOND-STAGE SIMULATED MINIMUM DISTANCE: OTHER MOMENTS

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

- 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 β
- Average labor supply \Rightarrow κ

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FULL ESTIMATION RESULTS

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

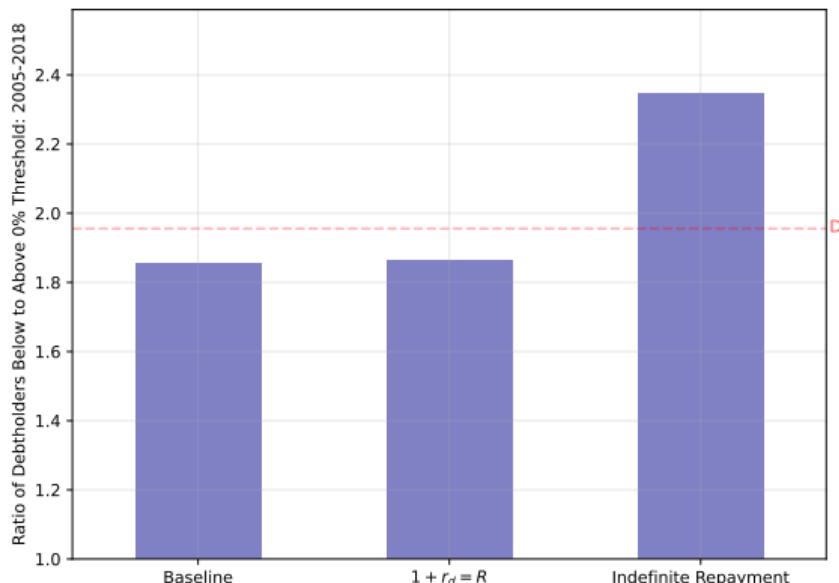
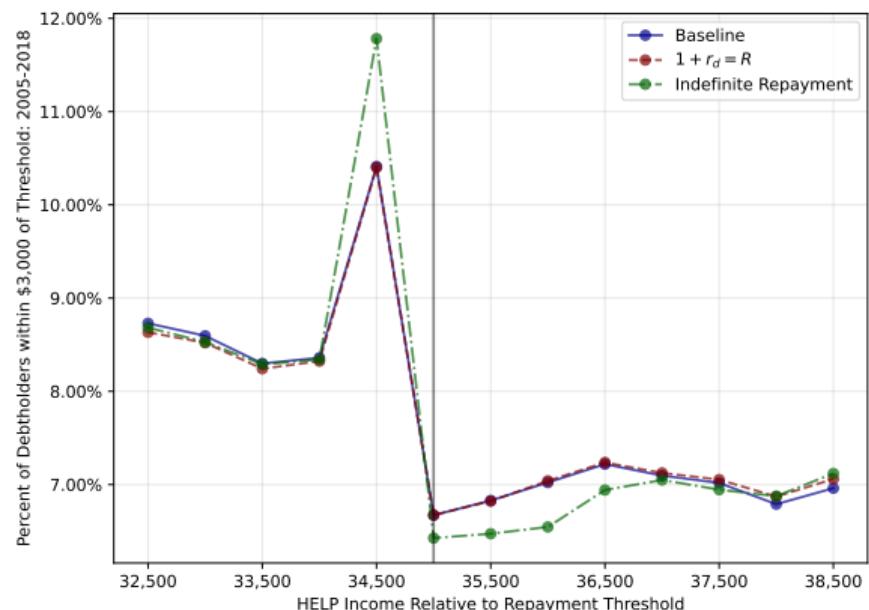
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MODEL FIT: OTHER TARGET MOMENTS

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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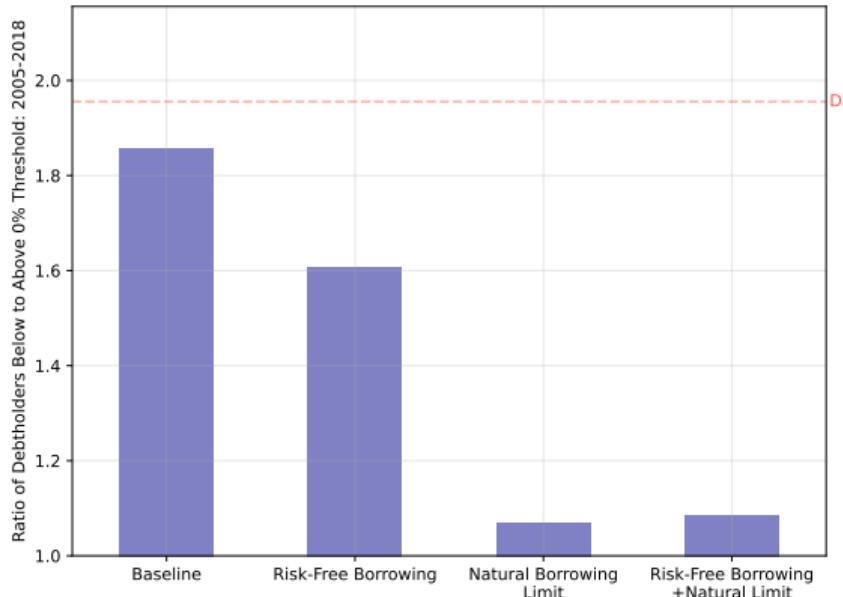
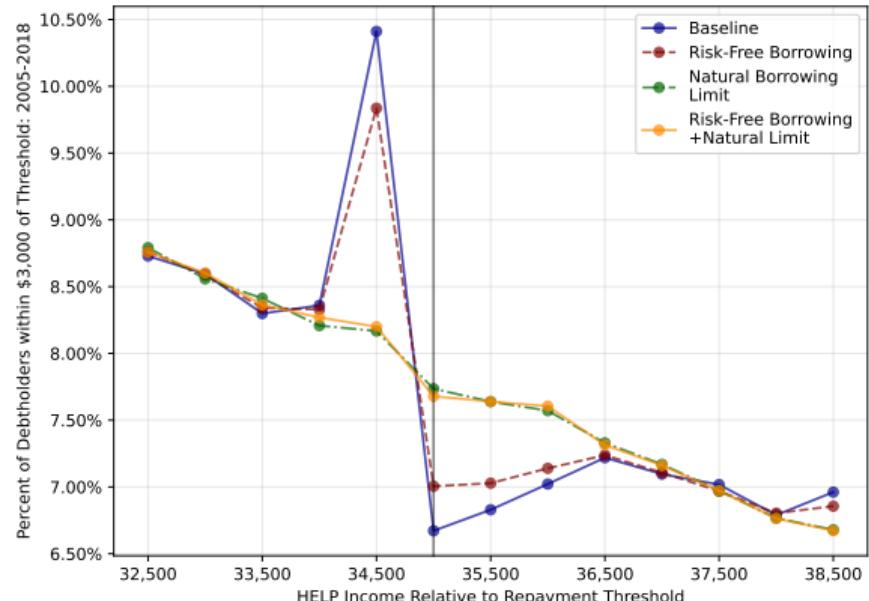
DYNAMICS: ANTICIPATION OF REPAYMENT REDUCES RESPONSES



