The Welfare Benefits of Pay-As-You-Go Financing

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Motivation

- Consumer lending markets are frought with economic frictions
  - Adverse selection, moral hazard, limited commitment, etc.
- To overcome them, lenders use sticks to discourage default
  - "A pound of flesh"
  - Collateral repossession
- Technology is making this cheaper for the lender
  - Remote starter interrupters for sub-prime auto loans
  - Utilities can remotely disable access to electricity
  - New types of lending contracts have emerged

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This Paper: Welfare analysis of PAYGo financing for smartphones

How Does PAYGo Financing Work?

You want to buy $200 smart phone, but you don't have $200.

- You apply for financing in the store. You are presented with a menu of different maturities and multiples. All require a 25% minimum downpayment.
- You select the 6-month maturity, which has a multiple of 1.56.
- You make the minimum downpayment and finance the remaining $150.

$$\text{Weekly payment} = \frac{\text{Loan Amount} \times \text{Multiple}}{\text{Number of payments}} = \frac{150 \times 1.56}{26} = \$6.50$$

- If you miss a payment, your phone locks (i.e., is unusable) until you make a payment.
- The phone permanently unlocks after you make your 26^{th} payment.
  - Regardless of when that payment is made.
- After completing payments, you can reuse your phone as collateral for a credit line.

This Paper

- Reduced-form evidence using data from a pricing experiment conducted by a fintech lender offering PAYGo financing for smartphones in Mexico
  - Heterogeneity across risk scores
  - Selection on maturity choice
  - Consistently inconsistent repayment (70-75%)
- Estimate a dynamic structural model to match the 4x2 pricing experiment
  - Exploit variation in both multiples and required downpayments
  - Identify “deeper" utility primitives from maturity choice and repayment dynamics
- Use the estimated model for counterfactual analysis
  - Quantify welfare effects of PAYGo financing
  - Decompose the effect of lockout on moral hazard and adverse selection
  - Quantitatively explore trade-offs in contract design: incentives vs insurance

Related Literature

Reduced-Form Evidence of Information Asymmetries in Contracting

- Karlan and Zinman (2009), Hertzberg et al (2018), Indarte (2023), Agarwal et al (2010), Dobbie and Skiba (2013), Gupta and Hansman (2022), Stroebel (2016)

Structural Models of Credit Markets

- Adams et al (2009), Einav et al (2012), Cuesta and Sepulveda (2021), DeFusco et al (2022), Xing (2023)

Selection Markets

- Einav et al. (2010a), Einav et al (2010b), Einav et al (2010c), Cardon and Hendel (2001), Einav et al. (2013), Handel (2013), ...

Secured Lending in LMICs

- Jack et al (2023), Gertler et al (2024)

Pricing Experiment

- 4 multiple arms $\times$ 2 downpayment arms, $\approx$ 30,000 consumers

Panel A: Pricing Arms

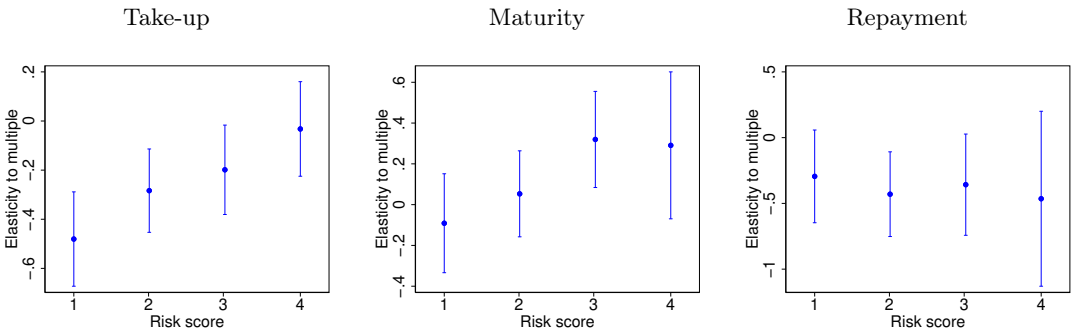
	Ctrl	Medium	High	Steep
3 month	1.36	1.4	1.55	1.4
6 month	1.54	1.63	1.8	1.7
9 month	1.64	1.8	2	1.95
12 month	2	2.2	2.4	2.5

