

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

Paul Gertler¹ Brett Green² Renping Li³ David Sraer¹

¹Hass School of Business
University of California, Berkeley

²Olin Business School
Washington University in St. Louis

³Freeman 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 26th 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), 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

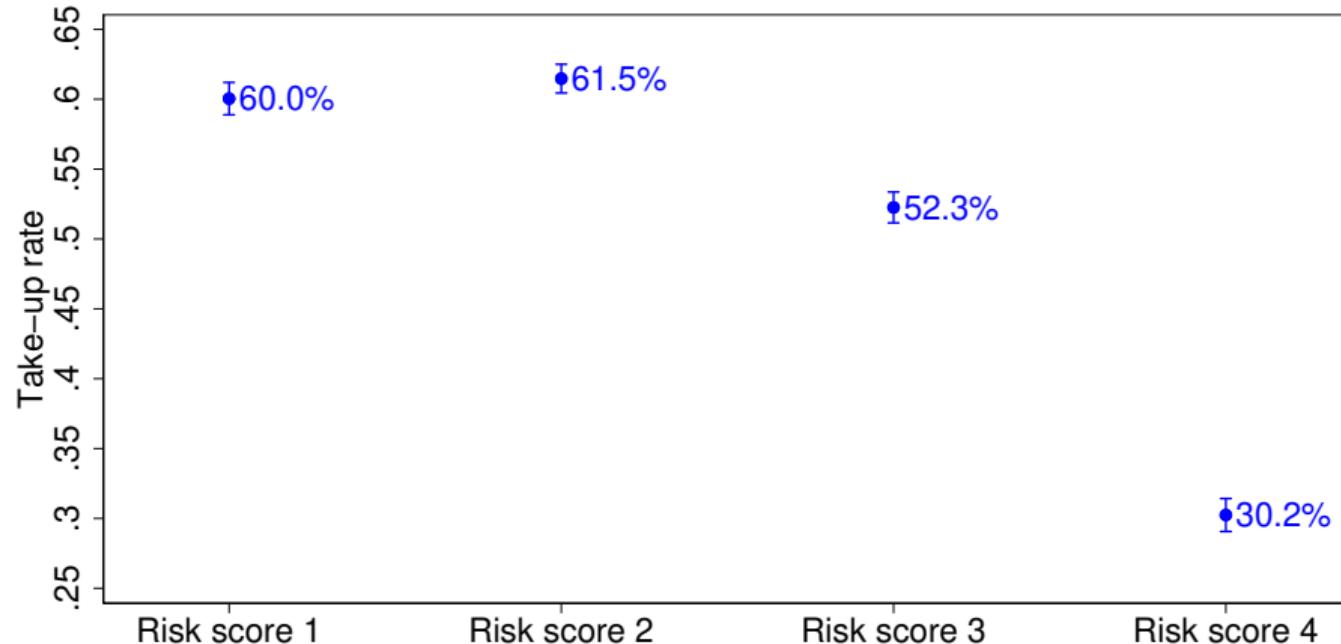
Panel A: Multiple Arms

	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

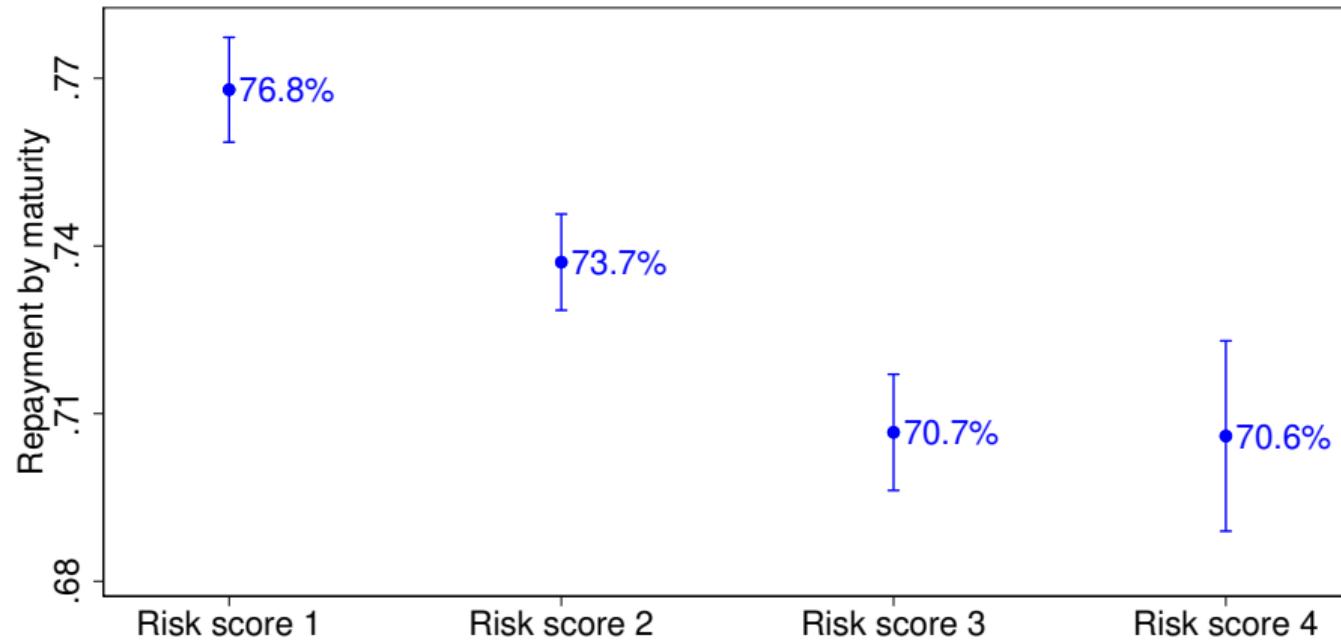
Panel B: Downpayment Arms

