

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

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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

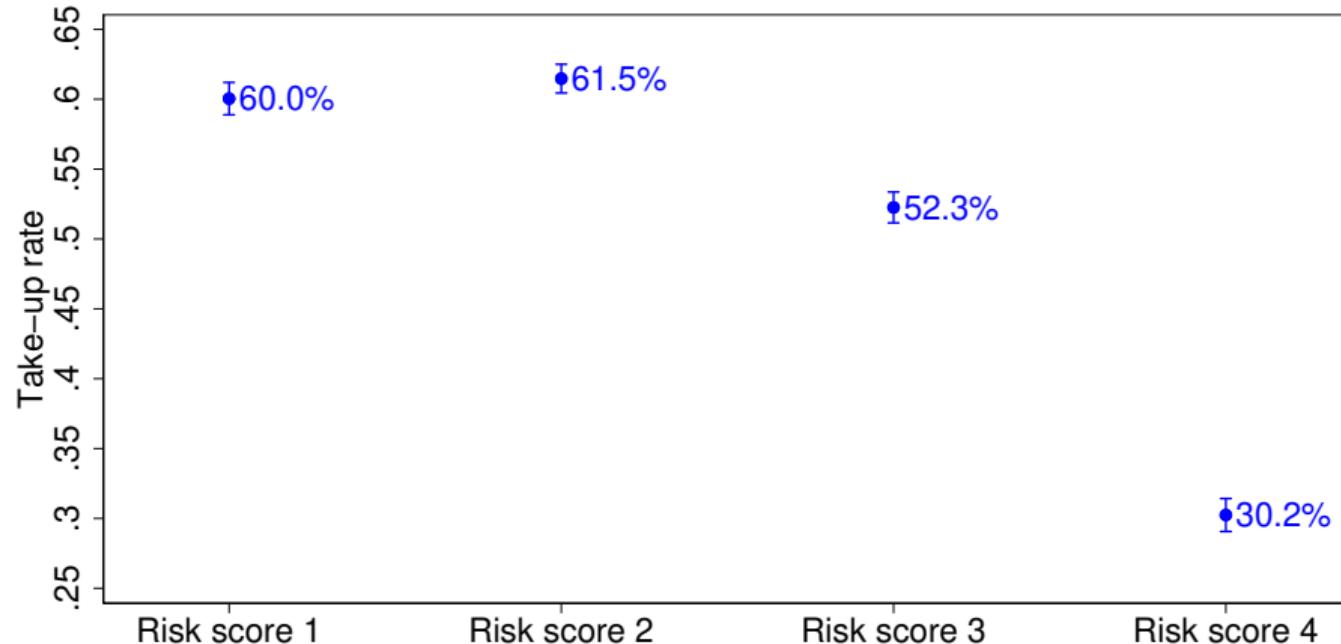
Panel A: Multiple Arms

	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

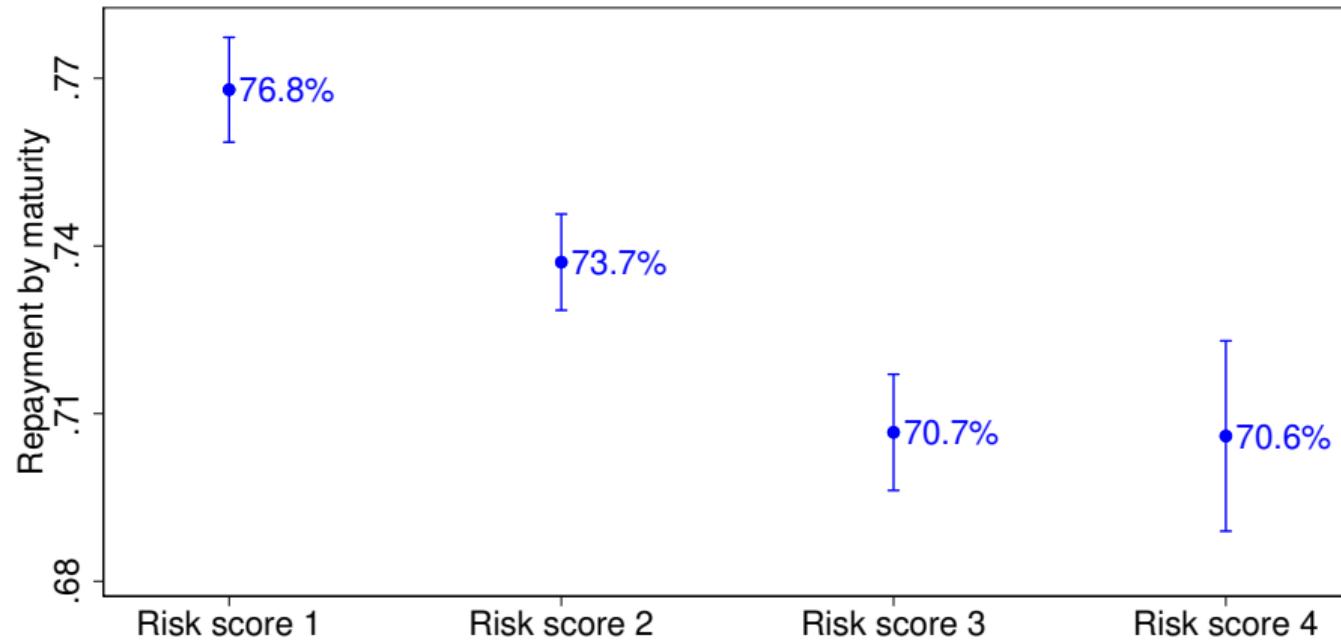
Panel B: Downpayment Arms

	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

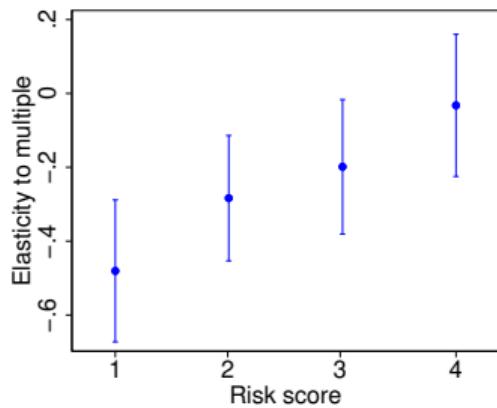


Reduced-Form Evidence: Repayment by Risk Score

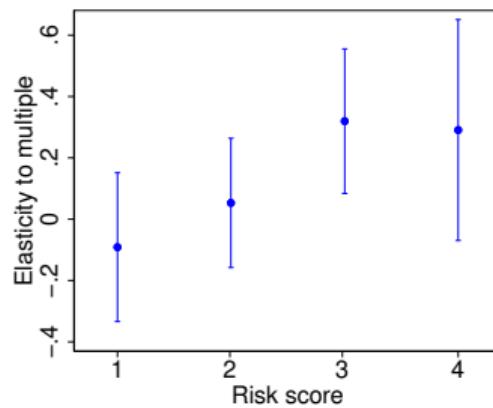