Panel B: Downpayment Arms

	Control	Lower
Risk score 1	25%	20%
Risk score 2	30%	25%
Risk score 3	35%	30%
Risk score 4	50%	40%

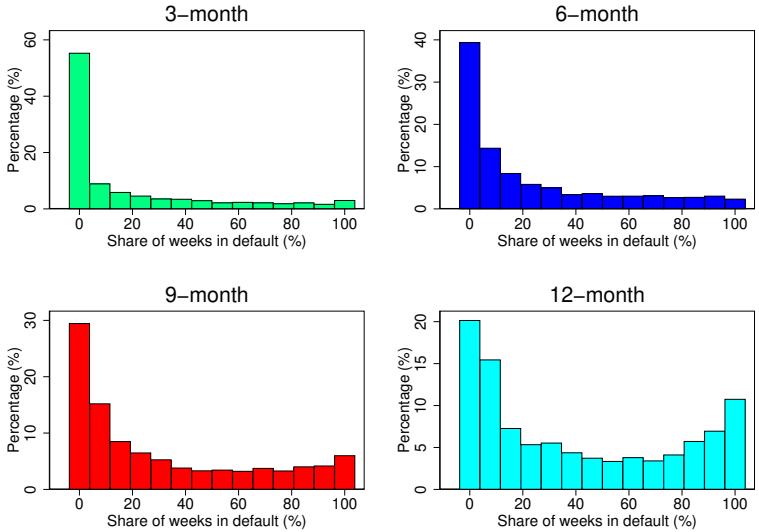
- Multiples imply weekly APR of 3-5% for on time repayers

Reduced-Form Evidence: Heterogeneity Across Risk Scores



- Low risk more elastic to multiple. High risk lengthen maturity.
- Repayment decreases with multiple (consistent with adverse selection/moral hazard)
  - Significantly smaller than in De Fusco et al. (2022) find for unsecured loans

Reduced-Form Evidence: Selection on Maturity, Inconsistent Repayment



Model Overview

Firm (passive)

- A firm produces a good that delivers flow utility to consumers.
- The firm offers a menu of PAYGo contracts to each consumer based on their risk score.

Consumers

- Rational agents with time-separable, quasilinear utility $u(c_{it}) + q_{it}$.
- Heterogeneous private income subject to iid shocks.
- Usage value for the good, which depreciates stochastically.
- Face three types of decisions in the model.
  1. Take-up: which contract to accept (if any)
  2. Downpayment choice: liquidity cost μ
  3. Repayment: whether to make the required payment in each period

The Economics of the Repayment Decision

- While in repayment, the Bellman equation for the consumer is

$$U_i(v, y, n, m) = \max \Big\{ v + u(y - m) + \beta \mathbb{E}[U_i(v', y', n - 1, m)|x)], \\ (1 - \lambda)v + u(y) + \beta \mathbb{E}[U_i(v', y', n, m)|x] \Big\}$$

  where λ denotes the "strength" of the lock.

- Optimal to make the payment if

$$\underbrace{\lambda v}_{\text{usage value}} + \underbrace{\beta \mathbb{E}[U_i(v', y', n - 1, m) - U_i(v', y', n, m)|x]}_{\text{principal reduction}} \geq \underbrace{u(y) - u(y - m)}_{\downarrow \text{ consumption}}$$

- Reasons for non-repayment:
  1. Negative income shocks $\implies \uparrow u(y) - u(y - m)$
  2. Depreciation shocks $\implies \downarrow v$