	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

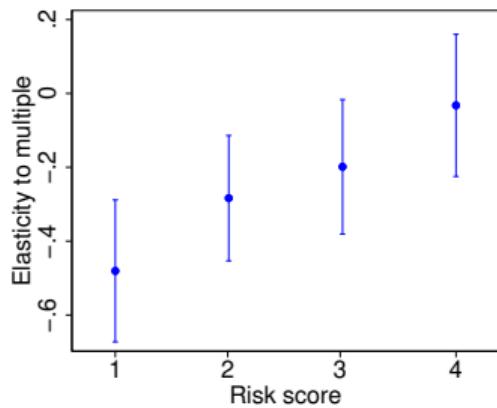


Reduced-Form Evidence: Repayment by Risk Score

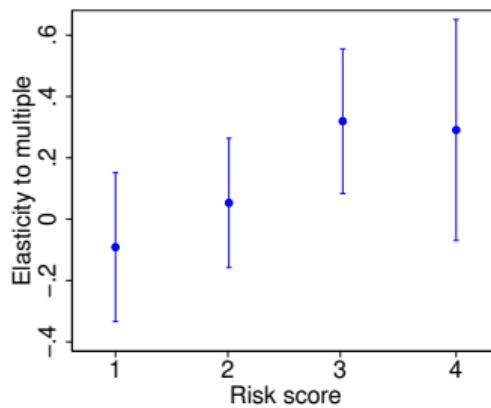


Reduced-Form Evidence: Heterogeneity Across Risk Scores

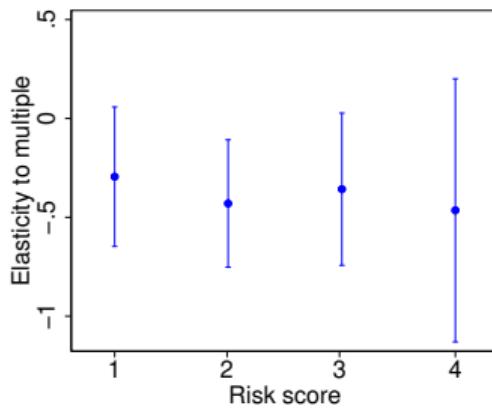
Take-up



Maturity



Repayment



- 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 μ
 - 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

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

where λ 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
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

