

# Mitigating the Risks of Financial Inclusion with Loan Contract Terms

Sara G. Castellanos<sup>1</sup>   Diego Jiménez<sup>2</sup>   Aprajit Mahajan<sup>3</sup>   Enrique Seira<sup>4</sup>

<sup>1</sup>Banco de México

<sup>2</sup>Stanford University

<sup>3</sup>University of California, Berkeley

<sup>4</sup>Instituto Tecnológico Autónomo de México

Second Consumer Financial Protection Bureau Conference

## This talk:

- Large RCT in Mexican credit card market.

## This talk:

- Large RCT in Mexican credit card market.
- Study population new to formal credit.

## This talk:

- Large RCT in Mexican credit card market.
- Study population new to formal credit.
- Experimental variation in contract terms: interest rates **and minimum payments**.

## This talk:

- Large RCT in Mexican credit card market.
- Study population new to formal credit.
- Experimental variation in contract terms: interest rates **and minimum payments**.
- Estimate causal effects on purchases, repayment, debt and default.

## This talk:

- Large RCT in Mexican credit card market.
- Study population new to formal credit.
- Experimental variation in contract terms: interest rates **and minimum payments**.
- Estimate causal effects on purchases, repayment, debt and default.
- Policy and Academic Interest: Concern over default and “overindebtedness” driven by high interest rates and low minimum payments (Mexican and US Congress).

## This talk:

- Large RCT in Mexican credit card market.
- Study population new to formal credit.
- Experimental variation in contract terms: interest rates **and minimum payments**.
- Estimate causal effects on purchases, repayment, debt and default.
- Policy and Academic Interest: Concern over default and “overindebtedness” driven by high interest rates and low minimum payments (Mexican and US Congress).

PRELIMINARY, COMMENTS WELCOME!

## Policy Priority: Expanding Credit

*“[FI] is not only a matter of finance, it is a matter of social equality as well.”*

(Minister of the Treasury, 2014).



## Policy Priority: Expanding Credit

*“[FI] is not only a matter of finance, it is a matter of social equality as well.”*

(Minister of the Treasury, 2014).

- 72 percent of individuals access formal credit through credit cards. [See graph.](#)

## Policy Priority: Expanding Credit

*“[FI] is not only a matter of finance, it is a matter of social equality as well.”*

(Minister of the Treasury, 2014).

- 72 percent of individuals access formal credit through credit cards. [See graph.](#)
- Only 22 percent of Mexican households had a card in 2012 (ENIGH) (US: 77%).

## Policy Priority: Expanding Credit

*“[FI] is not only a matter of finance, it is a matter of social equality as well.”*

(Minister of the Treasury, 2014).

- 72 percent of individuals access formal credit through credit cards. [See graph.](#)
- Only 22 percent of Mexican households had a card in 2012 (ENIGH) (US: 77%).
- Expanding credit to new borrowers:

## Policy Priority: Expanding Credit

*“[FI] is not only a matter of finance, it is a matter of social equality as well.”*

(Minister of the Treasury, 2014).

- 72 percent of individuals access formal credit through credit cards. [See graph.](#)
- Only 22 percent of Mexican households had a card in 2012 (ENIGH) (US: 77%).
- Expanding credit to new borrowers:
  - ✓ Smooth consumption, allows investment. Welfare-improving by revealed preference.

## Policy Priority: Expanding Credit

*“[FI] is not only a matter of finance, it is a matter of social equality as well.”*

(Minister of the Treasury, 2014).

- 72 percent of individuals access formal credit through credit cards. [See graph.](#)
- Only 22 percent of Mexican households had a card in 2012 (ENIGH) (US: 77%).
- Expanding credit to new borrowers:
  - ✓ Smooth consumption, allows investment. Welfare-improving by revealed preference.
  - ✗ High risk population due to asymmetric information problems. Unsophisticated or time-inconsistent individuals could borrow “too much” relative to unbiased benchmark.

## Experiment and Questions for Today

- Large private Mexican bank conducted experiment to understand the effects of contract terms on debt and default.

## Experiment and Questions for Today

- Large private Mexican bank conducted experiment to understand the effects of contract terms on debt and default.
- Present results and discuss two issues:

## Experiment and Questions for Today

- Large private Mexican bank conducted experiment to understand the effects of contract terms on debt and default.
- Present results and discuss two issues:
  1. How much risk do new borrowers represent?



## Experiment and Questions for Today

- Large private Mexican bank conducted experiment to understand the effects of contract terms on debt and default.
- Present results and discuss two issues:
  1. How much risk do new borrowers represent?
    - Document high default, card exit and high variance in revenue.

## Experiment and Questions for Today

- Large private Mexican bank conducted experiment to understand the effects of contract terms on debt and default.
- Present results and discuss two issues:
  1. How much risk do new borrowers represent?
    - Document high default, card exit and high variance in revenue.
  2. Can contract terms help mitigate debt and default?