Estimation

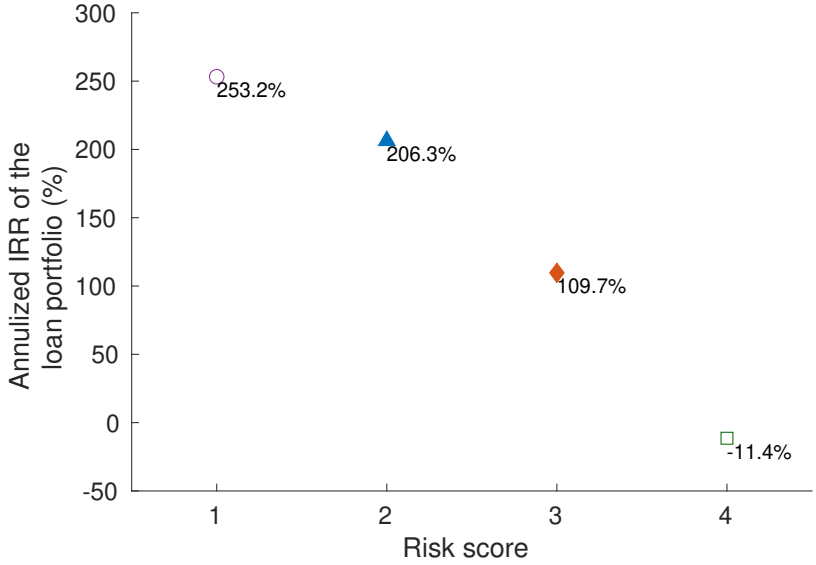
- We use Simulated Method of Moments (SMM)
  - We estimate each risk score separately
- Model estimated using 4 treatment groups, validated with remaining 4 treatments
- Each treatment group has 13 moments
  - 4 take-up moments, 8 repayment moments, 1 downpayment moment
- For each risk score, we have 11 parameters to estimate from 52 moments.
- We (exhaustively) assess model fit and identification in the paper

Key Parameter Estimates

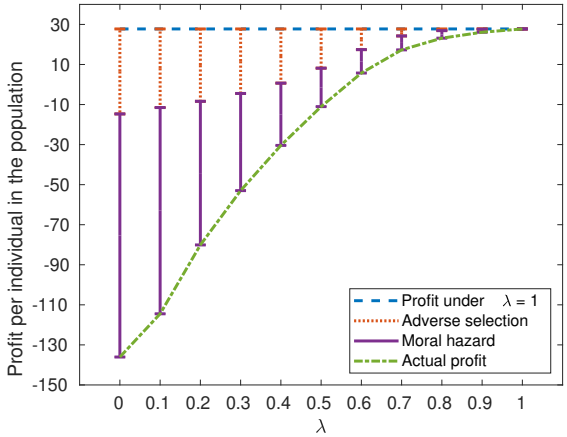
	RS1	RS2	RS3	RS4
$\bar{y}$ (average mean income, weekly in \$)	33.7	34.8	37.3	35.5
$\sigma_{\bar{y}}$ (dispersion of mean income)	0.98	0.87	0.86	0.97
σ_ϵ (size of income shock)	0.35	0.38	0.37	0.41
v_0 (initial usage value)	24.1	23.6	15.7	10.3
ϕ (prob. of depreciation, weekly)	0.030	0.030	0.034	0.041
β (discount factor, weekly)	0.997	0.989	0.995	0.996
μ (liquidity cost)	4.1	3.1	3.3	4.5

- Similar average income across risk scores, roughly minimum wage in Mexico
- Riskier consumers: more volatile income, lower device value, higher depreciation

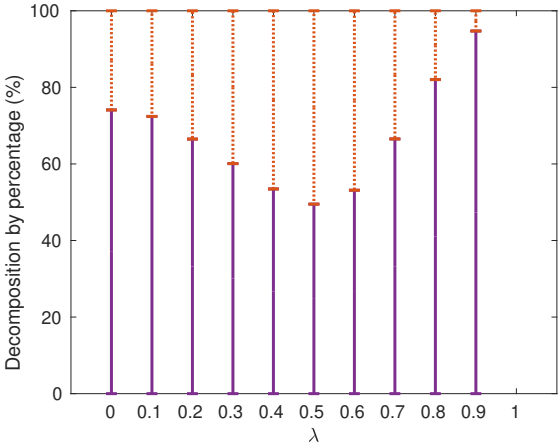
Model Implied Heterogeneity in Profitability



Decomposition of the Effect of Lockout



Total Profit



Decomposition of Profit Loss

Consumer Welfare and Firm Profitability

Welfare Measure

- The percentage increase in weekly income over two years that would deliver the same utility as having access to the menu of PAYGo contracts
  - Outside option: buy with income and liquidity at any future date (or not at all)
  - We report both $\mathcal{W}_{taker} \equiv \mathbb{E}[\mathcal{W}_i | i \text{ accepts a contract}]$ and $\mathcal{W}_{sample} \equiv \mathbb{E}[\mathcal{W}_i]$