Reduced-Form Evidence: Heterogeneity Across Risk Scores

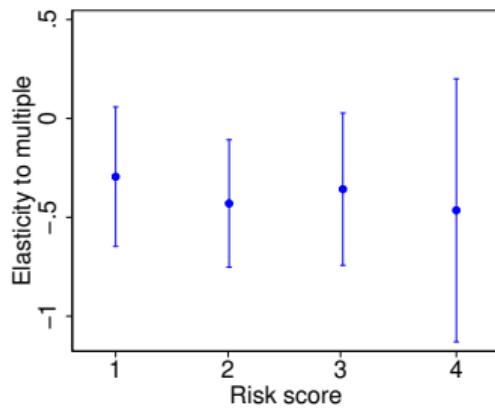
Take-up



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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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%
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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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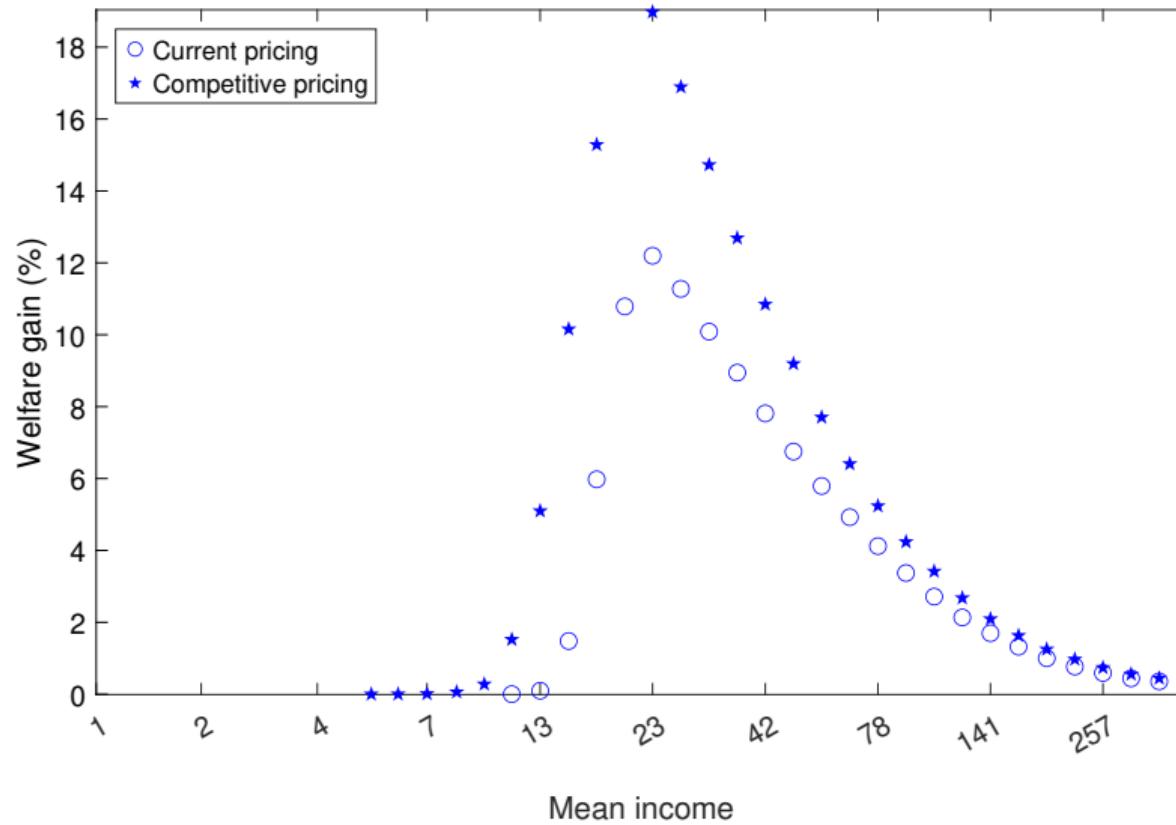
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Welfare by Income, Risk Score 1