- **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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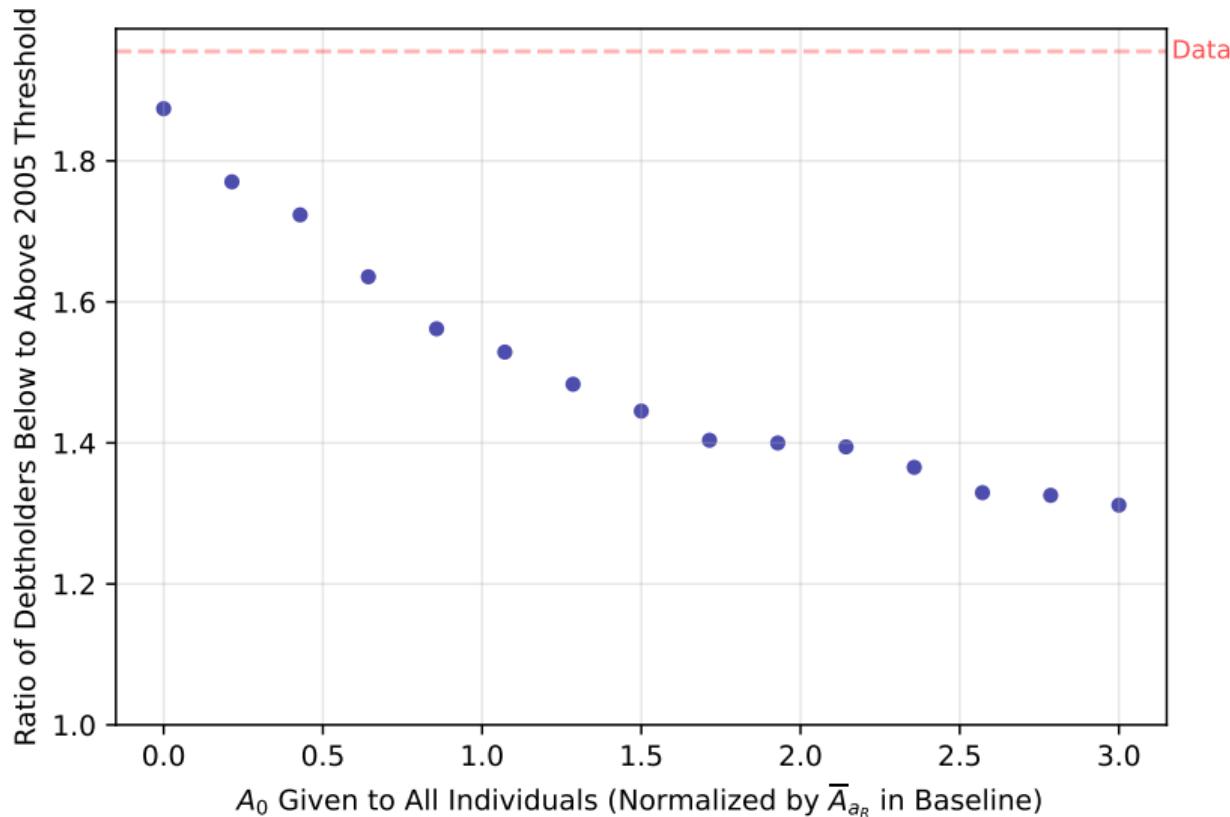
LIQUIDITY: INCOMPLETE MARKETS AMPLIFY RESPONSES



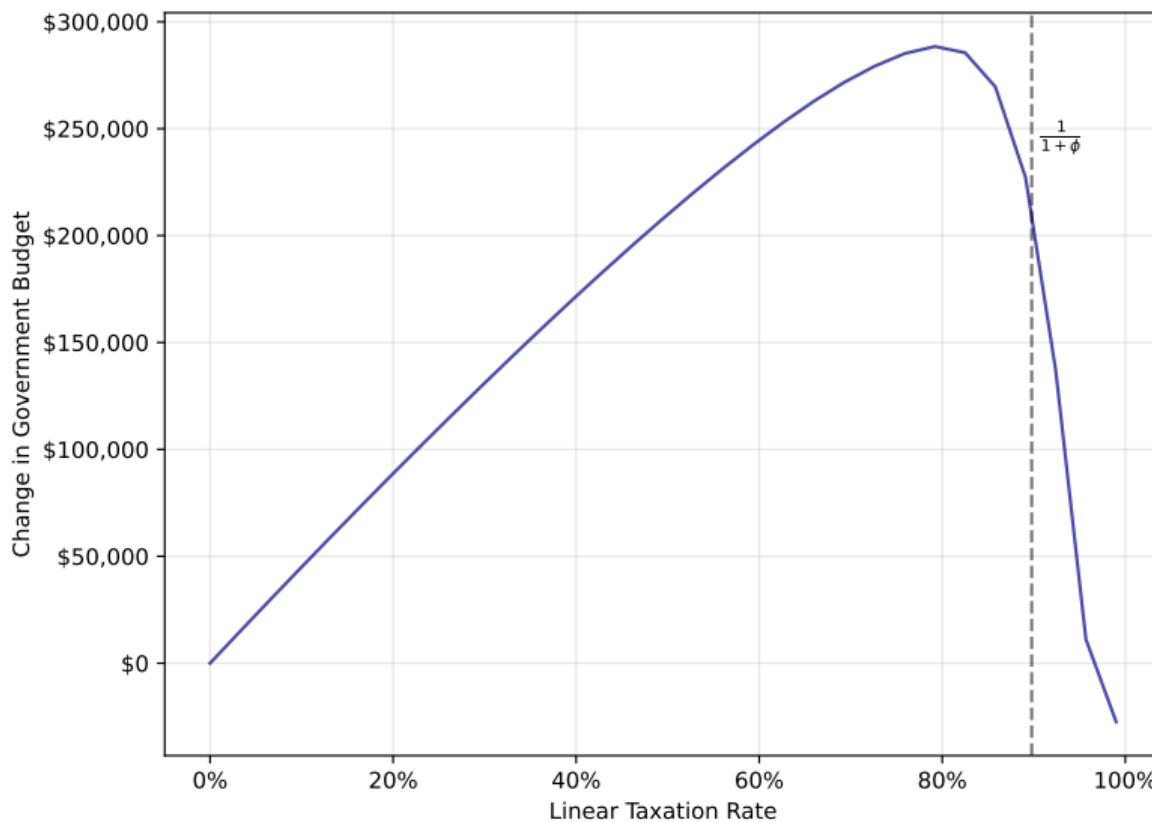
- **Model:** complete markets $\Rightarrow \downarrow$ value of repayment reduction \Rightarrow bunching $\downarrow 90\%$
- **Data:** bunching \downarrow in wealth and \uparrow in liquidity demands

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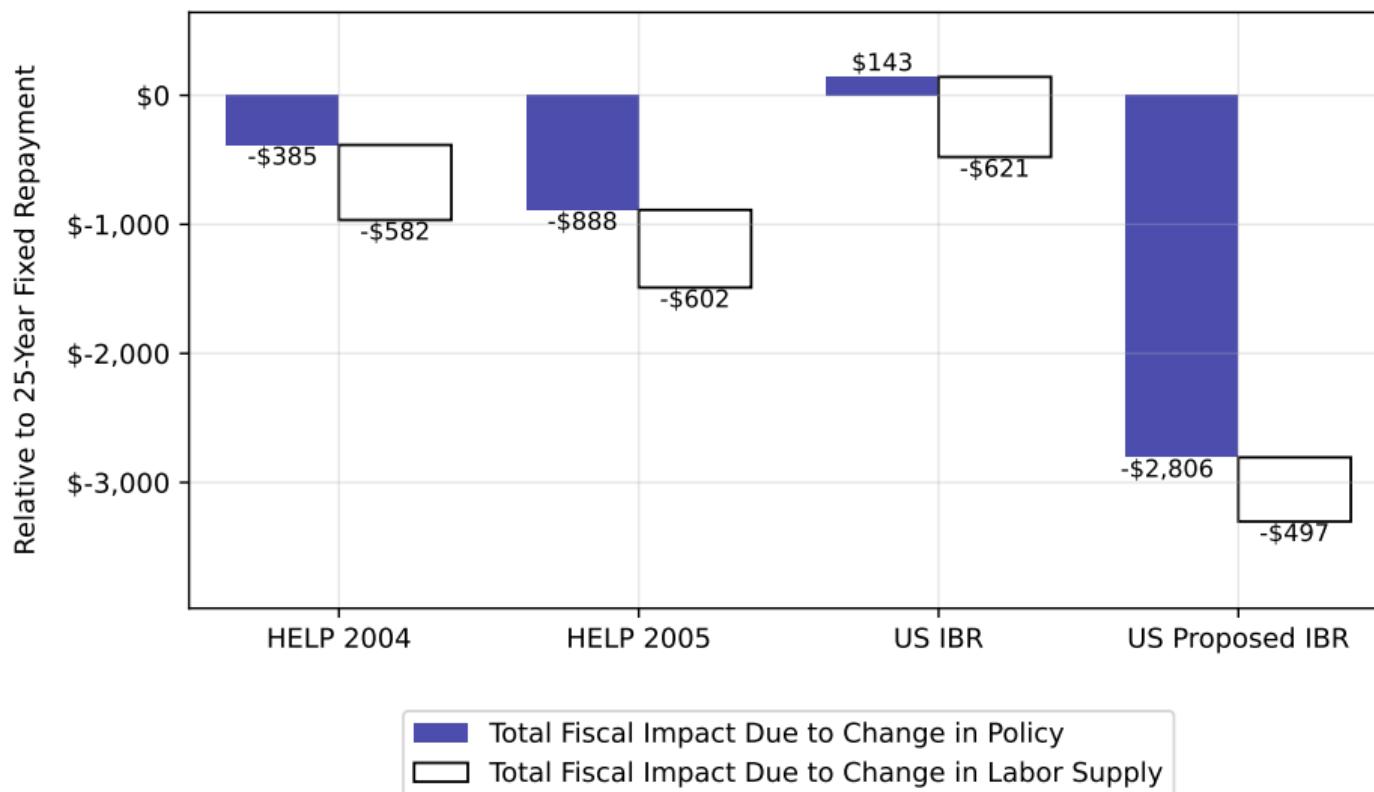
MODEL: BUNCHING DECREASES IN INITIAL ASSETS