## Experiment and Questions for Today

- Large private Mexican bank conducted experiment to understand the effects of contract terms on debt and default.
- Present results and discuss two issues:
  1. How much risk do new borrowers represent?
    - Document high default, card exit and high variance in revenue.
  2. Can contract terms help mitigate debt and default?
    - Effect of variation in interest rates and minimum payments on purchases, payments, debt and default.

## Population and Study Sample

- **Product:** Store credit card for clients with limited credit history targeted at low income individuals promoted in stores.

## Population and Study Sample

- **Product:** Store credit card for clients with limited credit history targeted at low income individuals promoted in stores.
  - Started in 2002, 3.3 million clients in 2007.

## Population and Study Sample

- **Product:** Store credit card for clients with limited credit history targeted at low income individuals promoted in stores.
  - Started in 2002, 3.3 million clients in 2007.
- **Study Population: Current** card holders as of January 2007.

## Population and Study Sample

- **Product:** Store credit card for clients with limited credit history targeted at low income individuals promoted in stores.
  - Started in 2002, 3.3 million clients in 2007.
- **Study Population: Current** card holders as of January 2007.
  - for 57% this was first credit card of any kind.

## Population and Study Sample

- **Product:** Store credit card for clients with limited credit history targeted at low income individuals promoted in stores.
  - Started in 2002, 3.3 million clients in 2007.
- **Study Population: Current** card holders as of January 2007.
  - for 57% this was first credit card of any kind.
  - for 47% this was the first banking product.



## Population and Study Sample

- **Product:** Store credit card for clients with limited credit history targeted at low income individuals promoted in stores.
  - Started in 2002, 3.3 million clients in 2007.
- **Study Population: Current** card holders as of January 2007.
  - for 57% this was first credit card of any kind.
  - for 47% this was the first banking product.
  - Relatively new to formal credit of any sort, lower-than-average credit scores.

See credit score distribution

## Study Design and Data

- **Treatment arms:** Within stratum, 8 equal-sized treatment arms of 18,000 clients using four interest rate and two minimum payment combinations and 18,000 in control.

## Study Design and Data

- **Treatment arms:** Within stratum, 8 equal-sized treatment arms of 18,000 clients using four interest rate and two minimum payment combinations and 18,000 in control.
  - Interest rate: 15%; 25%; 35%; 45%.
  - Minimum payment: 5%; 10%.

## Study Design and Data

- **Treatment arms:** Within stratum, 8 equal-sized treatment arms of 18,000 clients using four interest rate and two minimum payment combinations and 18,000 in control.
  - Interest rate: 15%; 25%; 35%; 45%.
  - Minimum payment: 5%; 10%.
  - Control arm: Interest rate 47% and minimum payments 4%

## Study Design and Data

- **Treatment arms:** Within stratum, 8 equal-sized treatment arms of 18,000 clients using four interest rate and two minimum payment combinations and 18,000 in control.
  - Interest rate: 15%; 25%; 35%; 45%.
  - Minimum payment: 5%; 10%.
  - Control arm: Interest rate 47% and minimum payments 4%
- Clients informed of new interest rate and minimum payments in usual monthly statement.

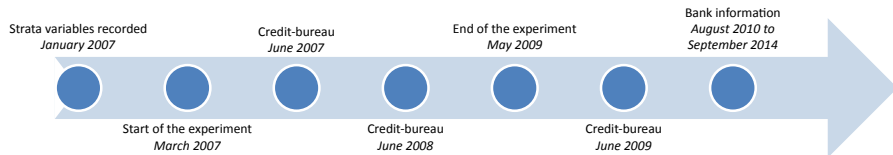
## Study Design and Data

- **Treatment arms:** Within stratum, 8 equal-sized treatment arms of 18,000 clients using four interest rate and two minimum payment combinations and 18,000 in control.
  - Interest rate: 15%; 25%; 35%; 45%.
  - Minimum payment: 5%; 10%.
  - Control arm: Interest rate 47% and minimum payments 4%
- Clients informed of new interest rate and minimum payments in usual monthly statement.
- Arm assignment ran from March 2007 to May 2009. All clients returned to standard terms.

## Study Design and Data

- **Treatment arms:** Within stratum, 8 equal-sized treatment arms of 18,000 clients using four interest rate and two minimum payment combinations and 18,000 in control.
  - Interest rate: 15%; 25%; 35%; 45%.
  - Minimum payment: 5%; 10%.
  - Control arm: Interest rate 47% and minimum payments 4%
- Clients informed of new interest rate and minimum payments in usual monthly statement.
- Arm assignment ran from March 2007 to May 2009. All clients returned to standard terms.
- **Data:**
  - Monthly bank statement data (03/07 – 05/09, 06/13 – 06/14).
  - Annual Credit Bureau data (2007 – 2013). Match 99% of sample.
  - ENIGH, MxFLS (unmatched)