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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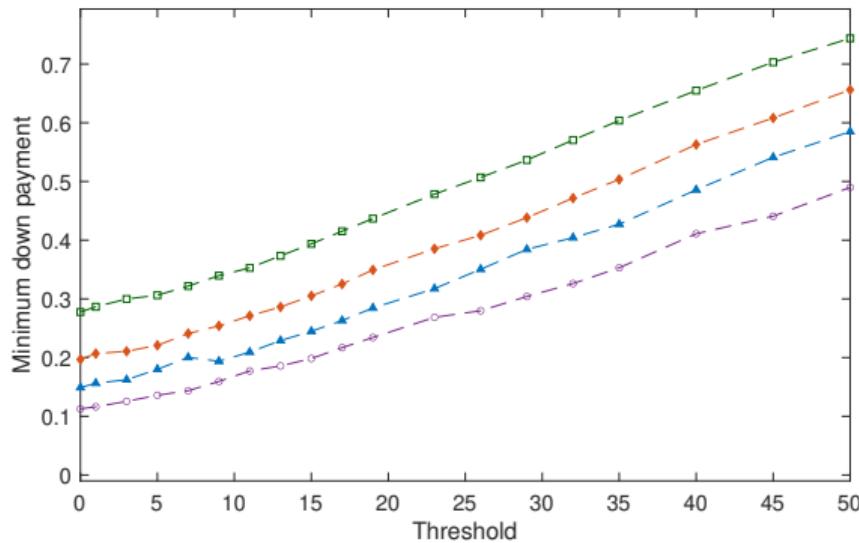
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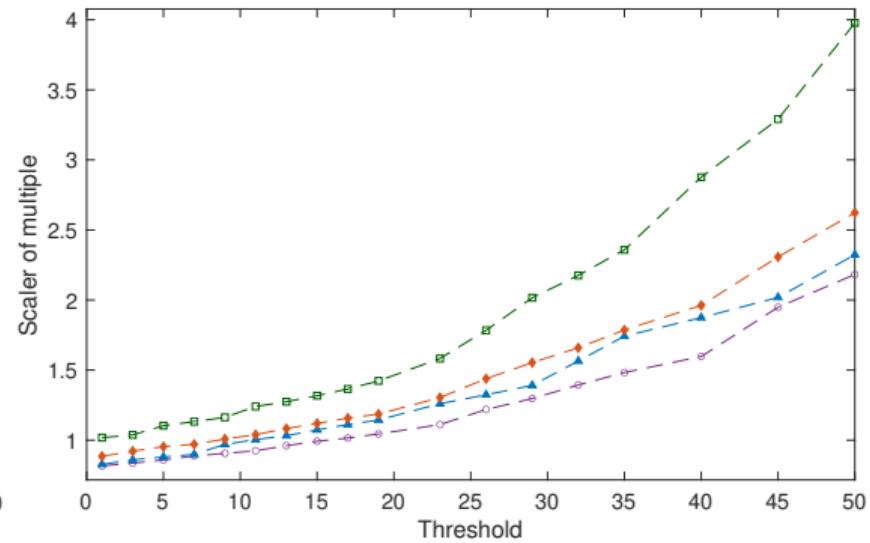
Main Finding: Only the leniency policy can improve on PAYGo