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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Treatment Group	(1) Take-up	(2) \mathcal{W}_{taker}	(3) \mathcal{W}_{sample}	(4) NPV	(5) IRR
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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%
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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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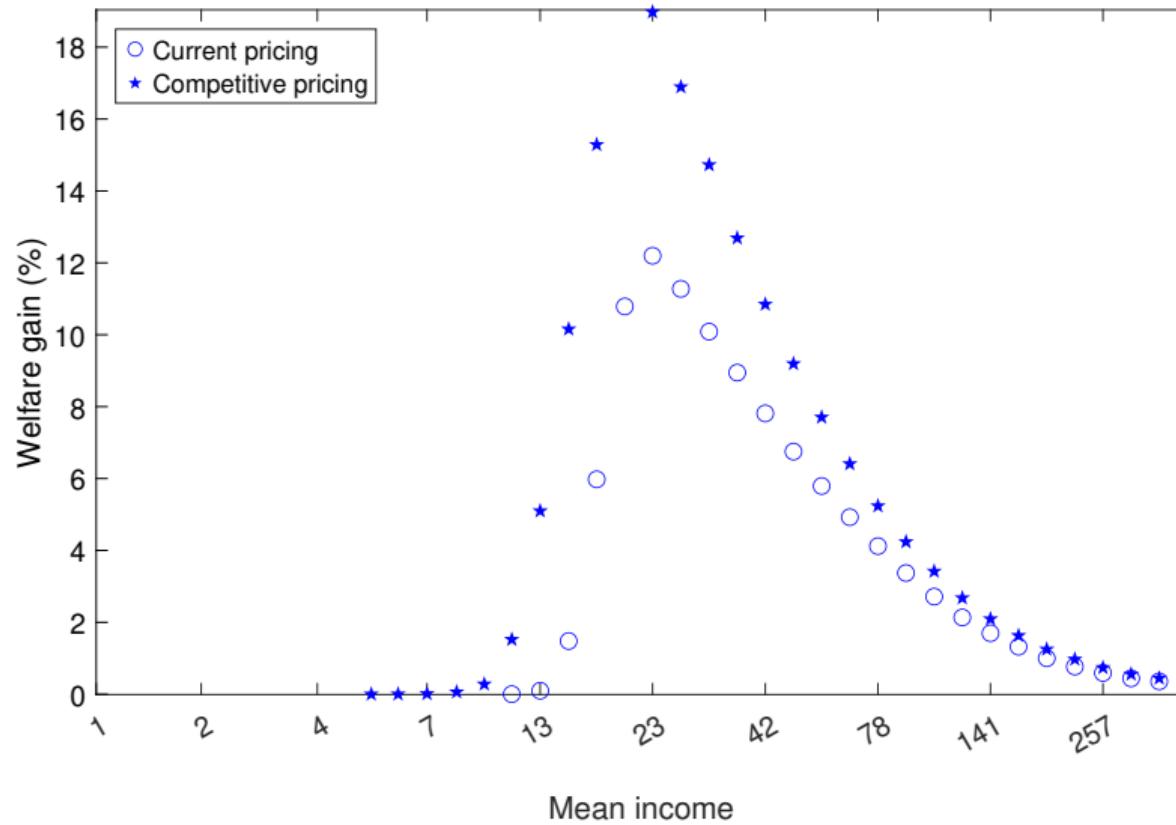
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Welfare by Income, Risk Score 1



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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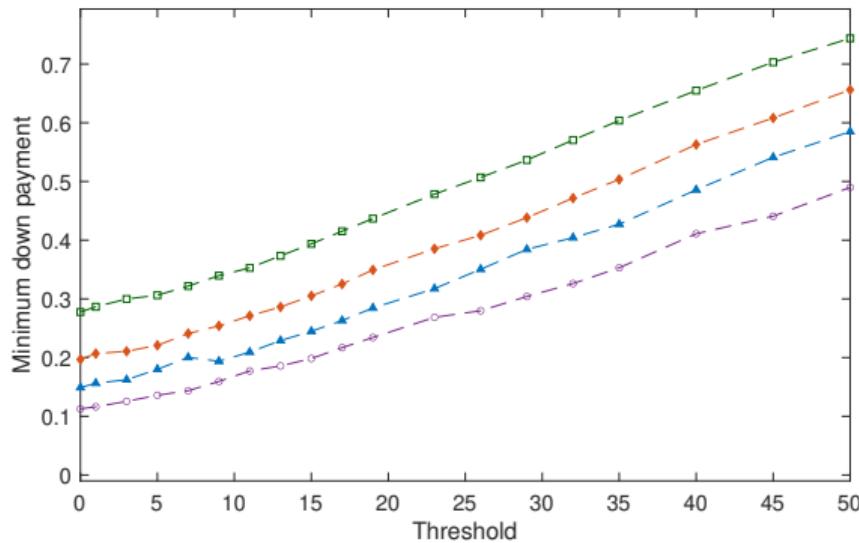
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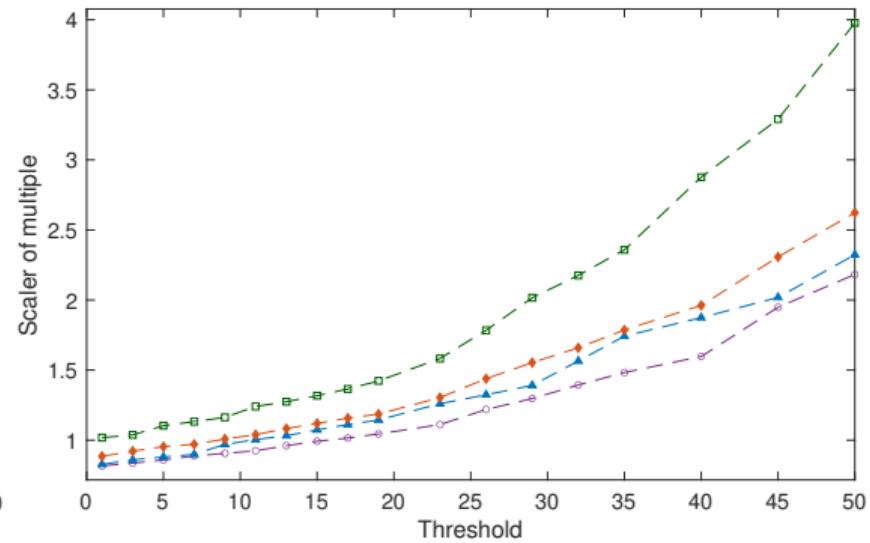
Main Finding: Only the leniency policy can improve on PAYGo