# Timeline



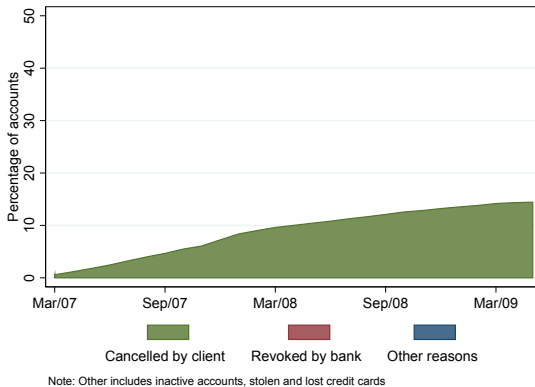


# Summary statistics

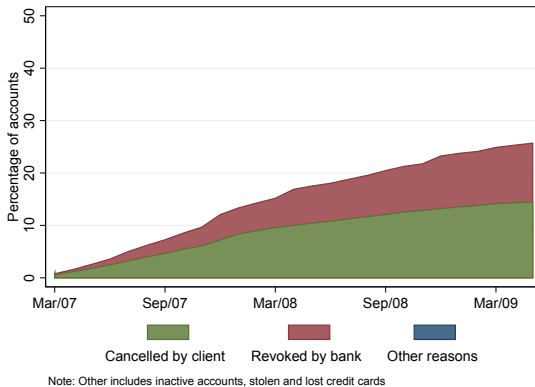
	(1)
	Start of experiment
<i>Credit bureau-supplied information</i>	
<i>Demographic information</i>	
Age	39
% Male	53
% Married	63
Monthly Income (Pesos)	13,842
	(1)
	Beginning of the experiment
<i>Credit card information (Pesos)</i>	
Payments	711
	(1,473)
Purchases	338
	(1,023)
Debt	1,198
	(3,521)
Credit limit	7,879
	(6,117)
Credit score	645
	(52)

# Results

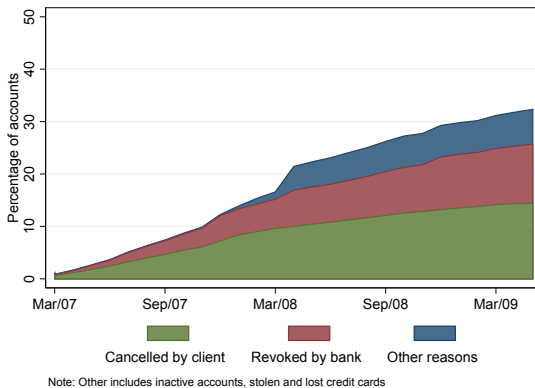
## Environment: High Rates of Card Exit



## Environment: High Rates of Card Exit

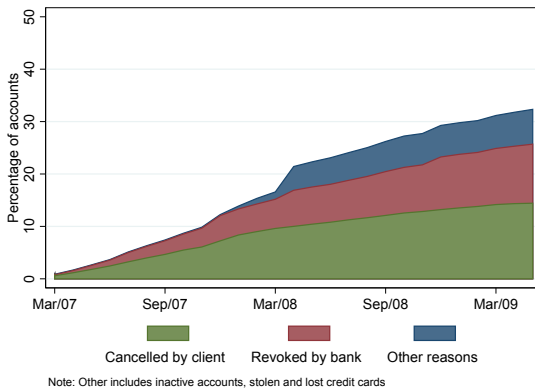


## Environment: High Rates of Card Exit



- 33% of control group exits bank during the experiment  $\simeq$  15% annual exit rate.

## Environment: High Rates of Card Exit



- 33% of control group exits bank during the experiment  $\simeq$  15% annual exit rate.
- Similar rates for similar populations also in other data. Market card Exits

## Estimation Outline

- Estimate treatment effects (and Lee (2009) Bounds to deal with card exits):

$$Y_{it} = \sum_{g=1}^8 \beta_{gt} T_{ig} + \sum_{s=1}^9 S_{is} + \epsilon_{it}$$

and graph for each treatment arm  $g$   $\{\hat{\beta}_{gt}\}_{t=1}^{26}$  and Lee Bounds.

## Estimation Outline

- Estimate treatment effects (and Lee (2009) Bounds to deal with card exits):

$$Y_{it} = \sum_{g=1}^8 \beta_{gt} T_{ig} + \sum_{s=1}^9 S_{is} + \epsilon_{it}$$

and graph for each treatment arm  $g$   $\{\hat{\beta}_{gt}\}_{t=1}^{26}$  and Lee Bounds.

- Focus today on only two contrasts:
  - Effect of an interest decrease holding minimum payment fixed at 5%:

$$\beta_{(r=45\%, MP=5\%),t} - \beta_{(r=15\%, MP=5\%),t}$$



## Estimation Outline

- Estimate treatment effects (and Lee (2009) Bounds to deal with card exits):

$$Y_{it} = \sum_{g=1}^8 \beta_{gt} T_{ig} + \sum_{s=1}^9 S_{is} + \epsilon_{it}$$

and graph for each treatment arm  $g$   $\{\hat{\beta}_{gt}\}_{t=1}^{26}$  and Lee Bounds.

