Regulatory Interventions in Consumer Financial Markets: The Case of Credit Cards

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Motivation

- After Global Financial Crisis: substantial increase in **regulation** of consumer financial products

- Creation of new regulatory agencies
  - US: Bureau of Consumer Financial Protection, 2010
  - UK: Financial Conduct Authority, 2012

- Shift in regulatory attitudes
  - Implementation or discussion of direct regulation of interest rates and fees, including price caps! Examples
  - Tighter supervision/higher operating costs

Motivation

- What is likely effect of interest rate caps on loans?
  - Standard competitive theory: reduction in market efficiency and consumer surplus *particularly for marginal borrowers*
  - Caps motivated by perceived *absence* of perfect competition

- What is likely effect on potentially *imperfect markets*?
  - Measure/quantify extent of market imperfection
  - Determine response of market participants
    - This paper's goal

- Focus on US credit card market
  - Significant regulatory interest
  - Evidence of market imperfection

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- Conflicting evidence from detailed pre-Financial Crisis data
  - *market power*: high & dispersed interest rates, beyond obs.
  - *competition*: many offers/person, dispersed interest rates
    - ▶ If accept lowest rate on offer: less dispersion & lower rates

- Theoretical contribution
  - Develop model of imperfect competition (search theory)
  - Two key channels to rationalize evidence
    - ▶ Endogenous examination effort
    - ▶ Product differentiation

- Quantitative/empirical contribution
  - Calibrate model to quantify each channel's importance
  - Perform counterfactual policy experiments
    - ▶ Cap on interest rates

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- Theoretical contribution
  - Develop model of imperfect competition (search theory)
  - Two key channels to rationalize evidence
    - ▶ *Endogenous examination effort*: quantitatively important
    - ▶ Product differentiation

- Quantitative/empirical contribution
  - Calibrate model to quantify each channel's importance
  - Perform counterfactual policy experiments
    - ▶ *Cap on interest rates*: consumer surplus ↑ substantially!

Literature

- Credit cards
  Ausubel (1991), Calem and Mester (1995); Grodzicki (2015); Agarwal, Chomsisengphet, Mahoney, Stroebel (2015); Stango and Zinman (2016)

- Search in consumer financial products
  - Mortgages: Woodward and Hall (2012); Allen, Clark, Houde (forthcoming)
  - Mutual funds: Sirri and Tufano (1998); Hortacsu and Syverson (2004)
  - Unsecured credit: Galenianos and Nosal (2016)

First (?) paper to quantitatively study regulatory interventions in consumer financial products market using a search framework.

Data

- Survey data (Stango and Zinman, 2016)
    1. Account-level data, Jan 2006-Dec 2008 ("accepted offers")
        - Interest rate, balance, limit, reward...
        - Cardholder characteristics, including FICO score
        - Four groups: sub-prime, near-prime, prime, super-prime

    2. Interest rates on *pre-approved* credit card offers that individuals receive in January 2007 ("received offers")

- Aggregate data
    3. Fraction of credit card borrowers by borrower group ("revolvers")
    4. Aggregate charge-off rate in Q1 2007, Fed Board
    5. Risk-free rate: interest rate of the one-year Treasury bill on January 16th, 2007
    6. Average funding costs: Standard & Poor's US Credit Card Quality Index Base Rate

Dispersion of Interest Rates

For borrowers in group j:

$$R_{ikt}^j = \gamma_X^j X_{it} + \gamma_Z^j Z_{ikt} + \epsilon_{ikt}^j$$

R_{ikt}^j: APR of individual i on credit card k in month t.

NEAR-PRIME BORROWERS	(1)	(2)	(3)	(4)	(5)	(6)
FICO SCORE				-0.046	-0.043	-0.052
				(0.011)	(0.011)	(0.013)
REWARD CARD					0.494	0.562
					(0.453)	(0.565)
CREDIT LIMIT					-0.211	-0.255
					(0.046)	(0.078)
CREDIT BALANCE					0.242	0.225
					(0.064)	(0.100)
R^2				0.019	0.044	0.043
OBSERVATIONS	27,059	944	900	900	885	661
10TH PERCENTILE	10.49	11.24	12.99	13.16	13.09	13.20
25TH PERCENTILE	14.90	14.99	15.94	16.01	16.06	16.55
50TH PERCENTILE	18.24	18.99	19.24	19.09	19.31	20.20
75TH PERCENTILE	23.15	23.24	23.30	24.07	23.87	25.72
90TH PERCENTILE	28.99	29.24	29.24	29.03	28.75	29.16