Optimal Lockout: More Lenient

Competitive Minimum Downpayment

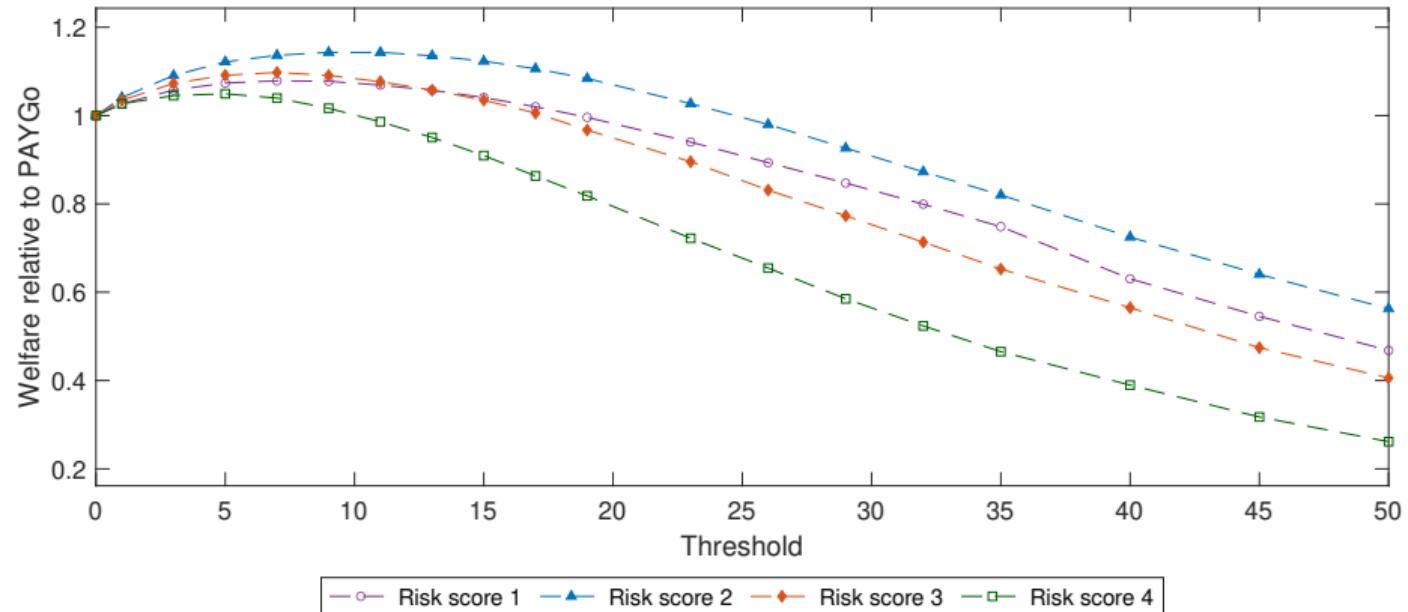


Competitive Multiple



Optimal Lockout: More Lenient

Competitive Welfare Under More Lenient Lockout



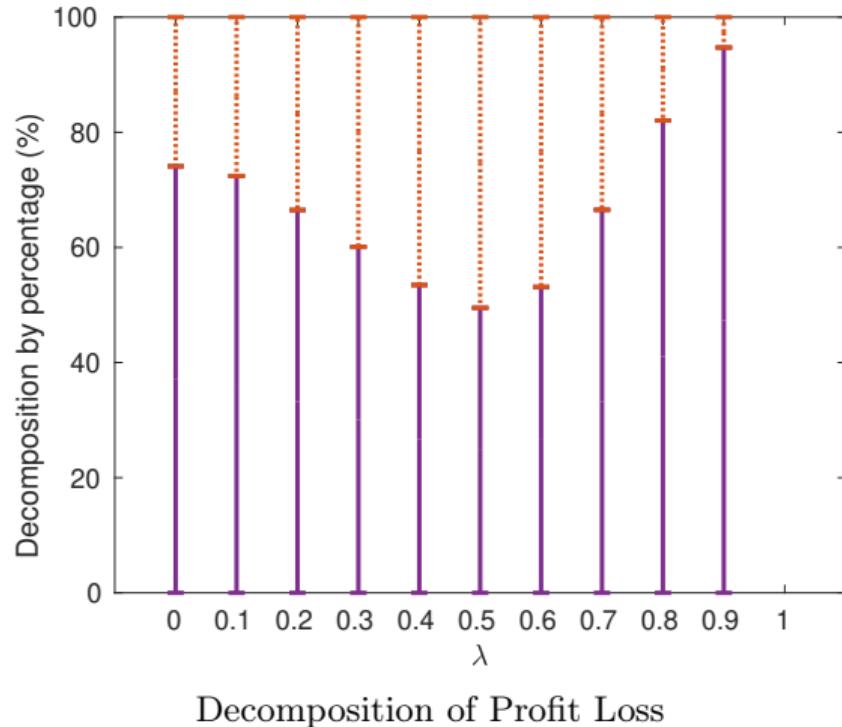
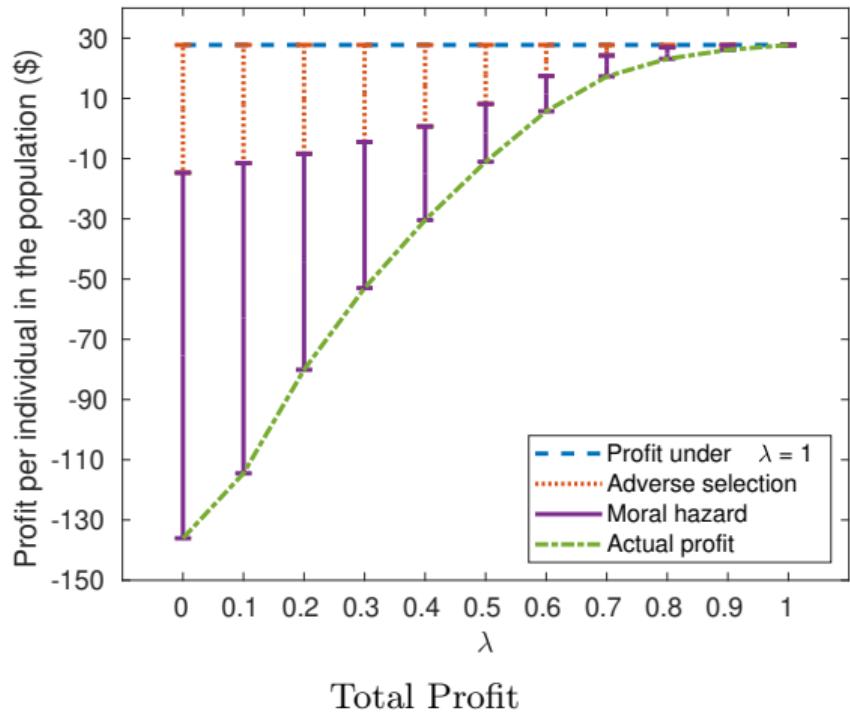
Summary

