

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

Paul Gertler<sup>1</sup>   Brett Green<sup>2</sup>   Renping Li<sup>3</sup>   David Sraer<sup>1</sup>

<sup>1</sup>Hass School of Business  
University of California, Berkeley

<sup>2</sup>Olin Business School  
Washington University in St. Louis

<sup>3</sup>Freeman School of Business  
Tulane University

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# Motivation

- Consumer lending markets are fraught 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 gives lenders the ability to remotely lock collateral
  - ▶ Solar home systems remotely controlled by lender (Gertler, Green, and Wolfram, QJE 2024)
  - ▶ New types of “PAYGo financing” 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<sup>th</sup> payment.
  - ▶ Regardless of when that payment is made.

# This Paper

- Reduced-form evidence using data from a pricing experiment conducted by a fintech lender offering PAYGo financing for smartphones in Mexico
- Estimate a dynamic structural model to match the 4x2 pricing experiment
  - ▶ Exploit variation in both multiples and required downpayments
  - ▶ Identify “deep” utility primitives from take-up, maturity choice and repayment dynamics
- Use the estimated model for counterfactual analysis
  - ▶ Decompose effect of lockout on moral hazard and adverse selection (not covered today)
  - ▶ Quantify welfare effects of PAYGo financing
  - ▶ Compare PAYGo financing to traditional repossession contracts (not covered today)
  - ▶ 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), Stroebe (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: Multiple Arms

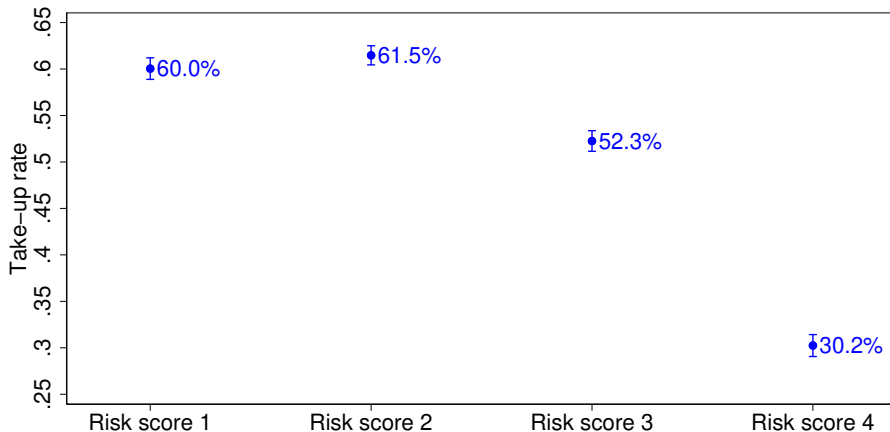
	Ctrl	Medium	High	Steep
3 month	1.36	1.4	1.55	1.4
6 month	1.54	1.63	1.8	1.7
9 month	1.64	1.8	2	1.95
12 month	2	2.2	2.4	2.5

Panel B: Downpayment Arms

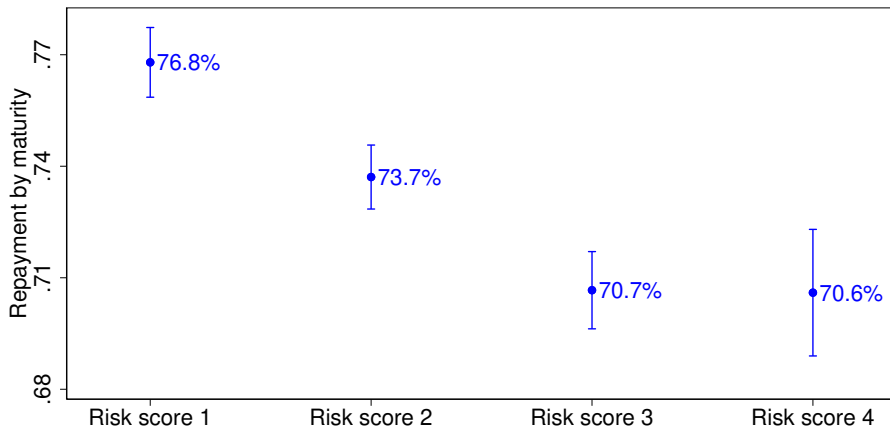
	Control	Lower
Risk score 1 (Least risky)	25%	20%
Risk score 2	30%	25%
Risk score 3	35%	30%
Risk score 4 (Most risky)	50%	40%