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  - Suggest welfare gains are hindered by market power

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- Firm profitability is also remarkably high
  - Suggest welfare gains are hindered by market power
- Counterfactual: consumer welfare under competitive pricing
  - Solve for the menu of contracts that maximizes consumer welfare subject to zero firm profit at an annual discount rate of 25%

Summary of Consumer Welfare and Firm Profitability

Treatment Group	(1) Take-up	(2) $\mathcal{W}_{taker}$	(3) $\mathcal{W}_{sample}$	(4) NPV	(5) IRR
Risk score 1					
CtrlMultipleCtrlDown	62.8%	7.7%	4.8%	37.3	201%
HighMultipleCtrlDown	55.3%	5.9%	3.4%	64.5	444%
CtrlMultipleLowerDown	67.5%	8.1%	5.2%	36.3	176%
Competitive Pricing	74.1%	11.3%	8.4%	0.0	25%
Risk score 2					
CtrlMultipleCtrlDown	61.3%	7.0%	4.5%	34.8	181%
HighMultipleCtrlDown	55.8%	5.1%	3.0%	59.7	391%
CtrlMultipleLowerDown	68.4%	7.4%	4.9%	35.5	164%
Competitive Pricing	76.4%	10.8%	8.3%	0.0	25%
Risk score 3					
CtrlMultipleCtrlDown	50.9%	4.6%	2.5%	26.8	143%
HighMultipleCtrlDown	48.9%	3.6%	1.8%	53.7	326%
CtrlMultipleLowerDown	59.7%	4.9%	2.7%	22.8	109%
Competitive Pricing	65.9%	6.3%	4.2%	0.0	25%
Risk score 4					
CtrlMultipleCtrlDown	26.2%	4.3%	1.2%	28.3	196%
HighMultipleCtrlDown	26.0%	3.9%	1.1%	37.0	239%
CtrlMultipleLowerDown	38.2%	5.1%	1.7%	14.4	82%
Competitive Pricing	40.5%	6.0%	2.4%	0.0	25%

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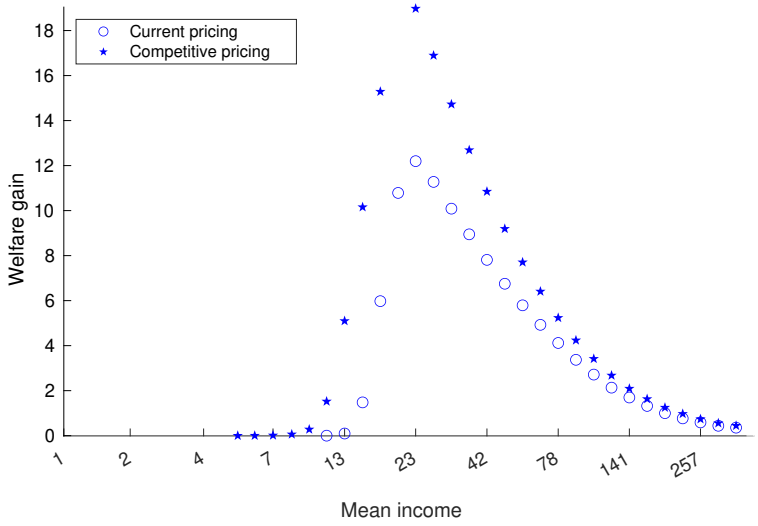
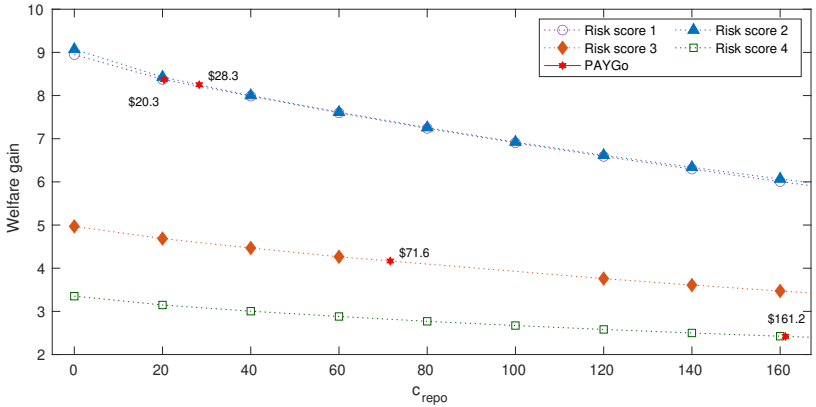
Welfare by Income, Risk Score 1