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

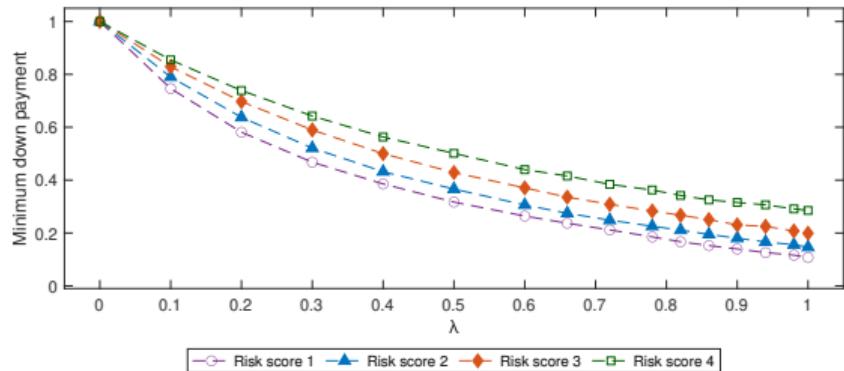
Supplemental Slides

Decomposition of the Effect of Lockout

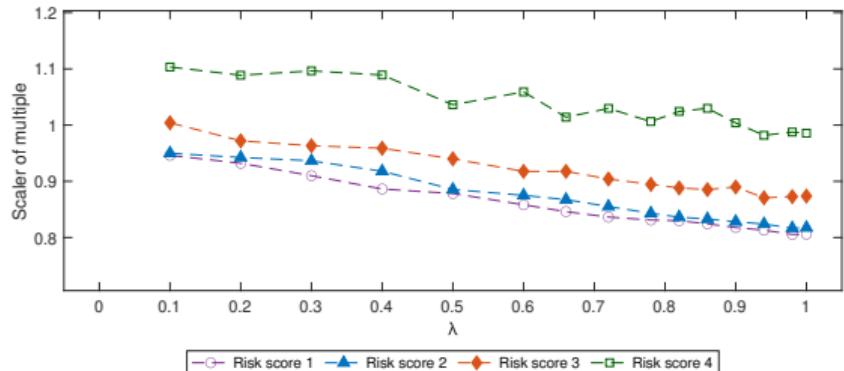


Effects of Lock Strength Under Competitive Pricing

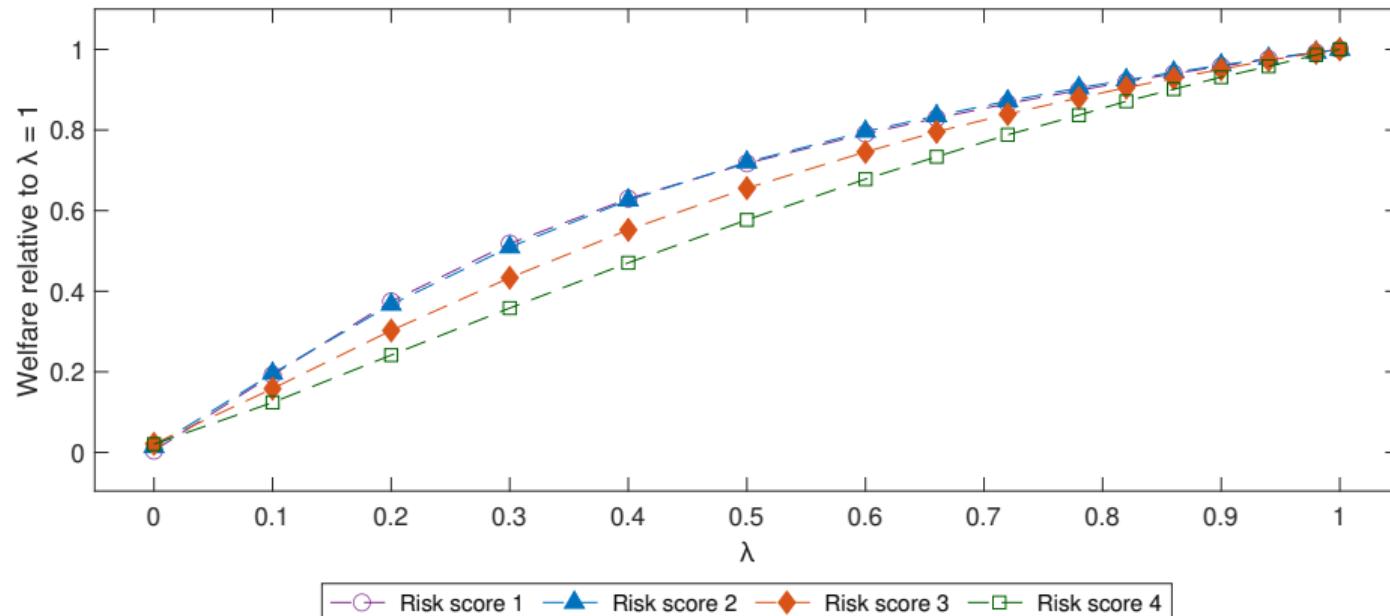
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Competitive Multiple