Optimal Lockout: More Lenient

Competitive Minimum Downpayment

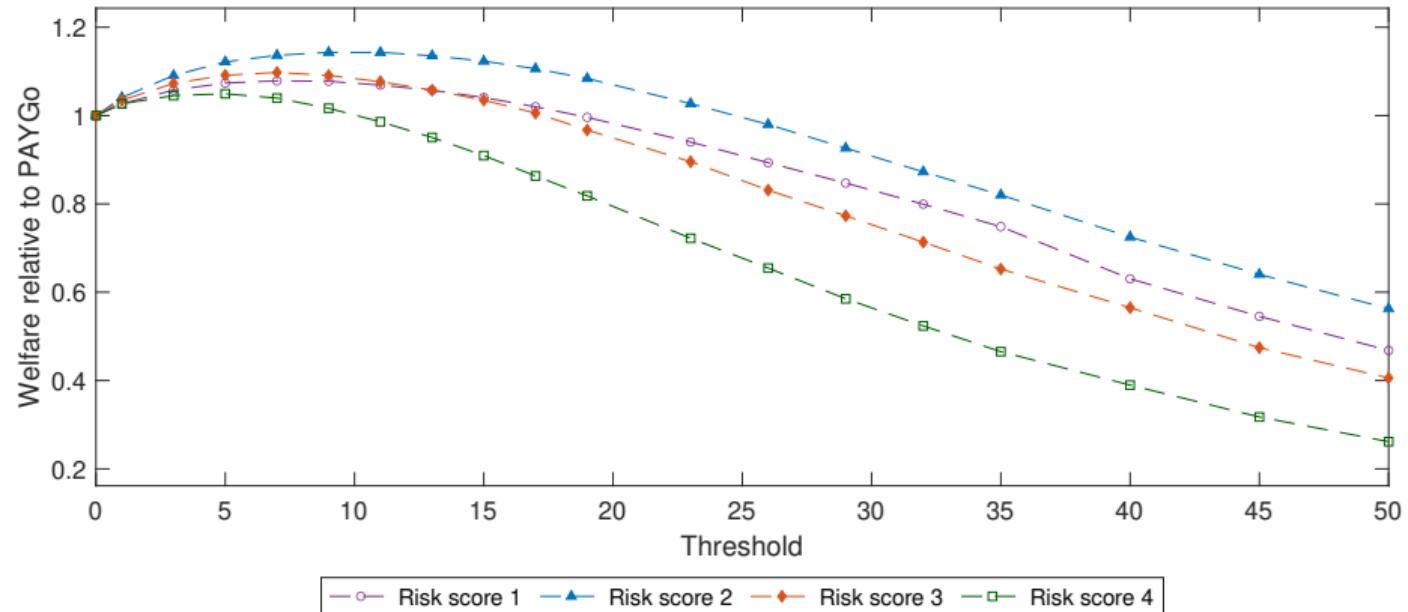


Competitive Multiple



Optimal Lockout: More Lenient

Competitive Welfare Under More Lenient Lockout



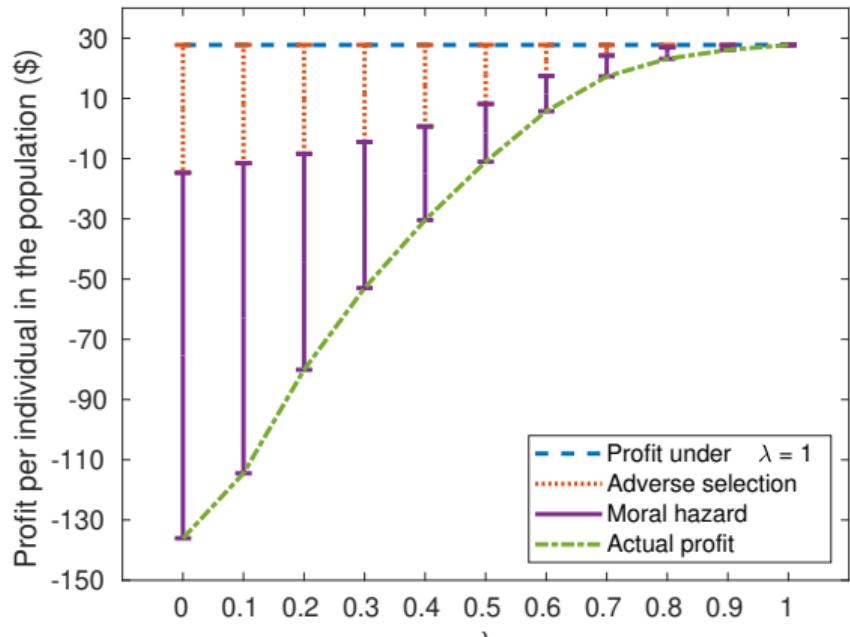
Summary

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

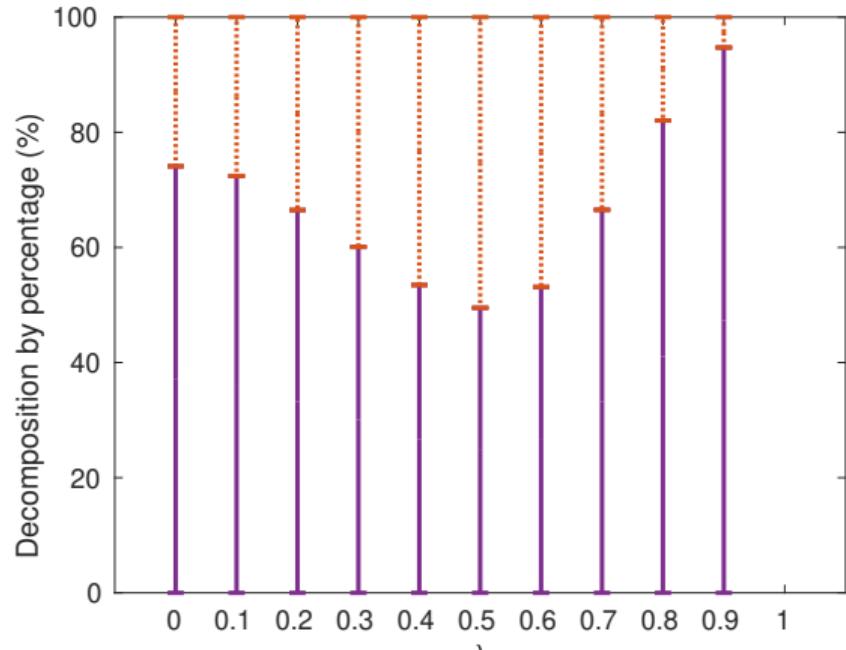
- Recent rapid growth so important to understand the welfare implications.
- The welfare gains to consumers from access to PAYGo financing are higher for low risk borrowers.
- PAYGo lending remains highly profitable for the lender
 - ▶ Welfare gains are 30-50% larger under competitive pricing
- Leniency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