- Focus today on only two contrasts:

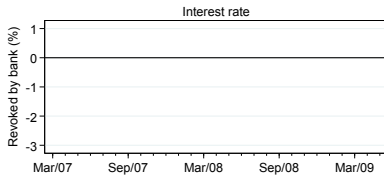
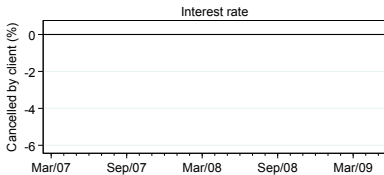
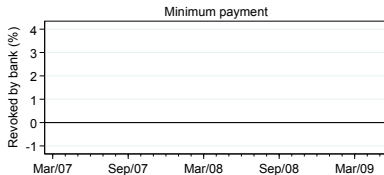
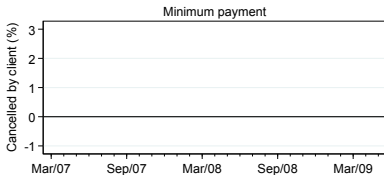
- Effect of an interest decrease holding minimum payment fixed at 5%:

$$\beta_{(r=45\%, MP=5\%),t} - \beta_{(r=15\%, MP=5\%),t}$$

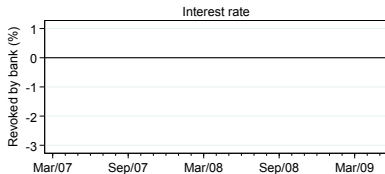
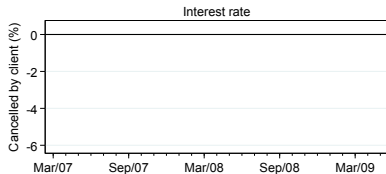
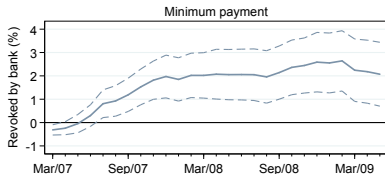
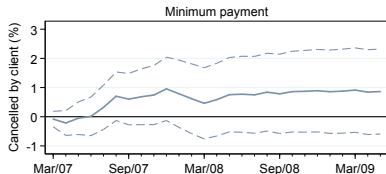
- Effect of a minimum payment increase holding interest rate fixed at 45%:

$$\beta_{(r=45\%, MP=5\%),t} - \beta_{(r=45\%, MP=10\%),t}$$

## Effects on Card Exit

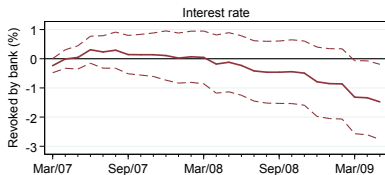
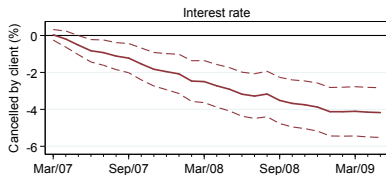
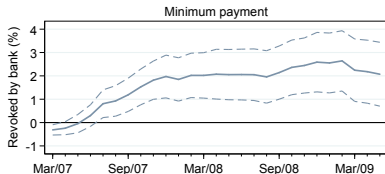
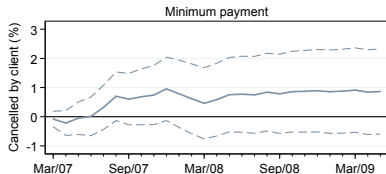


## Effects on Card Exit



- $\uparrow \text{MP} \Rightarrow \uparrow \text{Cancellations (14\%, 1.6 pp}^{**})$ ,  $\uparrow \text{Revocations (10\%, 1.2 pp}^{***})$ .

## Effects on Card Exit



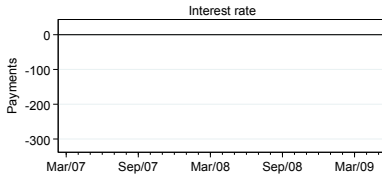
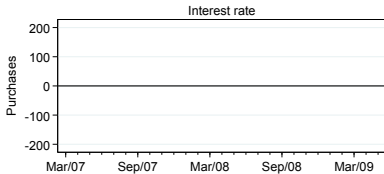
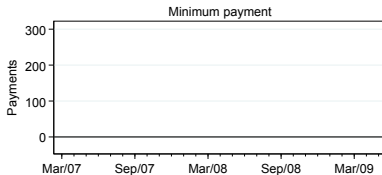
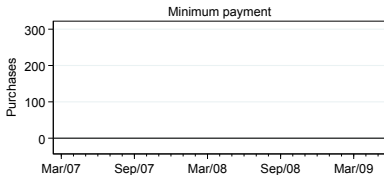
- $\uparrow \text{MP} \Rightarrow \uparrow \text{Cancellations (14\%, 1.6 pp}^{**})$ ,  $\uparrow \text{Revocations (10\%, 1.2 pp}^{***})$ .
- $\downarrow \text{R} \Rightarrow \downarrow \text{Cancellations (30\%, 3.3 pp}^{***})$ ,  $\downarrow \text{Revocations (6\%, 2.1 pp}^{***})$ .