LAFFER CURVE FROM LINEAR TAXATION



DECOMPOSITION OF FISCAL IMPACT: ENDOGENOUS LABOR SUPPLY

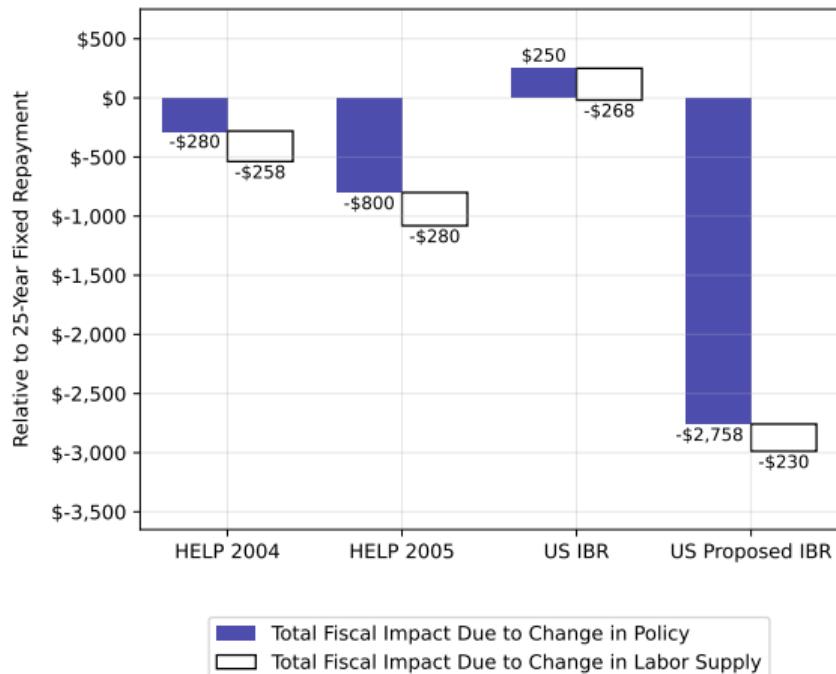


▶ Vary ϕ

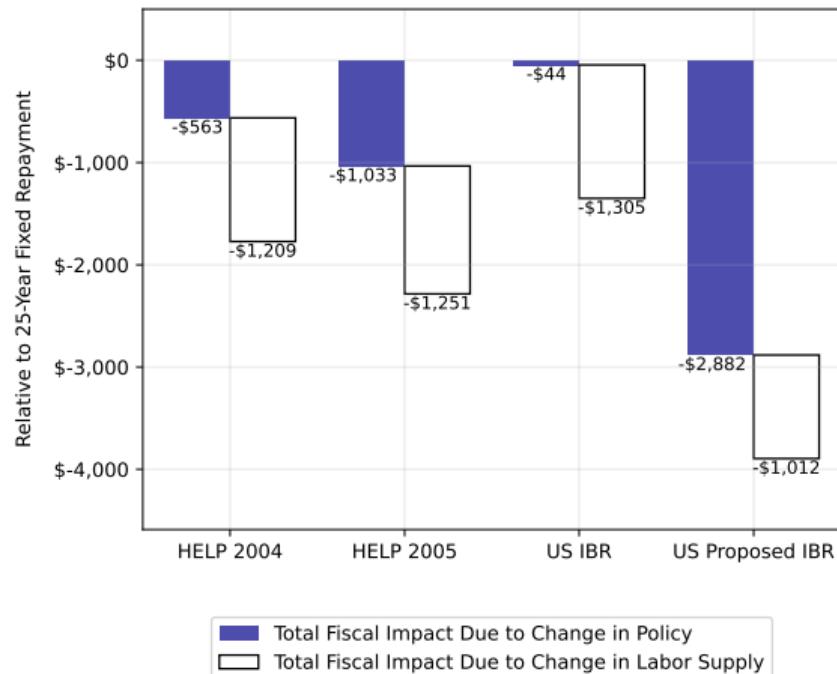
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DECOMPOSITION OF FISCAL IMPACT: ALTERNATIVE ϕ