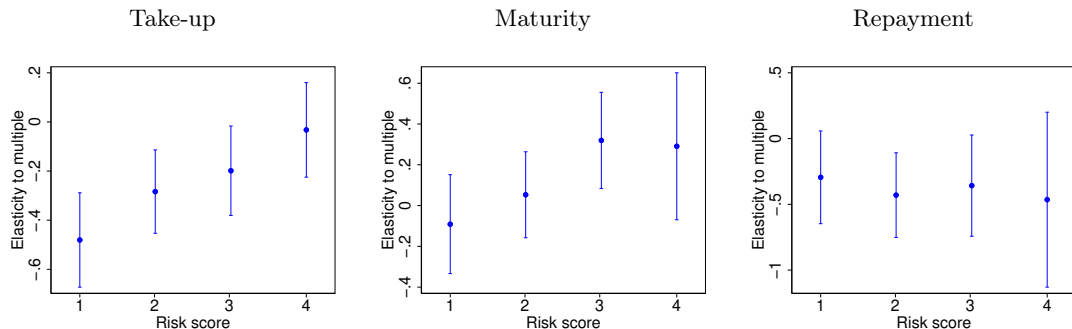
## Reduced-Form Evidence: Take-up by Risk Score



## Reduced-Form Evidence: Repayment by Risk Score



# 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)

# 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 four types of decisions in the model.
  - ① Take-up: if accept contract
  - ② Maturity choice: 3, 6, 9, or 12 months
  - ③ Downpayment choice: liquidity cost  $\mu$
  - ④ 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

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

where  $\lambda$  denotes the “strength” of the lock.

- 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 (Least risky)	RS2	RS3	RS4 (Most risky)
$\bar{y}$ (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
$\sigma_{\epsilon}$ (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
$\phi$ (prob. of depreciation, weekly)	0.030	0.030	0.034	0.041
$\beta$ (discount factor, weekly)	0.997	0.989	0.995	0.996
$\mu$ (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

# Consumer Welfare and Firm Profitability

## Welfare Measure

- The percentage increase in income over two years that would deliver the same utility as having access to the menu of PAYGo contracts
  - ▶ Benchmark: 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  $\mathcal{W}_{sample} \equiv \mathbb{E}[\mathcal{W}_i]$



# Welfare Measure

- Consider two scenarios:



**Scenario 1: Access to PAYGo**



**Scenario 2: Proportional  $\uparrow$  in income**

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# Summary of Consumer Welfare and Firm Profitability

Treatment Group	(1) Take-up	(2) $\mathcal{W}_{taker}$	(3) $\mathcal{W}_{sample}$	(4) NPV	(5) IRR
<i>Risk score 1</i>					
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%
<i>Risk score 2</i>					
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%
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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%
  - ▶ This counterfactual facilitates comparison of **social welfare** across contract design

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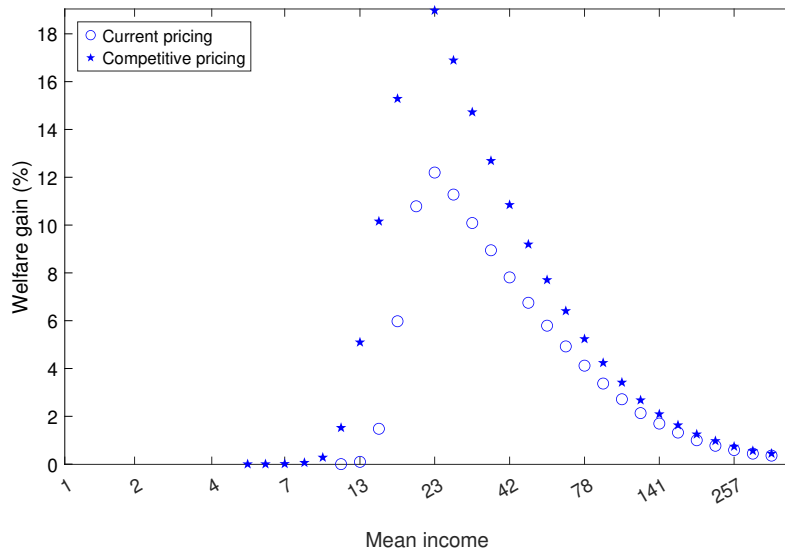
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# Welfare by Income, Risk Score 1