Supplemental Slides

Decomposition of the Effect of Lockout



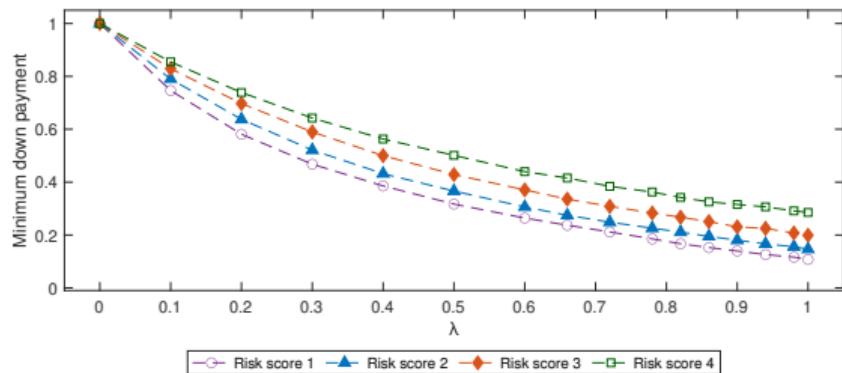
Total Profit



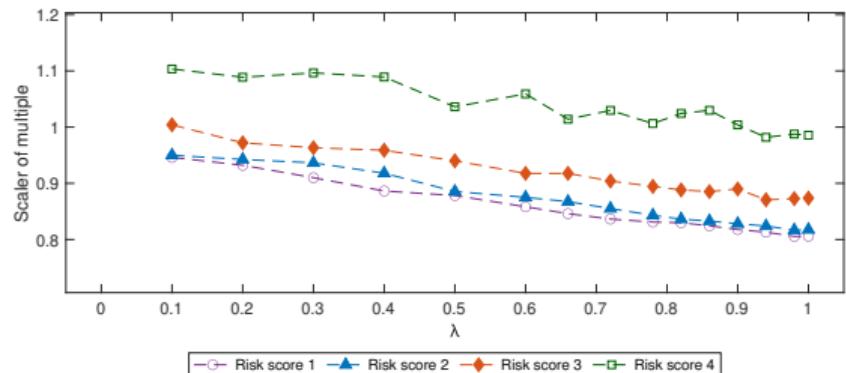
Decomposition of Profit Loss

Effects of Lock Strength Under Competitive Pricing

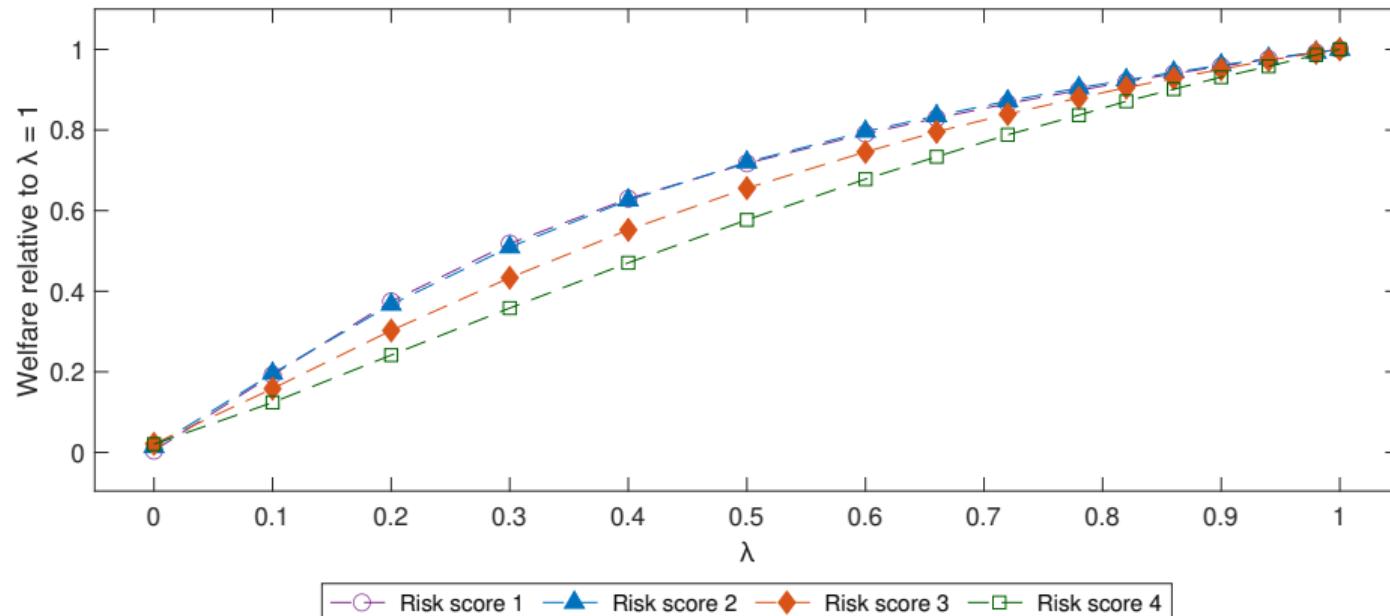
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Competitive Multiple