Cancellations by Payment Behavior

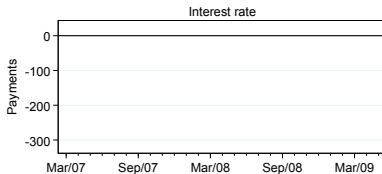
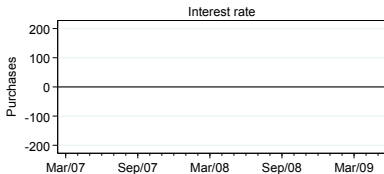
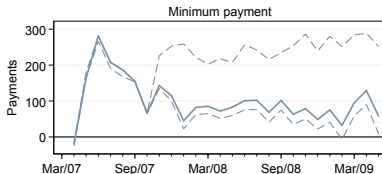
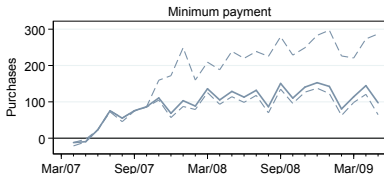
Revocations by Payment Behavior

Treatment Estimations

## Effect on Purchases and Repayment

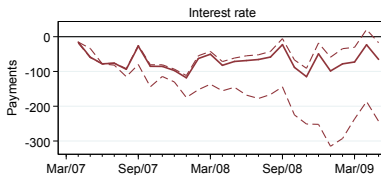
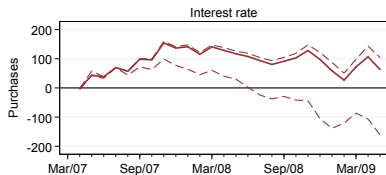


## Effect on Purchases and Repayment



- $\uparrow \text{MP} \Rightarrow \uparrow \text{Purchases (18\%, MXN \$92^{***})}, \uparrow \text{Repayments (8\%, MXN \$53^{**})}.$

## Effect on Purchases and Repayment



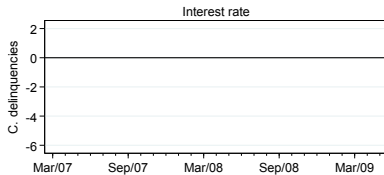
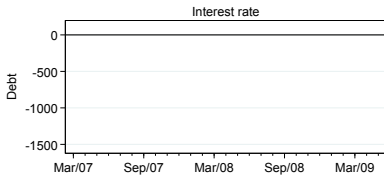
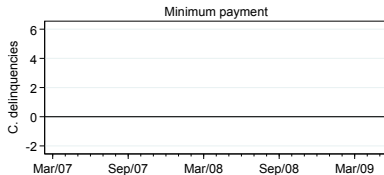
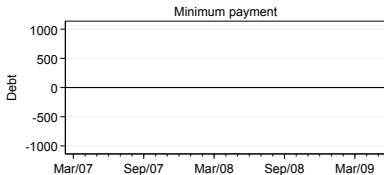
- $\uparrow \text{MP} \Rightarrow \uparrow \text{Purchases (18\%, MXN \$92^{***})}, \uparrow \text{Repayments (8\%, MXN \$53^{**})}.$
- $\downarrow \text{R} \Rightarrow \uparrow \text{Purchases (13\%, MXN \$65^{***})}, \downarrow \text{Repayments (9\%, MXN \$64^{***})}.$

Purchases by Payment Behavior

Payment by Payment Behavior

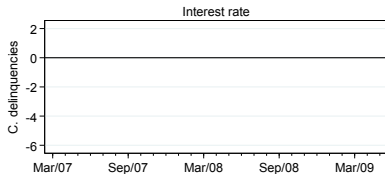
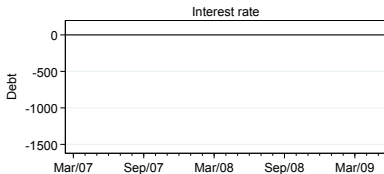
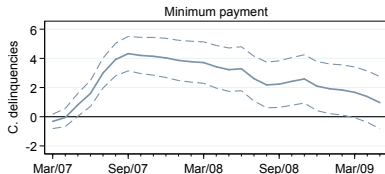
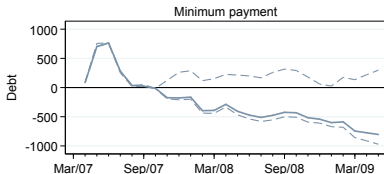
Treatment Estimations