# 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

## Stronger incentives

- Fees for missed payments
- Locked for multiple periods

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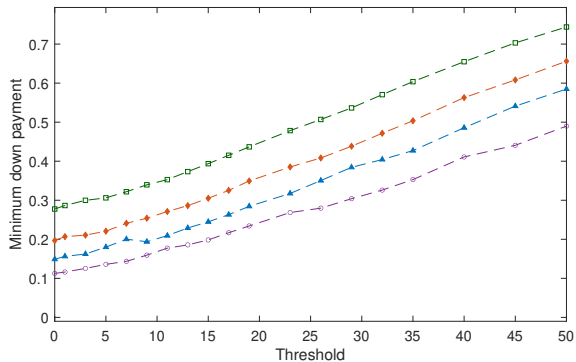
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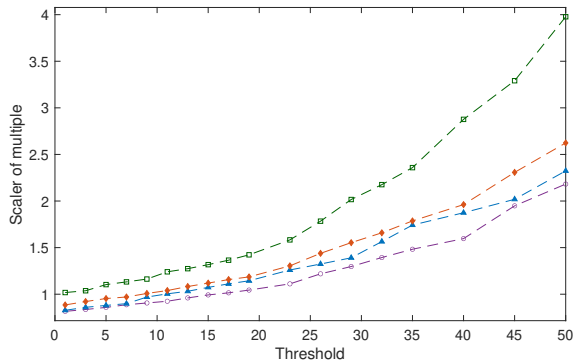
**Main Finding:** Only the leniency policy can improve on PAYGo

# Optimal Lockout: More Lenient

## Competitive Minimum Downpayment

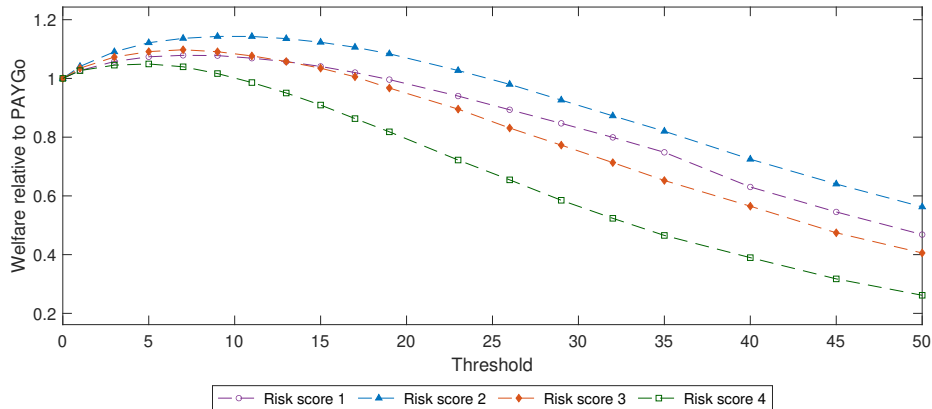


## Competitive Multiple



# Optimal Lockout: More Lenient

Competitive Welfare Under More Lenient Lockout



# Summary

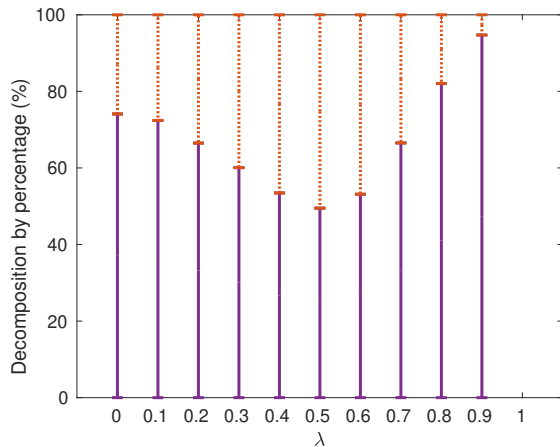
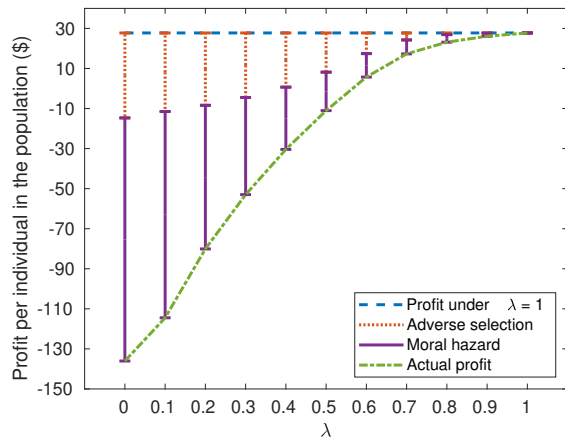
PAYGo financing is new form of lending that relies on lockout technology to screen borrowers and enforce repayment.