Column 6: Jan 2007, no teaser, (+) balance Balance-weighed

Empirical Targets

Table: Summary Statistics

Panel A: Accepted Offers	Sub-	Near-	Prime	Super-
10th Percentile Accepted Offer	14.39	13.20	11.56	10.79
25th Percentile Accepted Offer	17.58	16.55	14.81	13.82
50th Percentile Accepted Offer	21.93	20.20	17.93	16.84
75th Percentile Accepted Offer	27.80	25.72	21.90	19.54
90th Percentile Accepted Offer	30.16	29.16	28.68	23.98
Fraction with Credit Card Debt	54.56	55.33	54.00	36.02

Panel B: Received Offers	
Fraction Receiving 2+ Offers (%)	75.00
Median Number of Offers Received, Conditional on 2+ Offers	3.00
Average Number of Offers Received, Conditional on 2+ Offers	4.00
10th Percentile of Differences in Offered Rates	0.00
30th Percentile of Differences in Offered Rates	2.25
50th Percentile of Differences in Offered Rates	4.34
70th Percentile of Differences in Offered Rates	7.25
90th Percentile of Differences in Offered Rates	9.25
Charge-off rate	4.01
Average Funding Cost	7.02

The Model

- Static. Separate market for each borrower group (prime...)

- Borrowers
  - Measure 1
  - Heterogeneous willingness to pay $z \sim M(\cdot)$
  - Default probability ρ, default cost δ

- Lenders
  - Potential entrants, measure Λ
  - Heterogeneous funding cost $k \sim \Gamma(\cdot)$
  - A lender decides whether to **enter market** at cost χ
    - Entrants: measure L, cost distribution $G(\cdot)$
  - A lender decides **interest rate** R

- Frictional matching
  - Each lender sends one loan offer to random borrower
  - Each borrower
    - decides costly **examination effort** $e \leq 1$
    - examines characteristics of $n \sim Po(eL)$ offers and **chooses**

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Borrowers (1)

- Utility from accepting offer: $z - c$, where $c = R + a$

  - $R \sim F_R(\cdot)$ is interest rate; F_R determined by lender choices

  - $a \sim F_a(\cdot)$ is idiosyncratic attribute, centered around $a = 0$

    - ▶ Horizontal product differentiation
    - ▶ Vertical product differentiation: similar results (appendix)

  - Distribution of cost: $F_c(x) = \int_{-\infty}^{\infty} F_R(x - a) F_a'(a) da$

- A borrower chooses lowest cost offer, if $c \leq z$

Borrowers (2)

- Type-z borrower chooses e to maximize
  - $V_z(e) - q(e, L)$

- $q(e, L)$ is cost of exerting effort e

- $V_z(e)$ is expected value of loan for type-z borrower
  - $V_z(e) = \sum_n p_n(eL) v_{z,n}$

  where
    - $p_n(eL)$ = probability of examining n offers
    - $v_{z,n}$ = z-borrower's value from examining n offers
      - Utility net of cost, from lowest-c and acceptable offer

  Details

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Details

Borrowers (3)

Proposition 1. Given actions by lenders $\{L, F_R(\cdot)\}$

- The optimal effort choice for z-borrower is unique: $e(z)$

- Effort is strictly increasing in z

- Mapping from offers $\{L, F_R(\cdot)\}$ to:
  - Distribution of accepted rates $H_R(\cdot)$
  - Fraction of borrowers who take a loan

Lenders (1)

- Profits to k-lender of offering interest rate R

  - $\pi_k(R) = \Big(R(1 - \rho) - k \Big) P(R)$

- $P(R)$ is probability that borrower accepts offer

  - Depends on R and also on attribute draw (a), on the number of other offers to the borrower (n) and their characteristics (R', a'), and on the borrower's type (z)

    Details

- Type-k lender's optimal actions satisfy:

  - $\pi_k(R) \geq \chi \Leftrightarrow$ enter market
  - $\pi'_k(R) = 0$

Lenders (2)

Proposition 2. Given $e(z)$ and $\{L, G(\cdot)\}$:

- $\pi_k(R)$ maximized at $R(k)$

- $R(k)$ is strictly increasing in k

- Mapping from entry $\{L, G(\cdot)\}$ to offer dist'n $F_R(\cdot)$

Proposition 3. There is marginal lender $\hat{k}$ s.t. enter iff $k < \hat{k}$

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From theory to estimation

- Three key mappings:
  1. $\{L, G(\cdot)\} \rightarrow F_R(\cdot)$ [entry to offers]
  2. $\{L, F_R(\cdot)\} \rightarrow H_R(\cdot)$ [offers to accepted dist'n]
  3. $\{L, F_R(\cdot)\} \rightarrow \%$ with loan   [offers to acceptance %]