$$\phi = 0.052$$

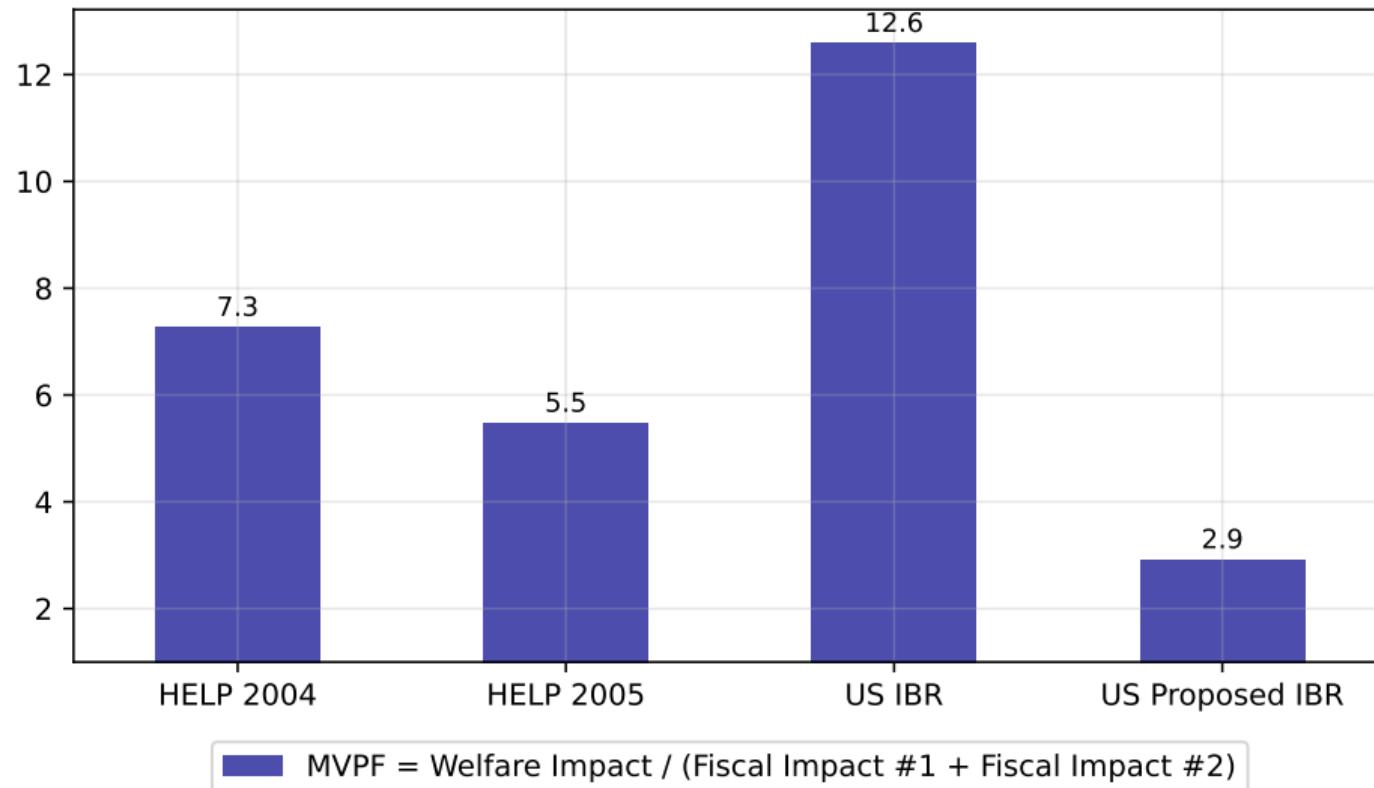


$$\phi = 0.21$$



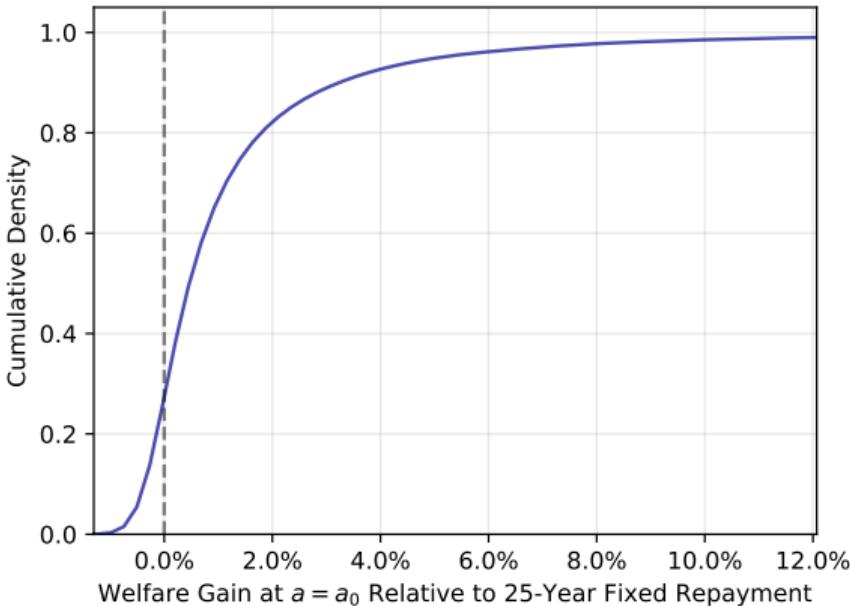
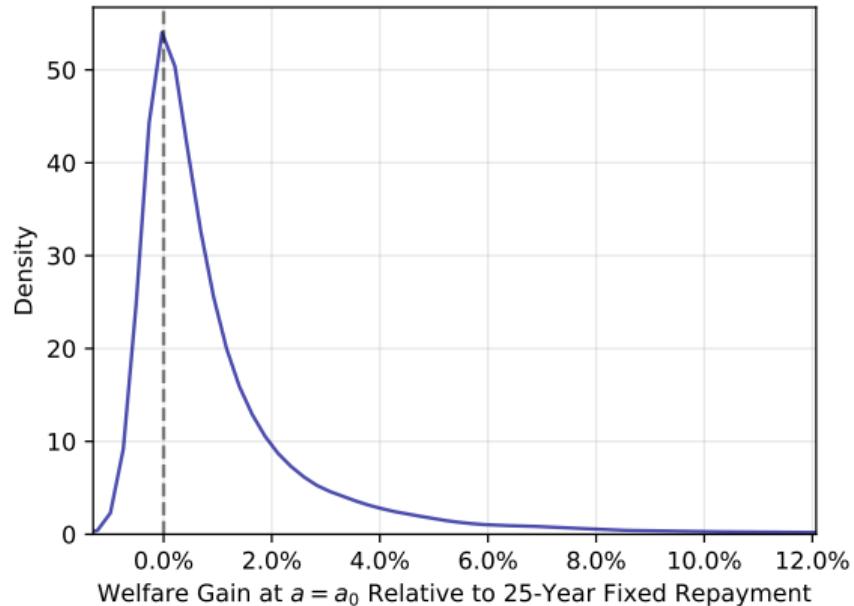
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MARGINAL VALUE OF PUBLIC FUNDS



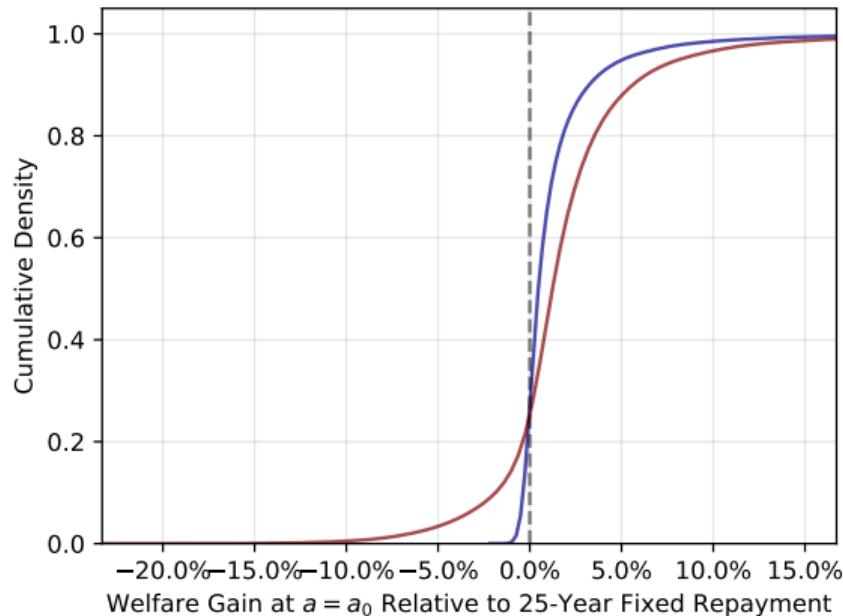
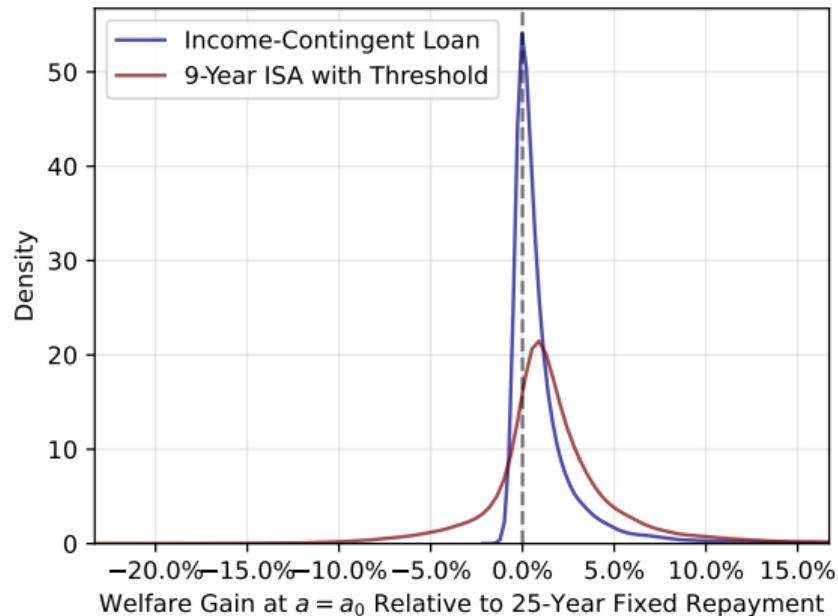
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DISTRIBUTION OF INITIAL WELFARE GAINS: ICL