- 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.
- 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



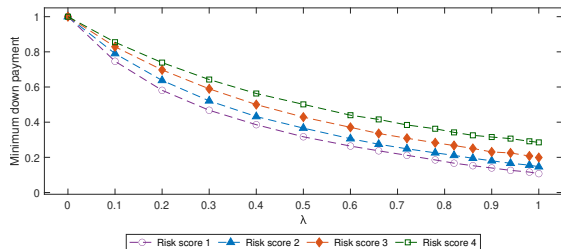
## Supplemental Slides

# Decomposition of the Effect of Lockout

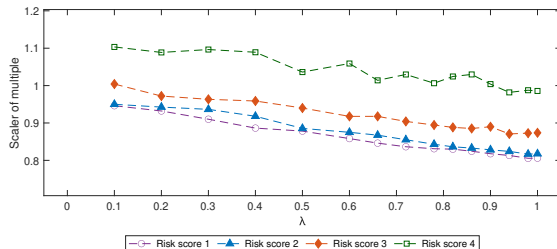


# Effects of Lock Strength Under Competitive Pricing

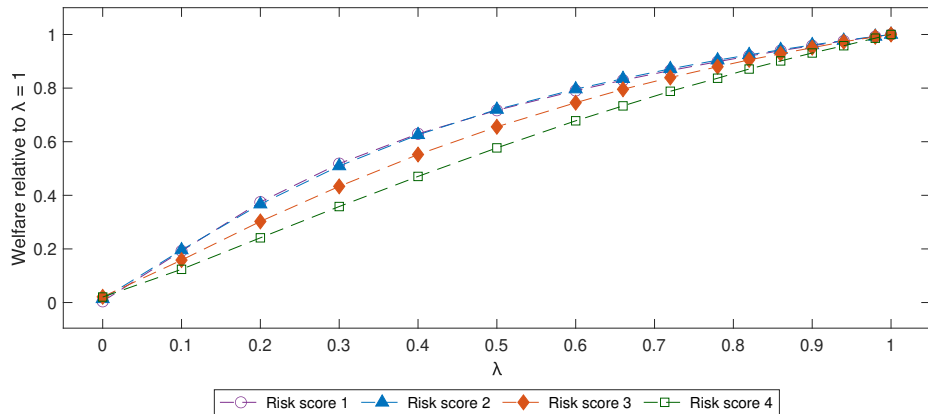
## Competitive Minimum Downpayment



## Competitive Multiple



# Effects of Lock Strength on Welfare Under Competitive Pricing

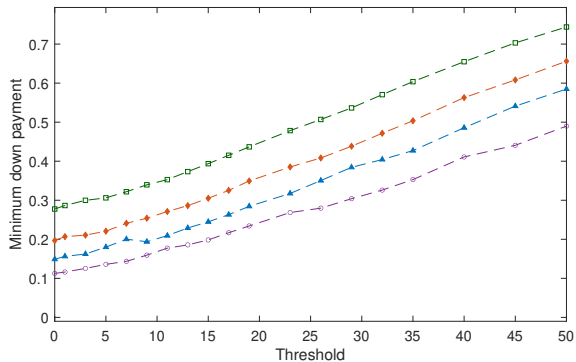


## Optimal Lockout: More Lenient

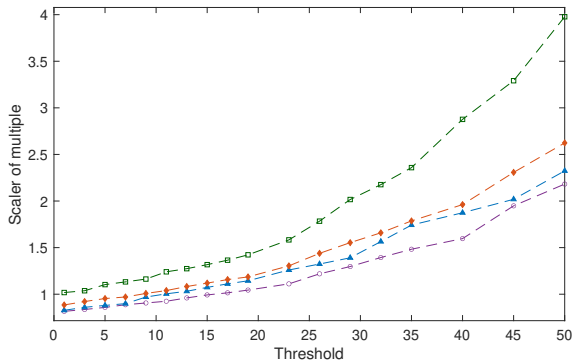
- Can a more lenient lockout benefit consumers?
  - ▶ Pro: Facilitate risk sharing and consumption smoothing
  - ▶ Con: Lower repayment incentive  $\implies$  higher prices
- $\Gamma \equiv (D, T, \theta, \bar{a})$ 
  - ▶ Allow a “buffer” of  $\bar{a}$  missed payments
  - ▶  $\bar{a}$  is number of cumulative payments missed at which the lender initiates the lockout technology