- Data for each borrower group: $G(\cdot)$; L; $F_R(\cdot)$; $H_R(\cdot)$; % w cc debt; charge-offs

- Three sets of parameters
  1. Cost of examination effort
  2. Extent of product differentiation
  3. Borrower preferences

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Identification

- Highly non-linear model, all moments affect all parameters

- Dispersion in *accepted* interest rates (H_R) given F_R
  - High examination costs: choose among subset of offers
  - High product differentiation: decide on non-R attributes
    $\Rightarrow$ both channels deliver dispersion in H_R!

- Dispersion in *offered* interest rates (F_R):
  - High examination costs: yes!
  - High product differentiation (incl. vertical): *low* dispersion of F_R
    $\Rightarrow$ only high examination costs can deliver dispersion in F_R!

- Similar argument for fraction with debt (possibly model-specific)

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Quantitative Analysis (1)

- Parametric assumptions:
  - Borrowers' preferences: $\log z \sim \mathcal{N}(\mu_{z_j}, \sigma_{z_j})$
  - Borrowers' cost of effort: $\beta_{0j}(eL)^{\beta_1}$
  - Product differentiation: $a \sim \mathcal{N}(0, \sigma_{a_j})$
  - Lenders' costs: $k \sim$ Pareto truncated at $\hat{k} = \frac{1-(k_{min}/k)^\xi}{1-\left(k_{min}/\hat{k}\right)^\xi}$
    - k_{min} is risk-free rate

- Two versions:
  1. Measurement error η in accepted offers: $\hat{R} = R\eta$
     - $\log \eta \sim \mathcal{N}(\mu_\eta, \sigma_\eta^2)$
     - $\mu_\eta = -0.5\sigma_\eta^2 \Rightarrow E(\eta) = 1$
  2. No measurement error

Quantitative Analysis (2)

Minimum Distance:

- Match 34 empirical moments and theoretical moments:
  - Percentiles of distribution of accepted rates (5x4)
  - Percentiles of distribution of differences between offered rates (5)
  - Number of offers (3)
  - Charge-Off Rate in 2008 (1)
  - Fraction of Credit Card Borrowers (4)
  - Average Funding Cost (1)

- Computation: Solve functional equation $R(k)$ and vector $e(z)$

Parameters

Table: Calibrated Parameters

PANEL A: NO MEASUREMENT ERROR				PANEL B: MEASUREMENT ERROR			
μ_{z_1}	3.644	σ_{z_1}	0.143	μ_{z_1}	3.575	σ_{z_1}	0.123
μ_{z_2}	3.563	σ_{z_2}	0.082	μ_{z_2}	3.532	σ_{z_2}	0.108
μ_{z_3}	3.525	σ_{z_3}	0.157	μ_{z_3}	3.444	σ_{z_3}	0.127
μ_{z_4}	3.242	σ_{z_4}	0.342	μ_{z_4}	3.224	σ_{z_4}	0.191
ξ	3.626	$\hat{k}$	11.048	ξ	4.489	$\hat{k}$	9.661
L_1	1.440	L_2	3.683	L_1	1.552	L_2	3.947
L_3	3.116	L_4	3.156	L_3	3.228	L_4	2.995
ρ_1	0.015	ρ_2	0.007	ρ_1	0.040	ρ_2	0.030
ρ_3	0.004	ρ_4	0.003	ρ_3	0.020	ρ_4	0.010
σ_{a_1}	0.158	σ_{a_2}	0.143	σ_{a_1}	0.077	σ_{a_2}	0.118
σ_{a_3}	0.155	σ_{a_4}	0.101	σ_{a_3}	0.144	σ_{a_4}	0.125
β_{01}	9.069	β_{02}	34.502	β_{01}	8.629	β_{02}	42.408
β_{03}	28.051	β_{04}	30.075	β_{03}	28.938	β_{04}	32.663
β_1	1.555	σ_η	0.000	β_1	1.739	σ_η	0.284

- Small measurement error relative to variance of R
- Almost identical parameters with/without measurement error