Effects of Lock Strength on Welfare Under Competitive Pricing

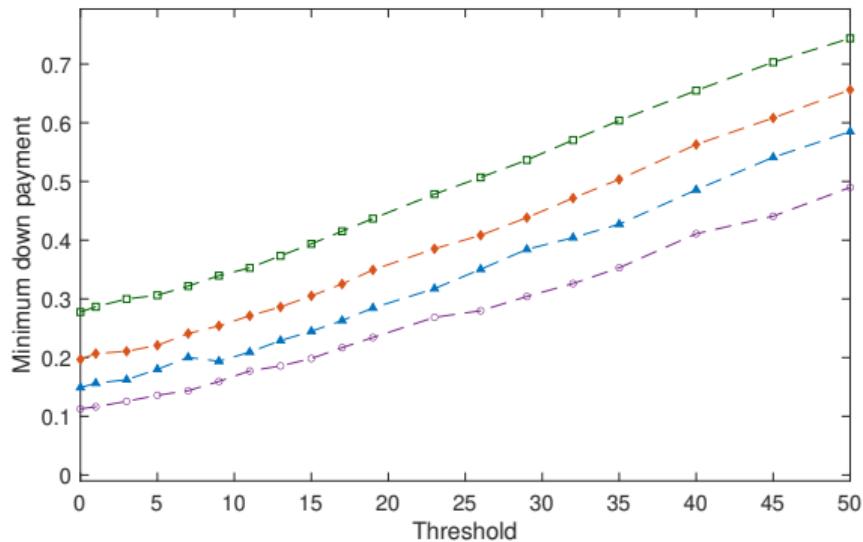


Optimal Lockout: More Lenient

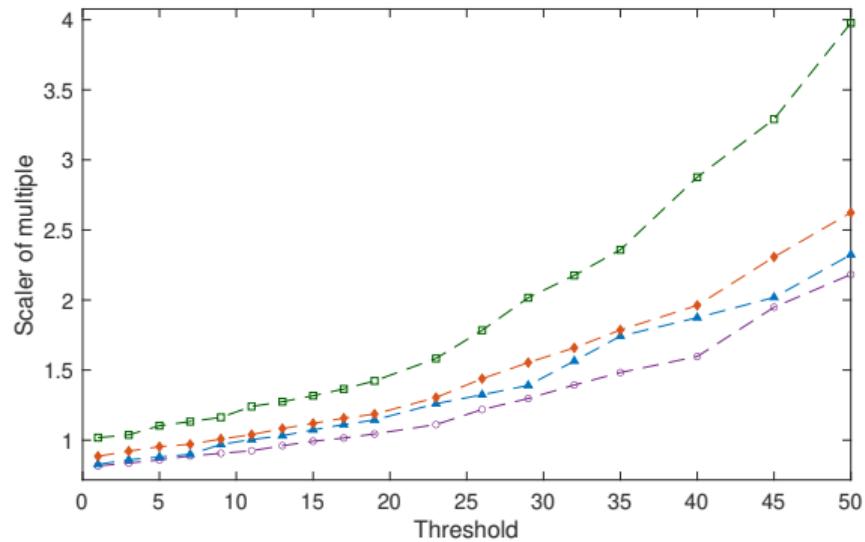
- Can a more lenient lockout benefit consumers?
 - ▶ Pro: Facilitate risk sharing and consumption smoothing
 - ▶ Con: Lower repayment incentive \implies higher prices
- $\Gamma \equiv (D, T, \theta, \bar{a})$
 - ▶ Allow a “buffer” of \bar{a} missed payments
 - ▶ \bar{a} is number of cumulative payments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