Secured Lending Counterfactual

- We simulate a counterfactual with traditional secured loans
- Firm commits to repossess after missed payment(s) at cost c_{repo}
  - Upon repossession, the firm recovers the residual value and consumer enters autarky
  - In the paper, we also vary probability repossession is successful.
  - Assume it is successful w.p.1 here.
- We use competitive prices for a clean comparison
  - Under competitive pricing, both the multiple and downpayment increase with c_{repo}
- Key trade-off: stronger incentives (secured) vs more insurance (PAYGo)

Welfare Comparison: PAYGo vs Secured Lending



- Low risk scores have higher usage values
  - Strong incentive to repay without the threat of repossession
  - Larger economic loss associated with reallocation to firm (i.e., insurance is more valuable)

Contract Design

We consider several modifications of the PAYGo contract and ask whether they can improve welfare.

More insurance

- Leniency: lock activated only after sufficient non-repayment
- Weaker lock: consumes a fraction of usage value for non-repayment

Stonger incentives

- Fees for missed payments
- Locked for multiple periods

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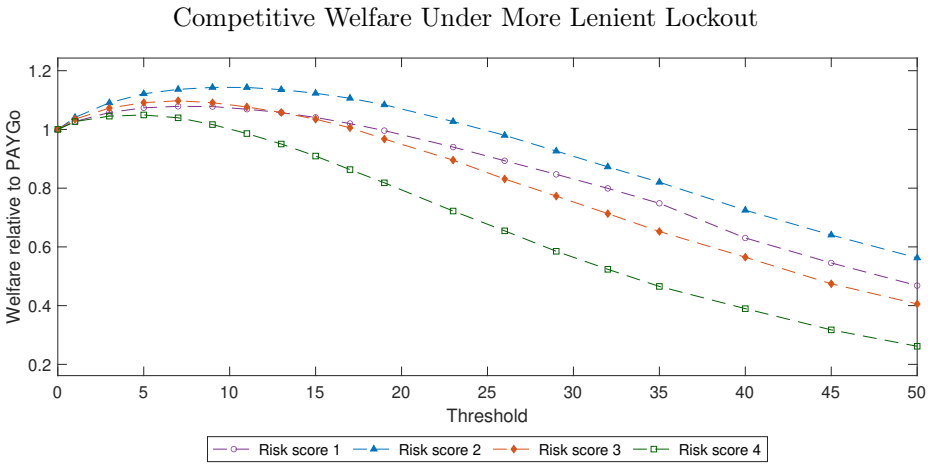
Main Finding: Only the leniency policy can improve on PAYGo

Optimal Lockout: More Lenient



Summary

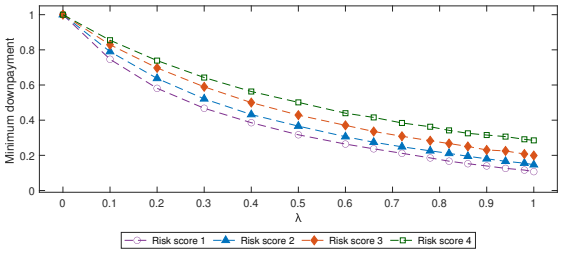
PAYGo financing is new form of lending that relies on lockout technology to screen borrowers and enforce repayment.