Model Fit

Table: Model Fit 1

|	Data	Model $\sigma_\eta = 0$	Model $\sigma_\eta > 0$
10TH PERCENTILE ACCEPTED RATE, SUBPRIME BORROWERS	13.22	17.53	14.22
25TH PERCENTILE ACCEPTED RATE, SUBPRIME BORROWERS	16.43	18.76	17.20
50TH PERCENTILE ACCEPTED RATE, SUBPRIME BORROWERS	22.05	21.40	21.28
75TH PERCENTILE ACCEPTED RATE, SUBPRIME BORROWERS	27.75	25.12	26.46
90TH PERCENTILE ACCEPTED RATE, SUBPRIME BORROWERS	30.27	28.19	31.96
10TH PERCENTILE ACCEPTED RATE, NEAR-PRIME BORROWERS	13.73	17.26	13.54
25TH PERCENTILE ACCEPTED RATE, NEAR-PRIME BORROWERS	16.99	18.52	16.36
50TH PERCENTILE ACCEPTED RATE, NEAR-PRIME BORROWERS	20.96	21.22	20.38
75TH PERCENTILE ACCEPTED RATE, NEAR-PRIME BORROWERS	25.67	24.95	25.32
90TH PERCENTILE ACCEPTED RATE, NEAR-PRIME BORROWERS	29.81	27.89	30.67
10TH PERCENTILE ACCEPTED RATE, PRIME BORROWERS	11.63	15.34	12.20
25TH PERCENTILE ACCEPTED RATE, PRIME BORROWERS	14.73	16.43	14.77
50TH PERCENTILE ACCEPTED RATE, PRIME BORROWERS	18.00	18.78	18.30
75TH PERCENTILE ACCEPTED RATE, PRIME BORROWERS	21.84	22.03	22.80
90TH PERCENTILE ACCEPTED RATE, PRIME BORROWERS	28.88	24.76	27.90
10TH PERCENTILE ACCEPTED RATE, SUPER-PRIME BORROWERS	10.53	13.75	11.14
25TH PERCENTILE ACCEPTED RATE, SUPER-PRIME BORROWERS	13.07	14.60	13.39
50TH PERCENTILE ACCEPTED RATE, SUPER-PRIME BORROWERS	16.63	16.41	16.43
75TH PERCENTILE ACCEPTED RATE, SUPER-PRIME BORROWERS	19.76	18.87	20.12
90TH PERCENTILE ACCEPTED RATE, SUPER-PRIME BORROWERS	24.67	20.96	24.28

Model Fit

<div align="center">

Table: Model Fit 2

</div>

	Data	Model $\sigma_\eta = 0$	Model $\sigma_\eta > 0$
Fraction Receiving 2+ Offers (%)	75.00	74.43	74.70
Median Number of Offers Received, Conditional on 2+ Offers	3.00	3.00	3.00
Average Number of Offers Received, Conditional on 2+ Offers	4.00	3.49	3.49
10th Percentile Distribution of Differences in Offered Rates	0.00	1.60	1.21
30th Percentile Distribution of Differences in Offered Rates	2.25	4.03	2.98
50th Percentile Distribution of Differences in Offered Rates	4.34	5.89	4.37
70th Percentile Distribution of Differences in Offered Rates	7.25	7.74	5.85
90th Percentile Distribution of Differences in Offered Rates	9.25	10.19	8.61
Fraction with Credit Card Debt, Subprime Borrowers	54.56	55.60	54.86
Fraction with Credit Card Debt, Near-Prime Borrowers	55.33	55.78	55.25
Fraction with Credit Card Debt, Prime Borrowers	54.00	54.74	54.20
Fraction with Credit Card Debt, Super-prime Borrowers	36.02	35.70	36.00
Charge-Off Rate	4.01	0.72	2.29
Average Funding Cost	7.02	6.16	5.95

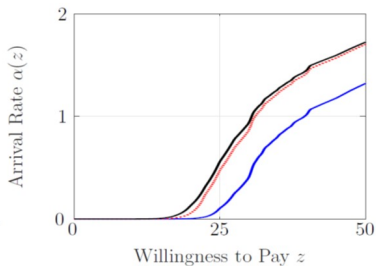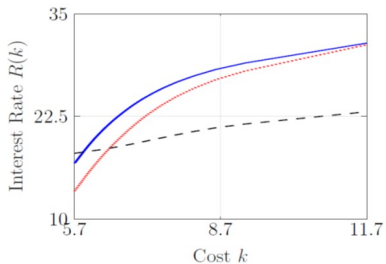# Model implications