Effects of Lock Strength on Welfare Under Competitive Pricing

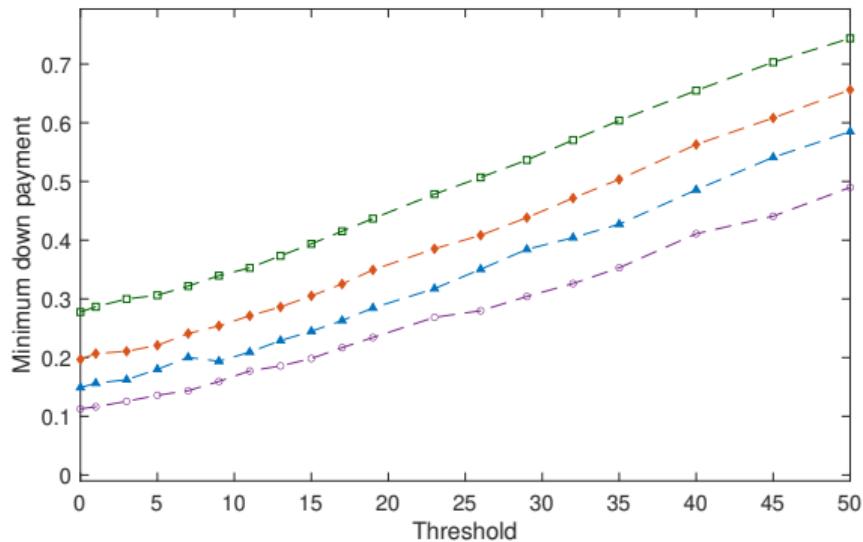


Optimal Lockout: More Lenient

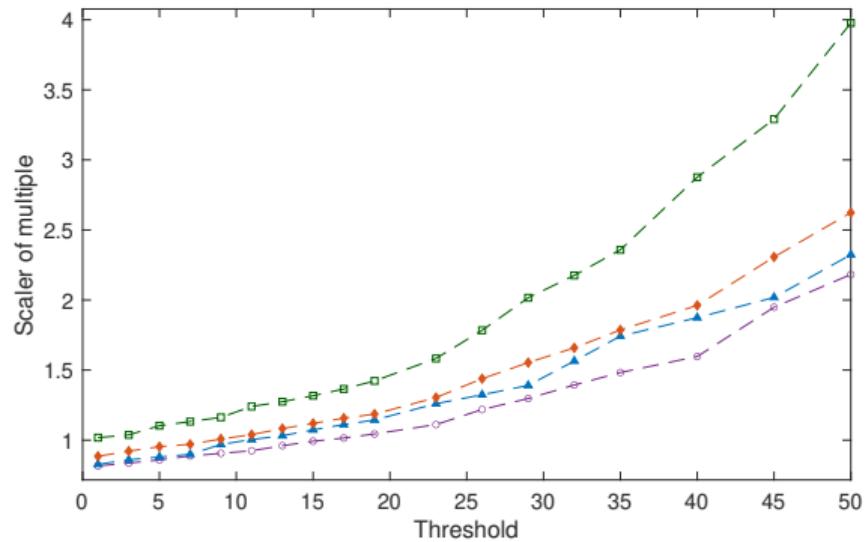
- Can a more lenient lockout benefit consumers?
 - ▶ Pro: Facilitate risk sharing and consumption smoothing
 - ▶ Con: Lower repayment incentive \implies higher prices
- $\Gamma \equiv (D, T, \theta, \bar{a})$
 - ▶ Allow a “buffer” of \bar{a} missed payments
 - ▶ \bar{a} is number of cumulative payments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