## Effect on Debt and Delinquencies



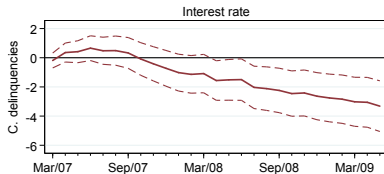
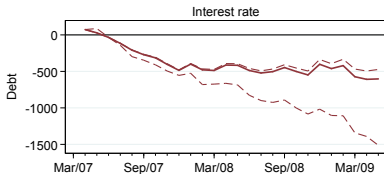
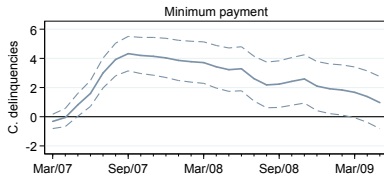
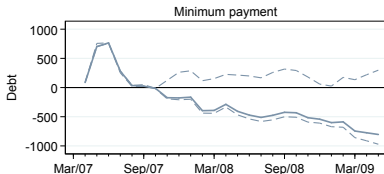


## Effect on Debt and Delinquencies



- $\uparrow \text{MP} \Rightarrow \downarrow \text{Debt (35\%, MXN \$789^{***})}, - \text{Delinquency (3\%, 1pp)}.$

## Effect on Debt and Delinquencies



- $\uparrow \text{MP} \Rightarrow \downarrow \text{Debt (35\%, MXN \$789^{***})}, - \text{Delinquency (3\%, 1pp)}.$
- $\downarrow \text{R} \Rightarrow \downarrow \text{Debt (27\%, MXN \$604^{***})}, \downarrow \text{Delinquency (10\%, 3.3pp^{***})}.$

## Effects on Bank Revenues

- Use different approaches to computing bank revenues (payments less purchases adjusting for balances held and defaults). Revenues Definition

## Effects on Bank Revenues

- Use different approaches to computing bank revenues (payments less purchases adjusting for balances held and defaults). Revenues Definition
- Across different definitions, treatment effects are negative.

## Effects on Bank Revenues

- Use different approaches to computing bank revenues (payments less purchases adjusting for balances held and defaults). Revenues Definition
- Across different definitions, treatment effects are negative.
- Implied elasticity of bank net revenues about with respect to interest rates  $\approx .7$ .
- Implied elasticity with respect to minimum payments  $\approx -.15$

	Revenues
r=15% MP=5%	-925.5*** (81.63)
r=45%, MP=10%	-292.7*** (29.91)
r=45%, MP=5%	1860.9*** (163.3)
R-squared	0.0186

## Summary

- Extremely high rates of card-exit.
  - 33% of the sample exit the experiment.
  - Exit rates comparable in Credit Bureaus for similar populations.
- Decreasing interest and increasing minimum payments both rates reduced debt.
- Elasticity of debt with respect to interest rate  $\approx .4$
- Elasticity of debt with respect to minimum payments  $\approx -.35$
- Elasticity of card exit with respect to interest rate and minimum payments are  $\approx .18$ .
- Elasticity of bank net revenues about with respect to interest rates  $\approx .7$  and with respect to minimum payments  $\approx -.15$
- Exit caused by contractual variation only small part of overall exit rates.

## Other Findings and To Dos

- **Heterogeneity:** Significant heterogeneity by stratum. Negligible exit and zero ATEs for older clients who paid their balances in full pre-experiment. Strongest effects for newer clients who made low monthly payments pre-experiment.
- **Cost of default:** Bank revocation associated with a 3 times lower probability of getting a new card  $\pm 5$  months from date of revocation. Credit score decreases sharply for those with revoked cards (from 620 ten months before to 550 five months after).
- **External effects:** No treatment effect on other loans or bills (e.g. phone bills), in the total amount in arrears for other loans and other credit cards or credit scores.
- **Payment habit formation:** After the experiment, all cardholders were returned to the same interest rate (around 47%) and minimum payment levels (around 4%). Using 2011 data to estimate the effects of previous treatment on current debt and purchase behavior (controlling for current debt?).
- How to reconcile large underlying default rates with insensitivity to relatively large changes in contractual terms.

THANKS!

# Appendix

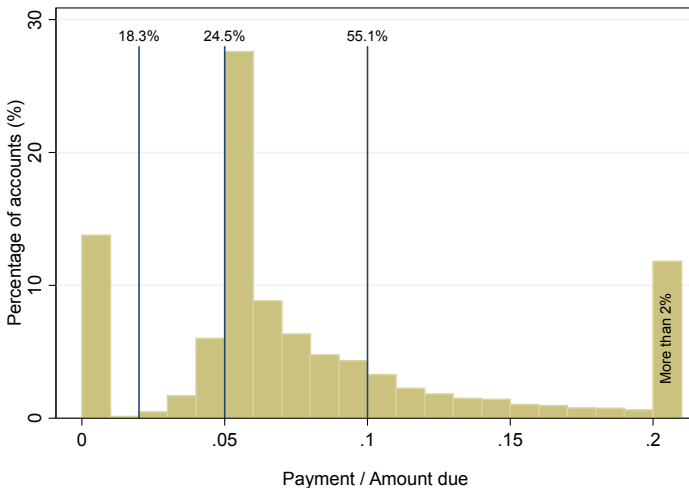


## Sampling weights by strata

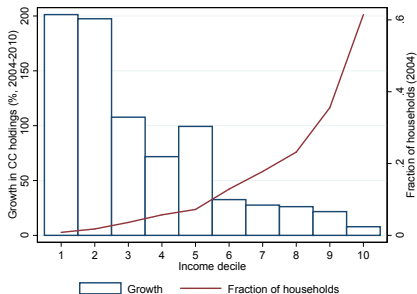
[Return to slide](#)