- Recent rapid growth so important to understand the welfare implications.
- The welfare gains to consumers from access to PAYGo financing are higher for low risk borrowers.
  - Within risk score, gains are highest for intermediate income individuals.
- PAYGo lending remains highly profitable for the lender
  - Welfare gains are 30-50% larger under competitive pricing
- Leniency policies can further increase welfare while harsher policies reduce welfare

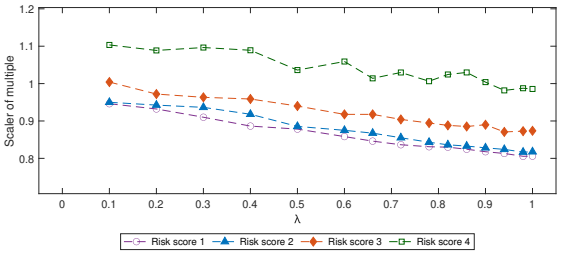
Supplemental Slides

Effects of Lock Strength Under Competitive Pricing

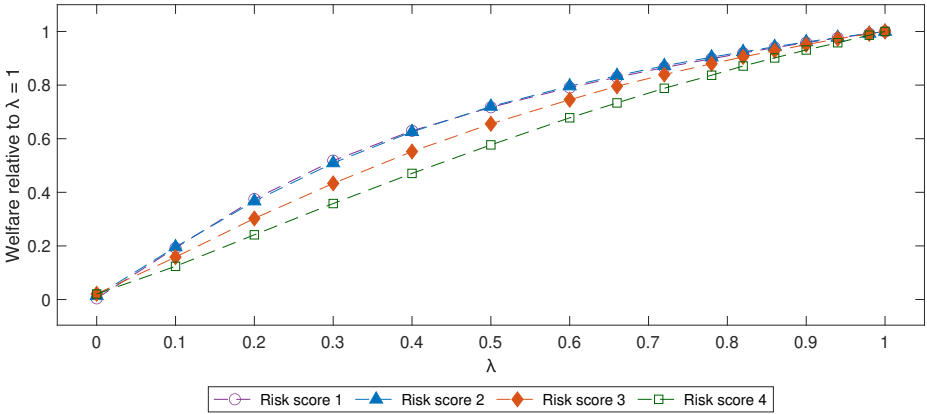
Competitive Minimum Downpayment



Competitive Multiple



Effects of Lock Strength on Welfare Under Competitive Pricing



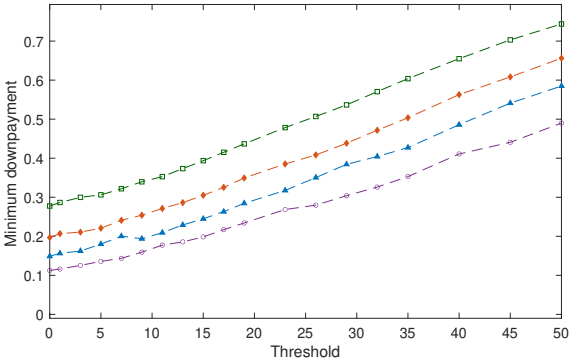
Optimal Lockout: More Lenient

- Can a more lenient lockout benefit consumers?
  - Pro: Facilitate risk sharing and consumption smoothing
  - Con: Lower repayment incentive $\implies$ higher prices

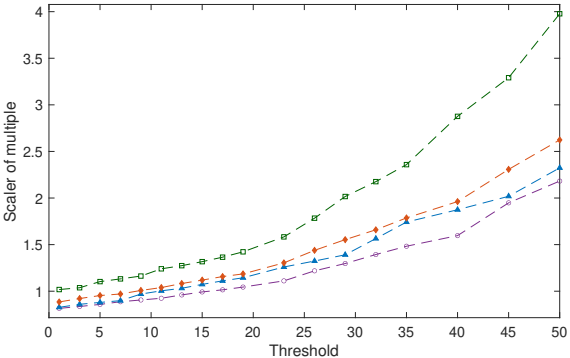
- $\Gamma \equiv (D, T, \theta, \bar{a})$
  - Allow a "buffer" of $\bar{a}$ missed payments
  - $\bar{a}$ is number of cumulative payments missed at which the lender initiates the lockout technology