Leniency

Competitive Minimum Downpayment

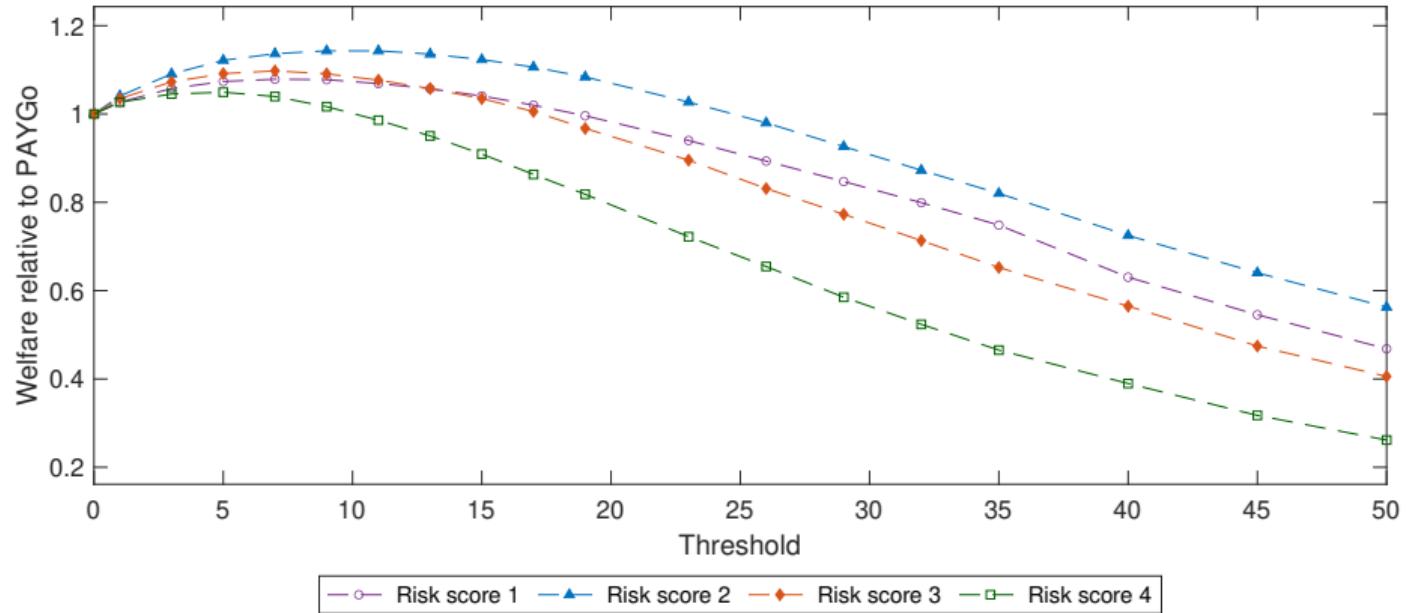


Competitive Multiple



Optimal Lockout: More Lenient

Competitive Welfare Under More Lenient Lockout

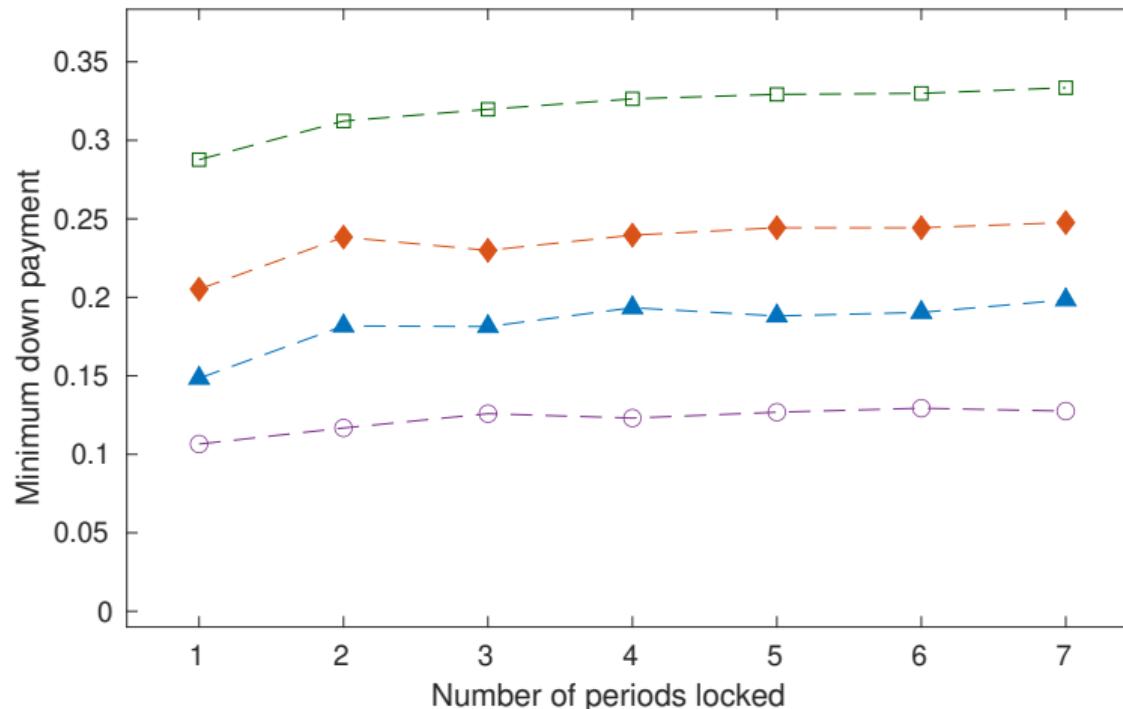


Optimal Lockout: Harsher

- 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