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

DISTRIBUTION OF INITIAL WELFARE GAINS: ISA

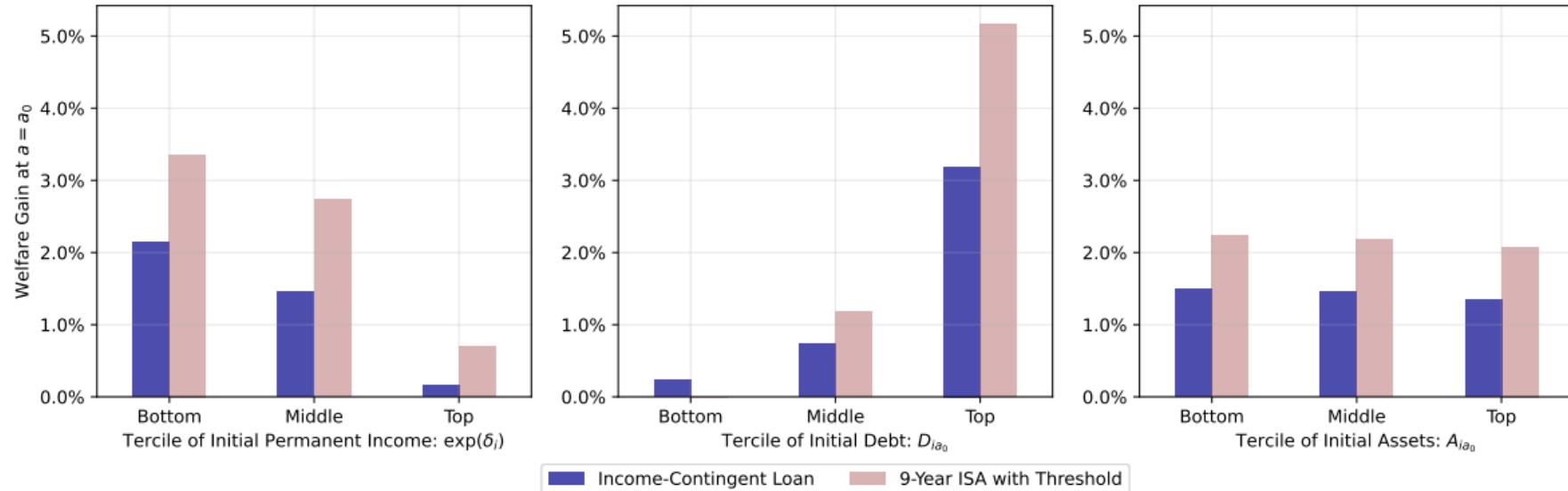


- 18% of borrowers have welfare loss above 0.5% for ISA vs. 1.2% for ICL

▶ Heterogeneity by States

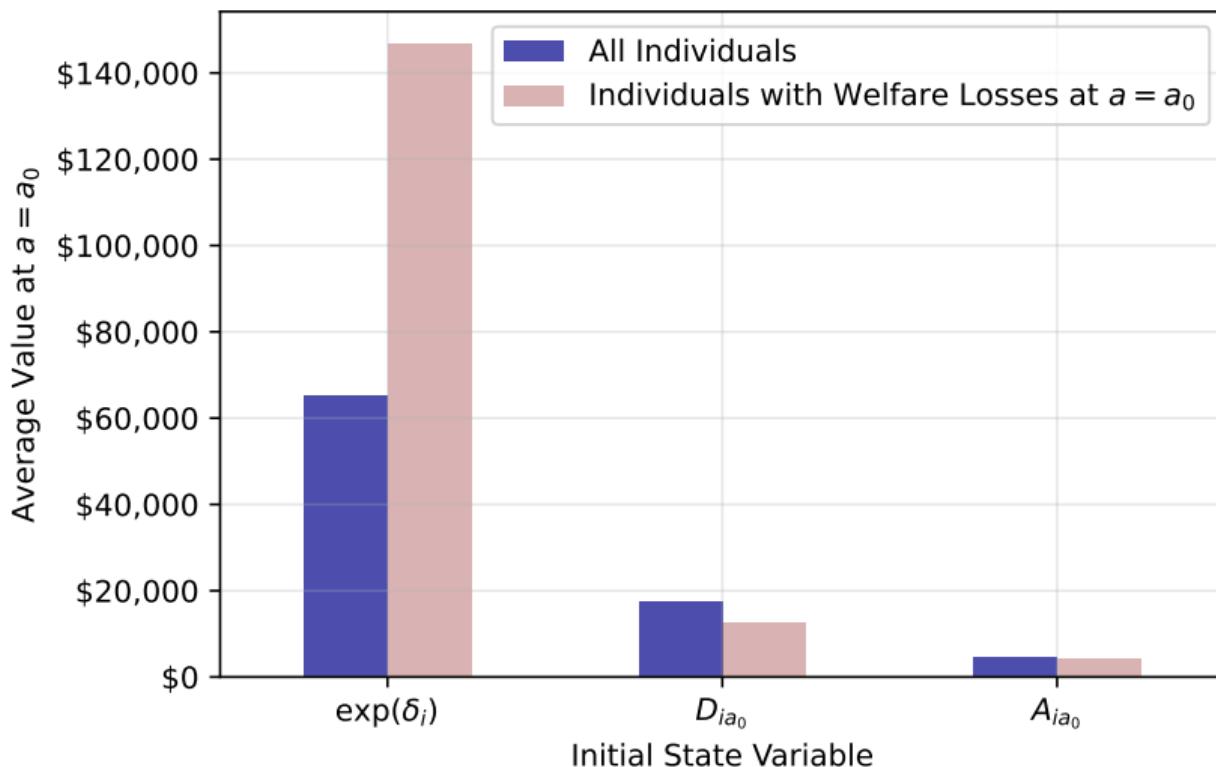
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HETEROGENEITY IN WELFARE GAINS ACROSS INITIAL STATES



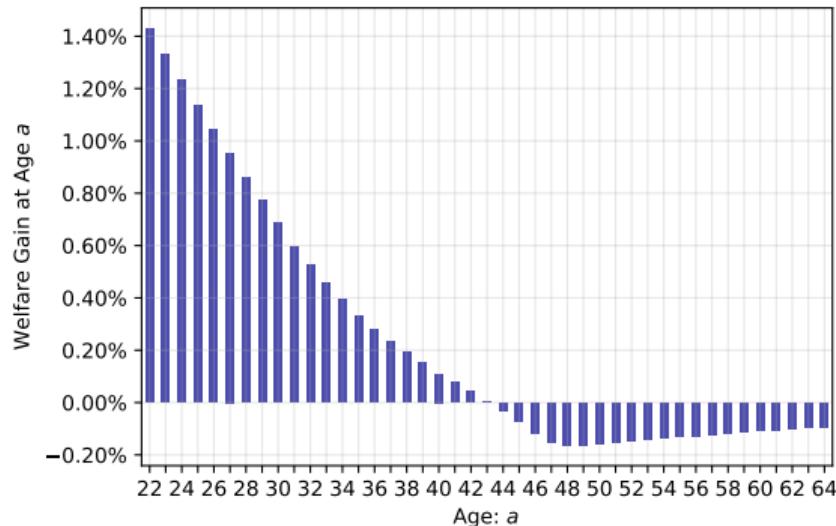
▶ Losers ICL ▶ Age ▶ Initial CEQ ◀ ICL ◀ ISA