Leniency

Competitive Minimum Downpayment

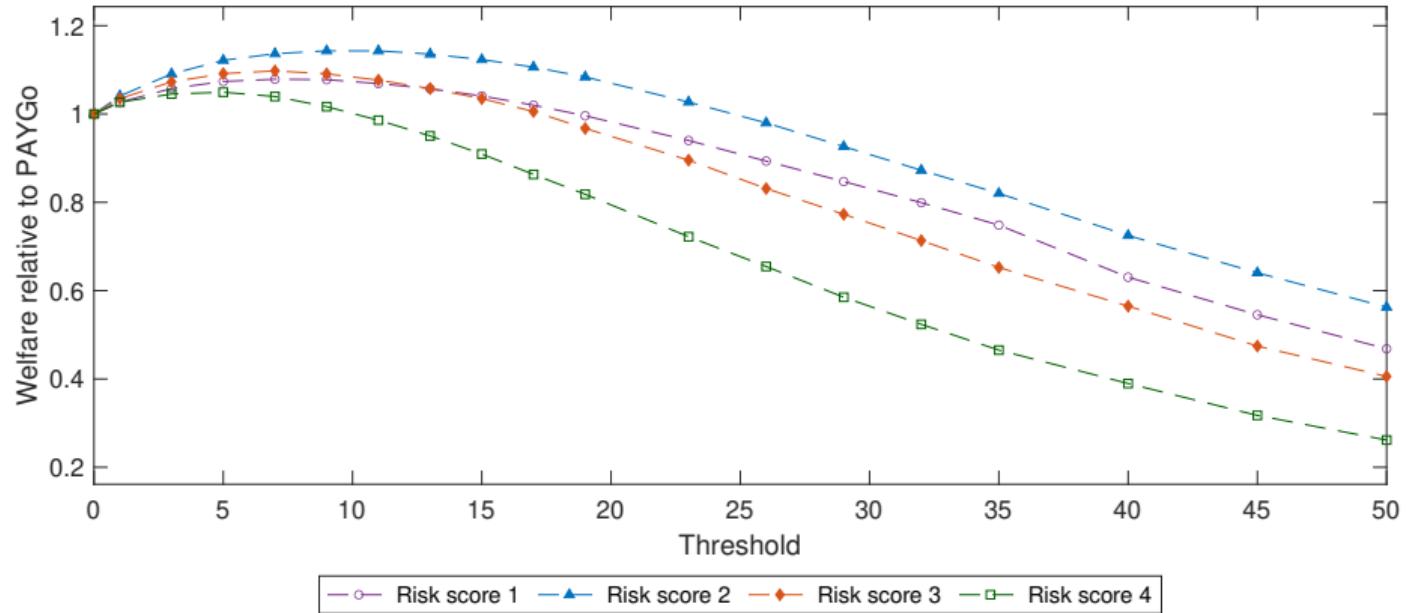


Competitive Multiple



Optimal Lockout: More Lenient

Competitive Welfare Under More Lenient Lockout

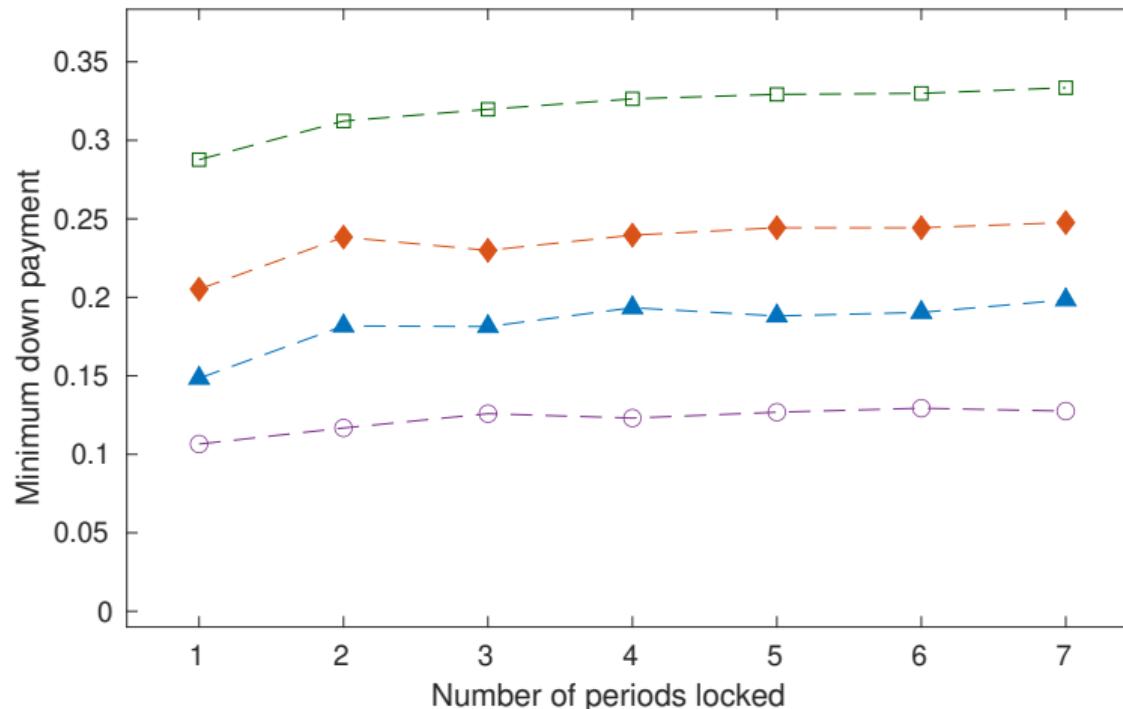


Optimal Lockout: Harsher

- 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