- Focus on near-prime borrowers
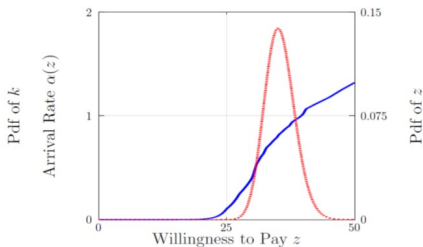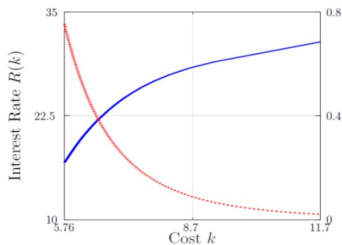
- Large potential gains from trade
- Low examination effort ⇒ high & dispersed accepted rates

Comparative statics

- $\sigma'_a = 30\sigma_a$ (black) $\Rightarrow$ low dispersion in $F_R(\cdot)$
- $\beta'_0 = 0.7\beta_0$ (red) $\Rightarrow$ higher effort, lower interest rates

Policy experiment: 25% interest rate cap

- Set price cap to $\overline{R} = 25$ percent
  - Binds for 35% of sub-prime, 25% of near-prime and 5% of prime borrowers

- Lenders optimize subject to additional $R \leq \overline{R}$ constraint
  - Highest-cost lenders exit
  - Remaining lenders adjust their interest rates

- Borrowers adjust their effort choices (potentially lower)
 - Fershman, Fishman (1994); Armstrong, Vickers, Zhou (2009)

Policy experiment: 25% interest rate cap

Table: Market Outcomes and Welfare with Price Caps

|	Sub-	Near-	Prime	Super-
Average Number of Offers per Borrower	**0.90**	**0.91**	0.99	1.00
Fraction with loan	**1.01**	**1.04**	1.01	1.00
Average Accepted Rate	0.86	0.85	0.97	1.00
Standard Deviation of Accepted Rates	0.76	0.80	0.94	1.00
Consumer Surplus	**1.19**	**1.34**	1.06	1.00
Lender Profits	0.49	0.52	0.90	1.00
Welfare	1.02	1.08	1.02	1.00

Note: Ratios to baseline outcomes.

Policy experiment: 25% interest rate cap
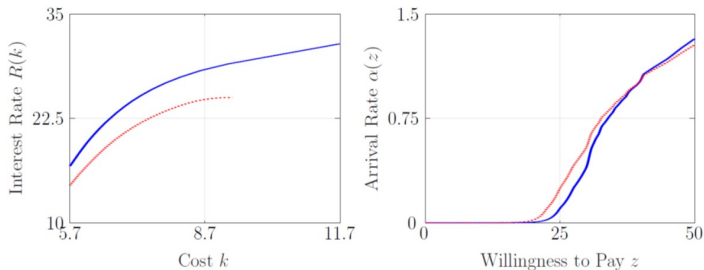
- Fewer lenders but stronger competition: $R(k) \downarrow$
- Effort of high-z borrowers $\downarrow$ and of low-z borrowers $\uparrow$

No cap, same entry $(\chi \uparrow)$ Table
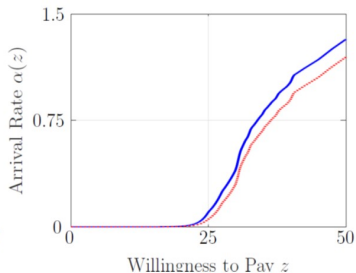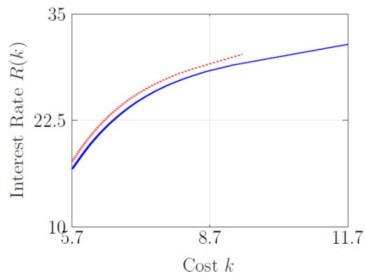
- Fewer lenders without cap leads to less competition: $R(k) \uparrow$
- Worse offer distribution $\Rightarrow$ less effort by borrowers

Different caps: 27.5, 25 and 22.5 pps

Table: Market Outcomes and Welfare on *Subprime Borrowers*

Cap	27.5 pps	25 pps	22.5 pps
Average Number of Offers per Borrower	0.97	0.90	0.80
Fraction with loan	**1.03**	**1.01**	**0.94**
Average Accepted Rate	0.92	0.86	0.80
Standard Deviation of Accepted Rates	0.88	0.76	0.62
Consumer Surplus	**1.14**	**1.19**	**1.15**
Lender Profits	0.73	0.49	0.30
Welfare	1.04	1.02	0.94

Note: Ratios to baseline outcomes.