INDIVIDUALS WITH INITIAL WELFARE LOSSES: ICL

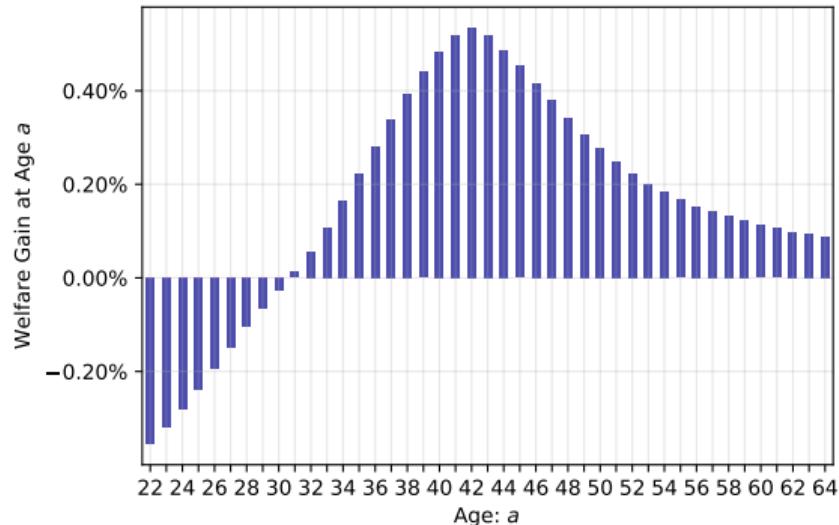


WELFARE GAINS BY AGE

ICL vs. 25-Year Fixed

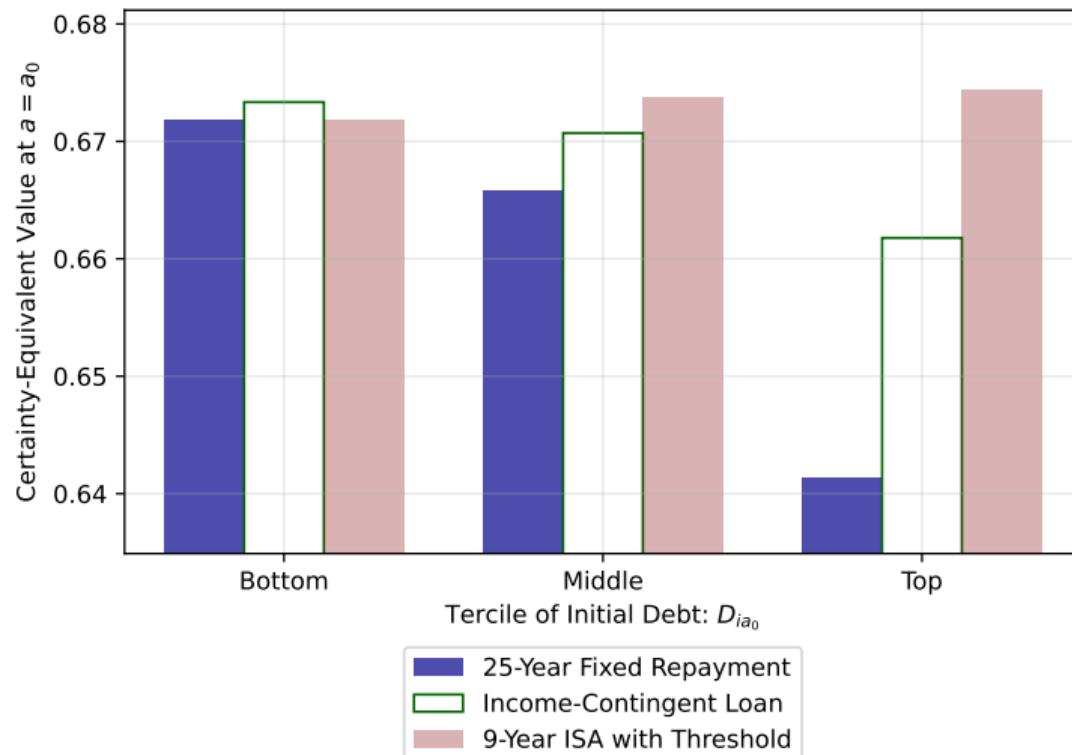


ICL + 20-Year Forgiveness vs. ICL



◀ ICL ▶ ISA

CERTAINTY-EQUIVALENTS ACROSS INITIAL DEBT



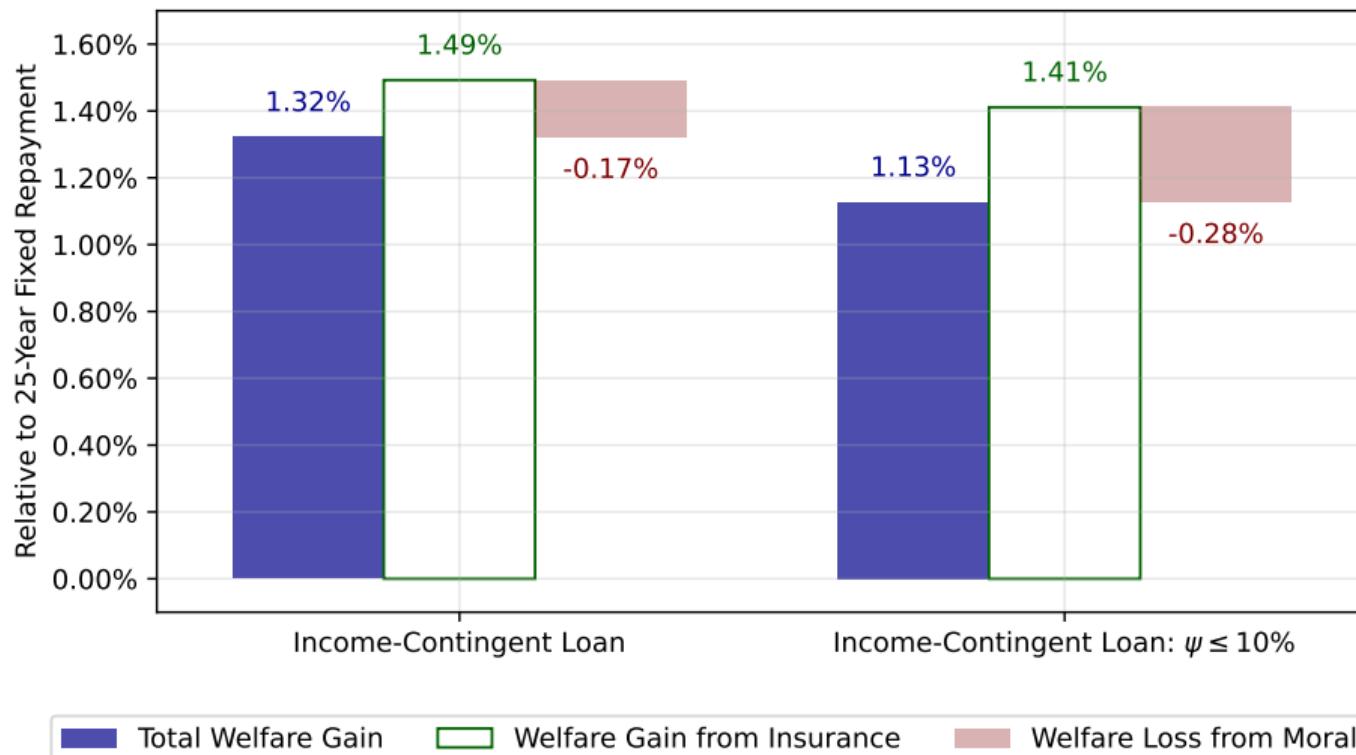
◀ ICL ▶ ISA

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

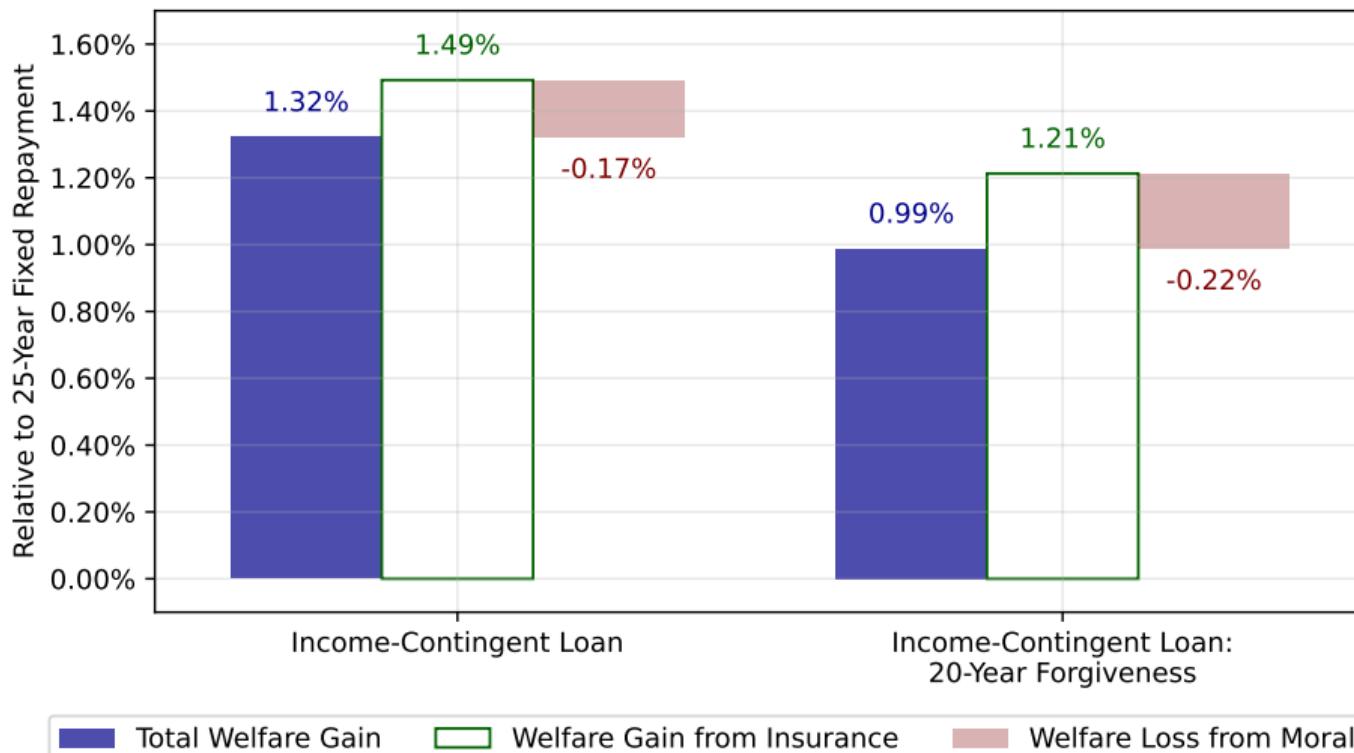
◀ ICL ▶ FP ▶ ISA