	Cardholder's payment behavior			Total (4)
	Minimum payer (1)	Part-balance payer (2)	Full-balance payer (3)	
Months of credit card use				
6 to 11 months	9.8	1.6	0.6	12
12 to 23 months	10.7	1.7	0.7	13
24+ months	61.5	9.8	3.8	75
Total	82	13	5	100

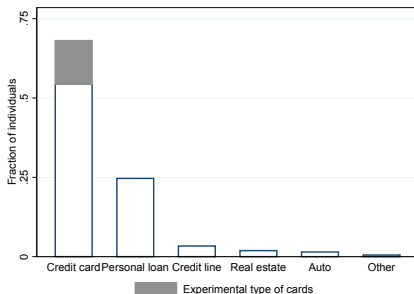
## Payment as a proportion of debt in the beginning of the experiment



## Level and growth in credit cards by deciles

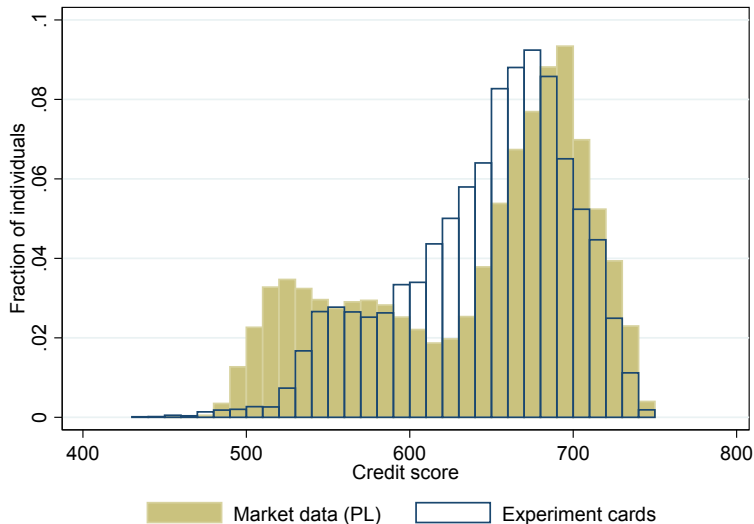
[Return to motivation](#)
[Return to experiment description](#)


Growth in credit cards by income decile  
(2002-2010)



First loan distribution by type of credit  
(2010)

## Credit score for experimental sample (2007) and market data (2016)

[Return to experiment description](#)

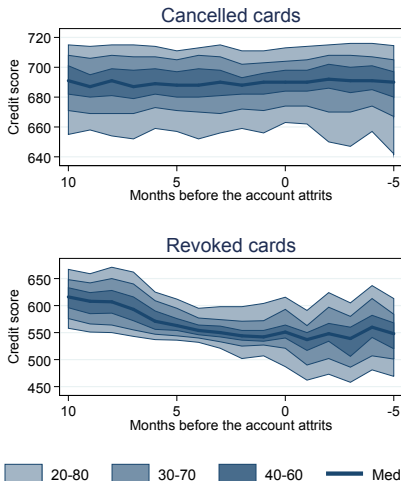
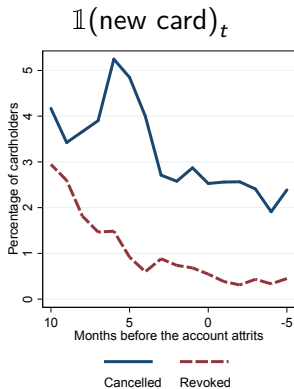
## Experiment description

[Return to experiment description](#)

- Bancarization of these clients was done through commercial stores.



## Long Term Effects: Getting a New Card?



# Treatment Regressions

[Return to results](#)