Leniency

Competitive Minimum Downpayment



Competitive Multiple



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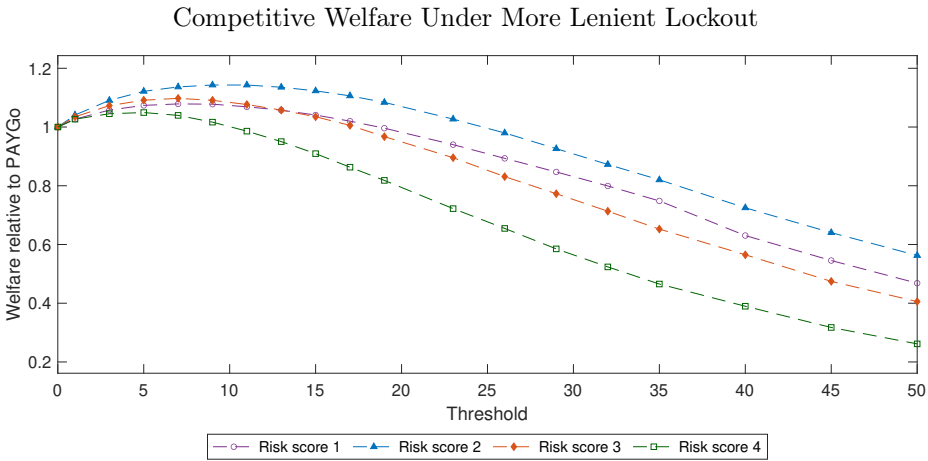
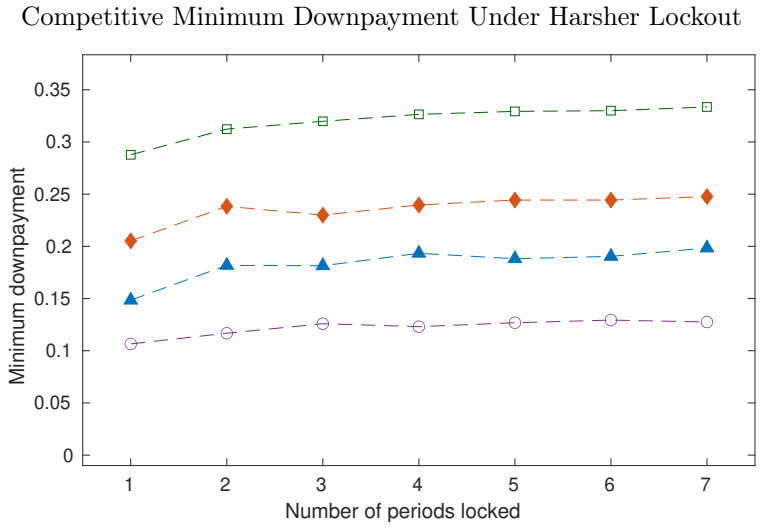


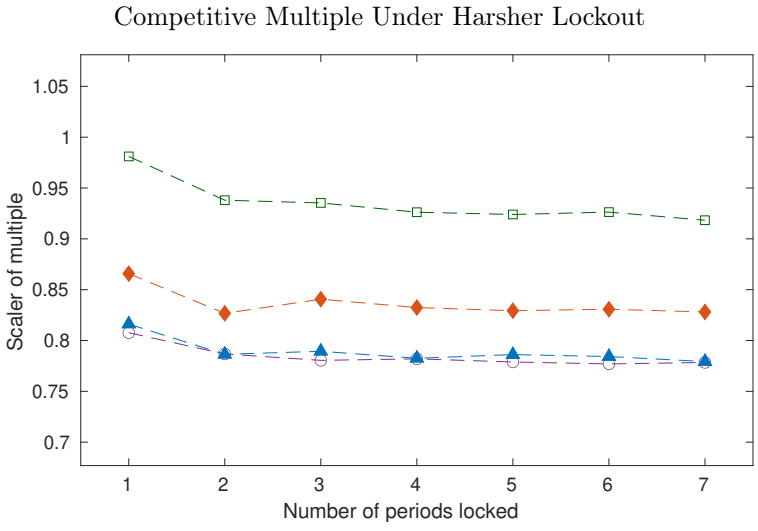
Optimal Lockout: Harsher

- Can a harsher lockout benefit consumers?
  - Pro: Create more repayment incentive, reduce prices
  - Con: Destroy more welfare upon lockout
- Two ways we have considered this:
  - Lock for multiple periods after missing a payment
  - Charge a higher price following missed payments
- Conclusion: harsher punishments decrease the welfare gains from PAYGo

Optimal Lockout: Harsher



Optimal Lockout: Harsher



Optimal Lockout: Harsher