CONSTRAINING REPAYMENT RATE REDUCES WELFARE GAINS



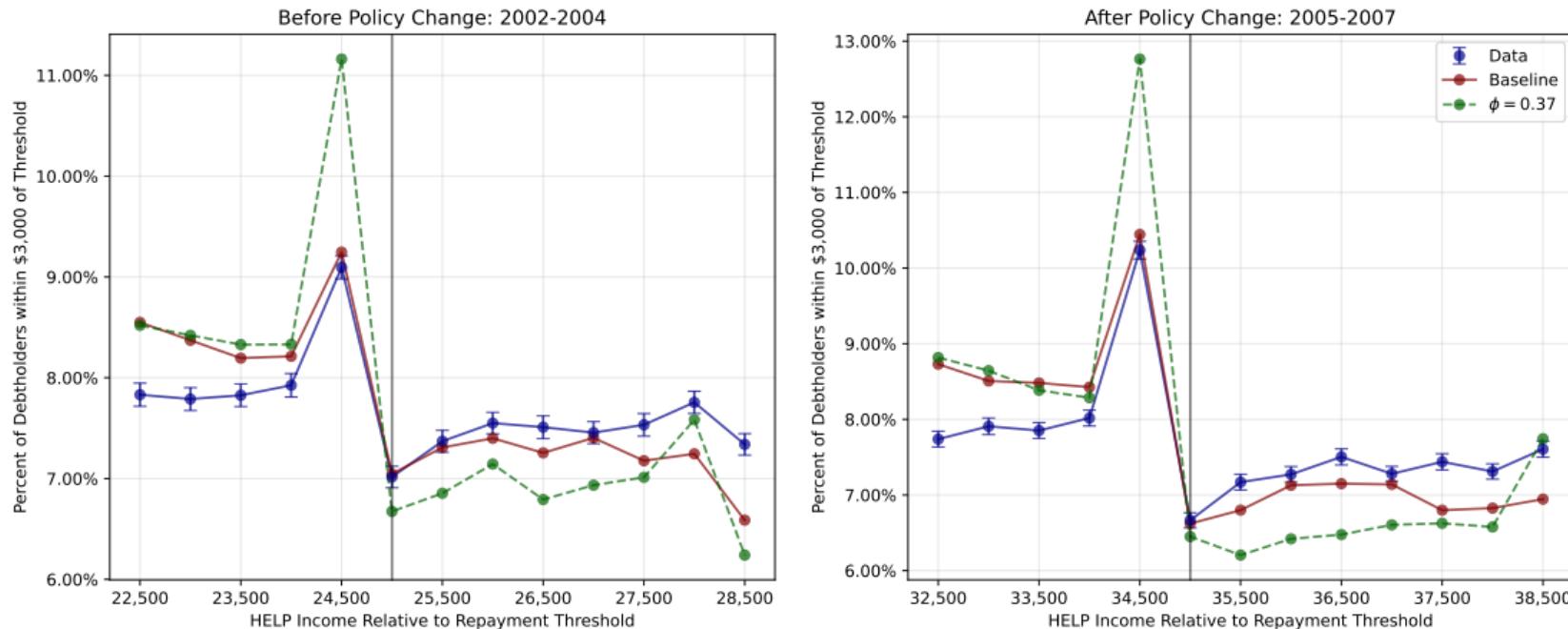
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FORGIVENESS REDUCES WELFARE GAINS



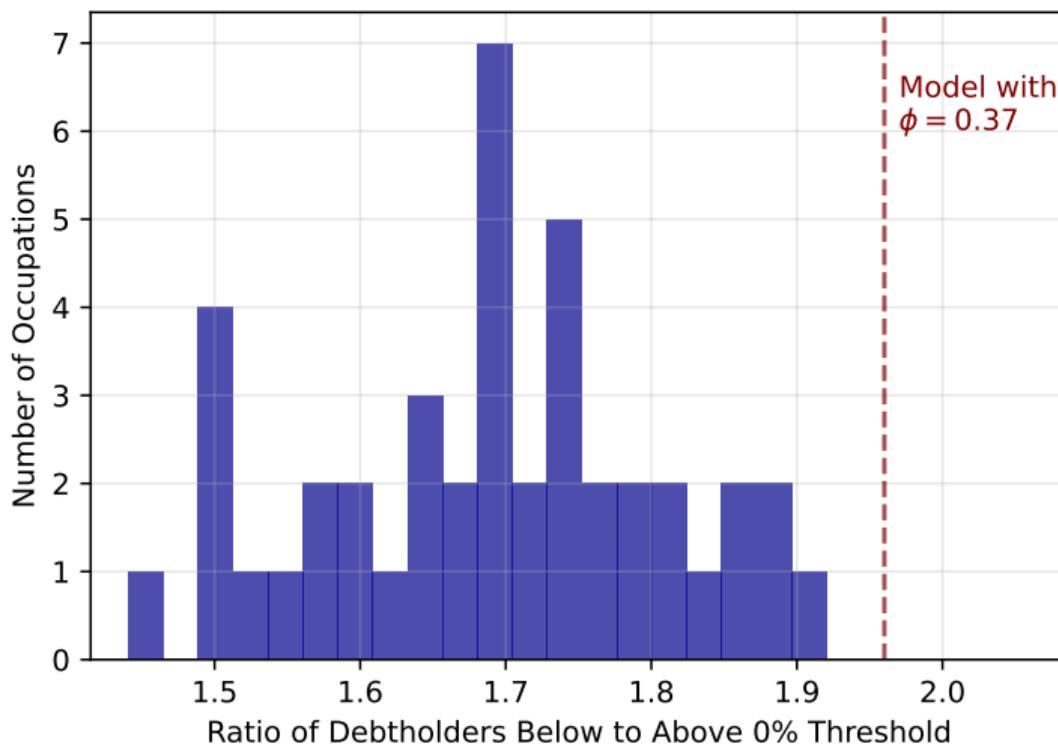
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FIT OF MODEL IN WHICH FIXED REPAYMENT IS OPTIMAL



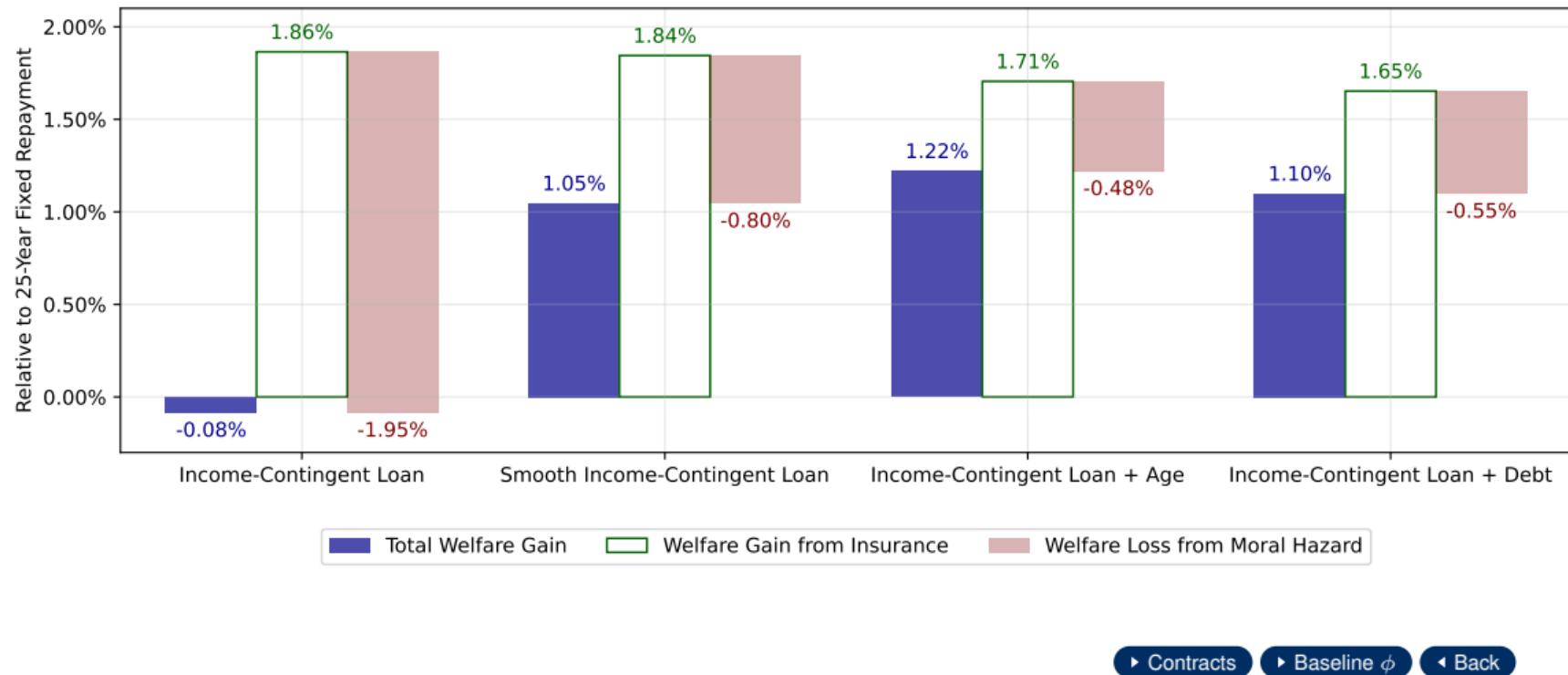
- Insurance gains < moral hazard loss \iff bunching_{model} > $1.7 \times$ bunching_{data}