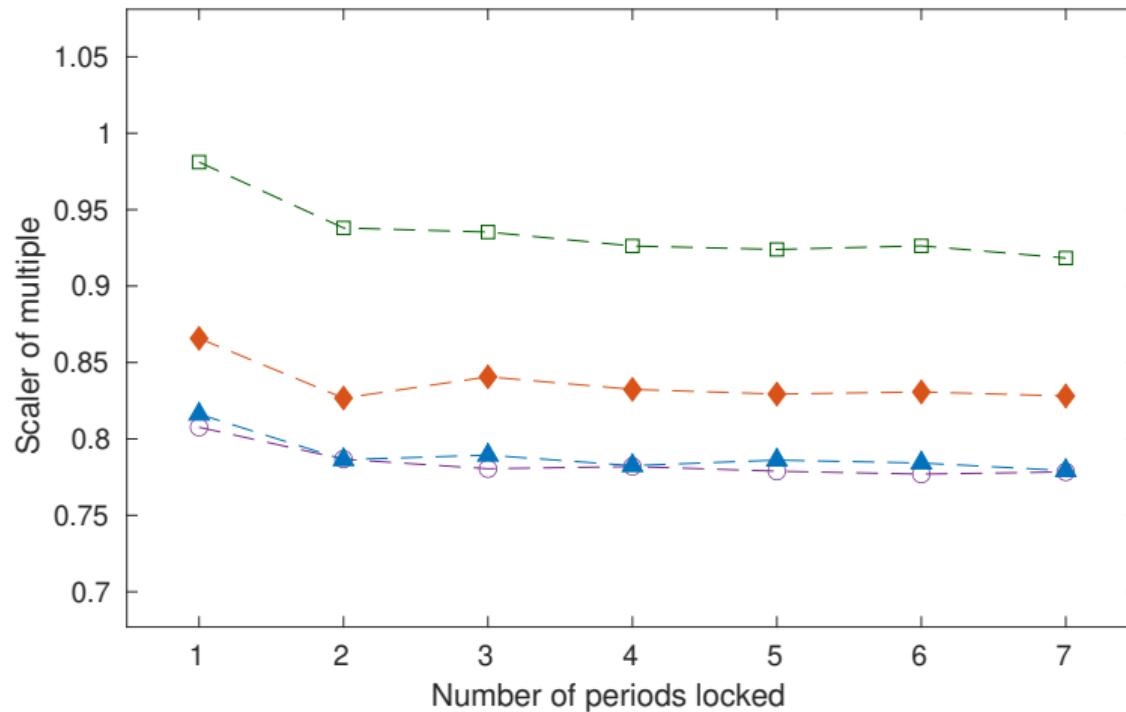
Optimal Lockout: Harsher

Competitive Minimum Downpayment Under Harsher Lockout



Optimal Lockout: Harsher

Competitive Multiple Under Harsher Lockout



Optimal Lockout: Harsher

Competitive Welfare Under Harsher Lockout