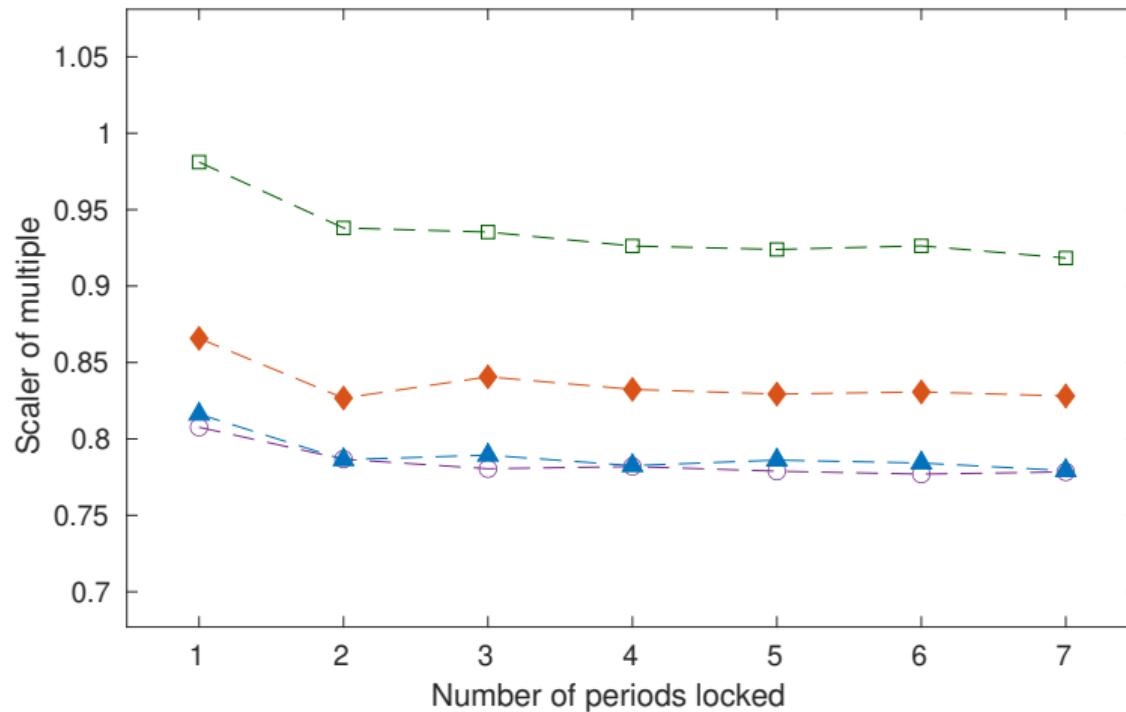
Optimal Lockout: Harsher

Competitive Minimum Downpayment Under Harsher Lockout



Optimal Lockout: Harsher

Competitive Multiple Under Harsher Lockout



Optimal Lockout: Harsher

Competitive Welfare Under Harsher Lockout