- More stringent caps reduce access to credit
- Interior cap to maximize consumer surplus

Conclusions

- Since Global Financial Crisis: increased focus in enhanced regulation and interest rate caps

- We build and calibrate model to evaluate effect of policies
  - Capture high and dispersed interest rates + many cc offers
  - Identify high cost of examining offers as important market feature

- Implementing interest rate caps yields surprising results
  - Considerable reduction in interest rates
  - Reduction of lender entry, as competitive theory predicts
  - Increase in examination effort: new feature!
  - Net effect: large gain in consumer surplus for marginal borrowers

Examples of Price Regulations:

- United States:
  - Abolition of overdraft fees on credit cards in 2009
    - ▶ Agarwal, Chomsisengphet, Mahoney, Stroebel (2015)
  - Abolition of prepayment penalties on mortgages in 2010
    - ▶ Mayer, Piskorski, Tchistyi (2013)

- United Kingdom:
  - November 2014: Cap on interest rate on payday loans = max 0.8 percent per day.
  - November 2016: Cap on pension exit fees = max 1 percent.
  - Among those currently under study:
    - ▶ Cap/ban on mutual fund fees (*The Financial Times*, May 26, 2016)
    - ▶ Mortgage origination fees (*The Financial Times*, December 12, 2016).
    - ▶ Brokers' mortgage procuration fees (*The Financial Times*, December 12, 2016).

Balance-weighed interest rates

Near-Prime Borrowers	(1)	(2)	(3)	(4)	(5)	(6)
FICO Score					-0.052	-0.076
					(0.013)	(0.014)
Reward Card					0.562	-0.253
					(0.565)	(0.504)
Credit Limit					-0.255	-0.173
					(0.078)	(0.061)
Credit Balance					0.225	0.053
					(0.100)	(0.072)
R^2					0.043	0.090
Observations	27,059	27,059	900	900	661	661
10th Percentile	10.49	9.90	12.99	12.25	13.20	13.73
25th Percentile	14.90	14.24	15.94	15.81	16.55	16.99
50th Percentile	18.24	18.24	19.24	19.24	20.20	20.96
75th Percentile	23.15	24.24	23.30	25.40	25.72	25.67
90th Percentile	28.99	29.74	29.24	29.99	29.16	29.81

Back

Equations for borrower values

- Distribution of lowest cost

  - Distribution of cost: $F_c(x) = \int_{-\infty}^{\infty} F_R(x-a)F_a'(a)da$

  - Dist'n of lowest cost in n offers: $\bar{F}_{c,n}(x) = 1 - (1 - F_c(x))^n$

- $v_{z,n} =$ z-borrower's value from examining n offers

  - $v_{z,0} = 0$

  - $v_{z,n} = \int_{-\infty}^{z}(z-x)d\bar{F}_{c,n}(x), \quad n \geq 1$

- Probability of examining n offers:

  - $p_n(e, L) = [(eL)^n e^{-eL}]/n!$

Back

Equations for lender probability of making loan

- Probability z-borrower accepts offer with cost c:
  - $P_c(c, z) = \sum_{n=0}^{\infty} p_n(e(z))(1 - F_c(c))^n$, if $c \leq z$
  - $P_c(c, z) = 0$, if $c > z$

- Probability z-borrower accepts loan with interest rate R:
  - $P_R(R, z) = \int_{-\infty}^{\infty} P_c(R + a, z) dF_a(a)$

- Probability that loan offer with rate R is accepted:
  - $P(R) = \sum_z s_z e(z) P_R(R, z)$

$$\Rightarrow P(R) = \sum_z s_z e(z) \int_{-\infty}^{z-R} e^{-eL \int_{\underline{R}}^{\overline{R}} F_a(R+a-x) dF_R(x)} dF_a(a)$$

No cap, same entry as w cap

Table: Market Outcomes and Welfare with Higher Entry Cost

	Sub-	Near-	Prime	Super-
Average Number of Offers per Borrower	0.82	0.87	0.98	1.00
Fraction with loan	0.85	0.84	0.97	1.00
Average Accepted Rate	0.98	1.05	1.01	1.00
Standard Deviation of Accepted Rates	0.72	0.82	0.97	1.00
Consumer Surplus	0.84	0.73	0.96	1.00
Lender Profits	0.30	0.44	0.83	1.00
Welfare	0.74	0.68	0.93	1.00

Note: Ratios to baseline outcomes.