# Leniency

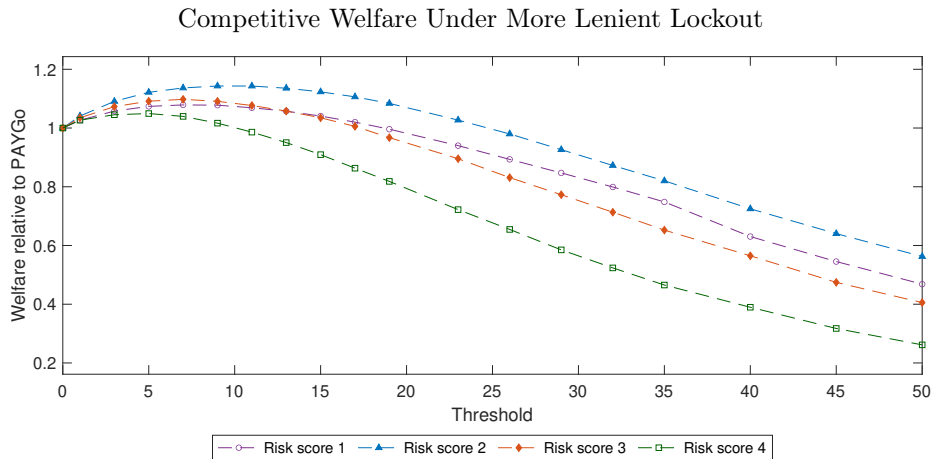
Competitive Minimum Downpayment



Competitive Multiple



# Optimal Lockout: More Lenient



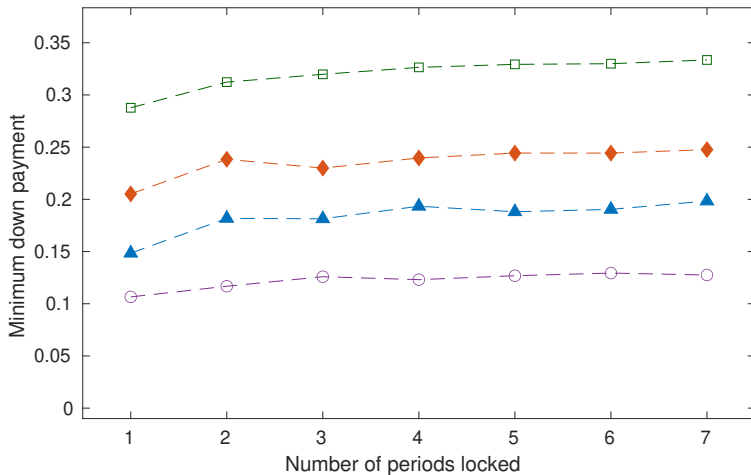
## Optimal Lockout: Harsher

- 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



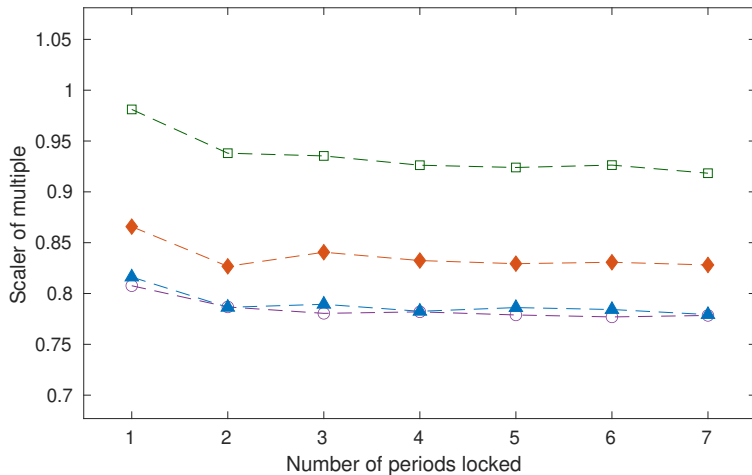
# Optimal Lockout: Harsher

Competitive Minimum Downpayment Under Harsher Lockout



## Optimal Lockout: Harsher

Competitive Multiple Under Harsher Lockout



# Optimal Lockout: Harsher

Competitive Welfare Under Harsher Lockout