BUNCHING WHEN FIXED REPAYMENT IS OPTIMAL vs. OCCUPATIONS

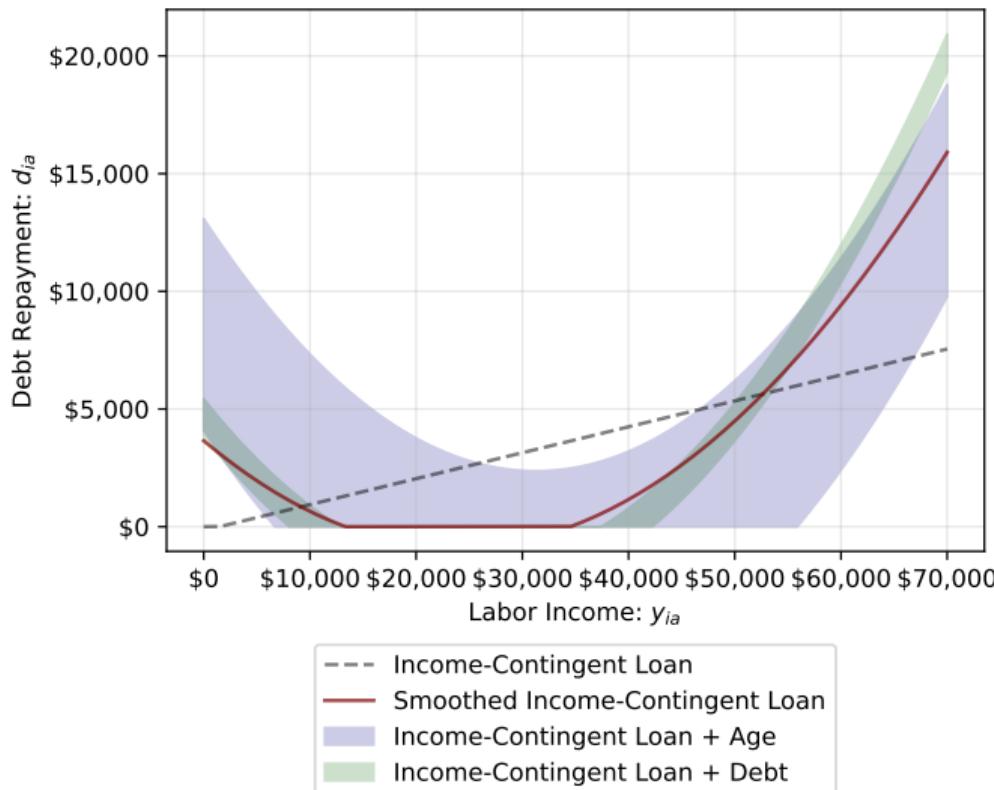


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ALTERNATIVE CONTRACTS REDUCE WELFARE COST OF MORAL HAZARD

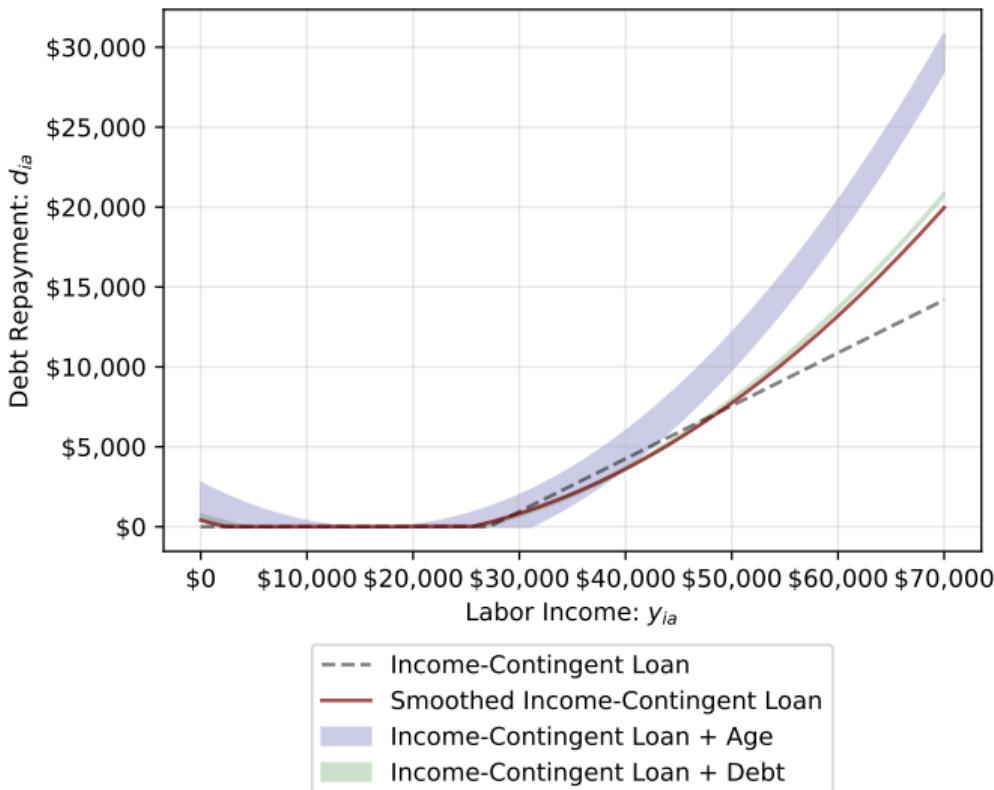


ALTERNATIVE FORMS OF INCOME-CONTINGENT LOANS: $\phi = 0.37$



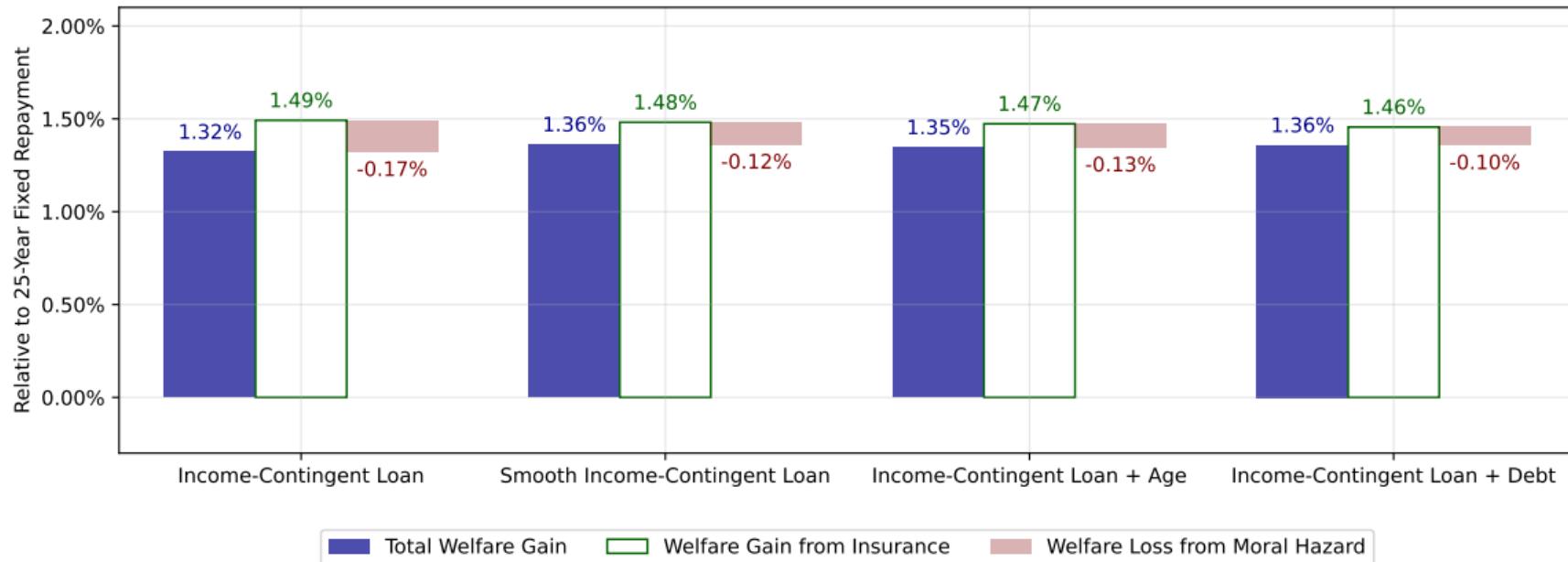
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ALTERNATIVE FORMS OF INCOME-CONTINGENT LOANS: BASELINE ϕ



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REDUCING WELFARE COST OF MORAL HAZARD: BASELINE ϕ



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

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