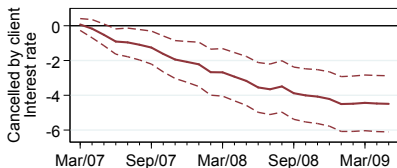
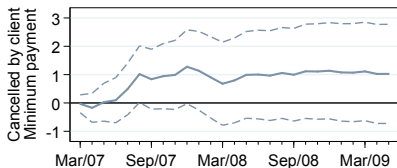
	Payments	Purchases	Debt	Net revenue	Cost	Delinquencies	Cumulative delinquencies	Revoked cards	Cancelled cards	Credit score	Attrition
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I:15% P:5%	-64*** (25)	65** (26)	-604*** (123)	-544*** (57)	-352*** (57)	-0.024*** (0.008)	-0.033*** (0.009)	-0.021*** (0.007)	-0.033*** (0.006)	1.93 (1.69)	-0.049*** (0.010)
I:15% P:10%	106*** (29)	254*** (30)	-902*** (118)	-407*** (56)	-501*** (56)	-0.030*** (0.008)	-0.025*** (0.009)	-0.008 (0.008)	-0.012* (0.007)	4.74*** (1.7)	-0.005 (0.010)
I:25% P:5%	-61** (25)	9.81 (23)	-319** (138)	-409*** (59)	-263*** (61)	-0.019** (0.009)	-0.032*** (0.009)	-0.018** (0.007)	-0.021*** (0.007)	3.45** (1.71)	-0.034*** (0.010)
I:25% P:10%	90*** (26)	175*** (26)	-857*** (117)	-251*** (59)	-409*** (59)	-0.015* (0.009)	-0.007 (0.009)	-0.001 (0.008)	-0.004 (0.007)	3* (1.70)	0.007 (0.010)
I:35% P:5%	11 (29)	18 (26)	-333*** (128)	-194*** (63)	-66 (64)	-0.011 (0.009)	-0.003 (0.009)	0.002 (0.008)	-0.019*** (0.007)	0.376 (1.71)	-0.014 (0.010)
I:35% P:10%	99*** (32)	151*** (28)	-677*** (124)	-183*** (59)	-314*** (59)	-0.007 (0.009)	-0.000 (0.009)	0.003 (0.008)	-0.003 (0.007)	2.41 (1.71)	0.013 (0.010)
I:45% P:10%	53** (26)	92*** (26)	-789*** (119)	-0.593 (63)	-229*** (62)	-0.006 (0.009)	0.010 (0.009)	0.012 (0.008)	0.016** (0.007)	2.91* (1.71)	0.039*** (0.010)
Constant	677*** (22)	506*** (26)	2240*** (100)	745*** (49)	1470*** (50)	0.132*** (0.007)	0.310*** (0.007)	0.205*** (0.006)	0.111*** (0.005)	612*** (1.33)	0.393*** (0.008)
Observations	87093	87093	87093	144000	144000	87093	144000	144000	144000	135361	144000
p-value Treatments	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
p-value Strata	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.100	0.000
R-squared	0.023	0.029	0.019	0.009	0.042	0.018	0.048	0.030	0.005	0.065	0.009
Dependent Variable Mean	655	510	1559	623	968	0.117	0.276	0.178	0.119	615	0.374

*Note:* These are cross-sectional regressions where the dependent variable is below the column number. Probability weights are used according to the population. Robust standard errors are shown in parenthesis. Monetary variables are measured in 2007 MXN pesos.

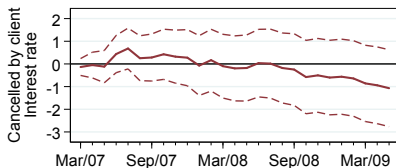
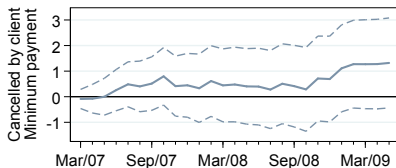
# Cancellations by client

[Return to results](#)

## Minimum-payers



## Full-payers

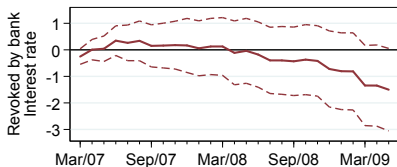
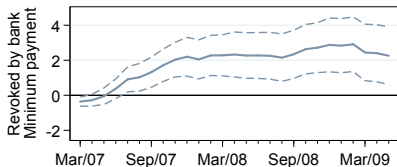




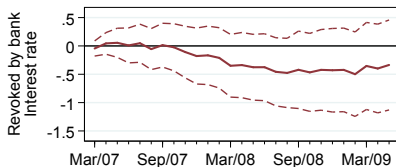
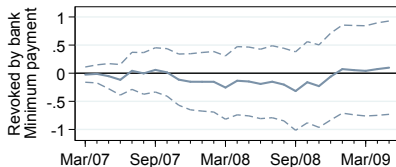
# Revoked by bank

[Return to results](#)

## Minimum-payers



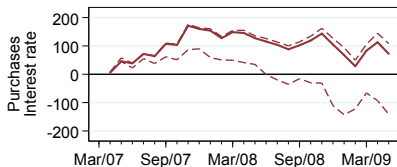
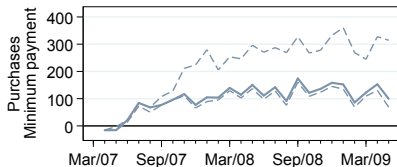
## Full-payers



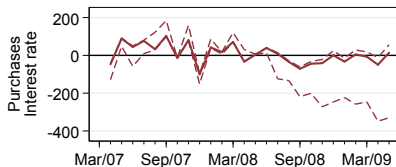
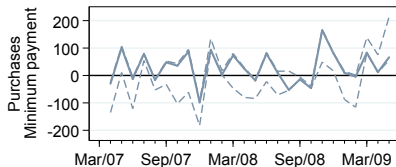
# Purchases

[Return to results](#)

## Minimum-payers



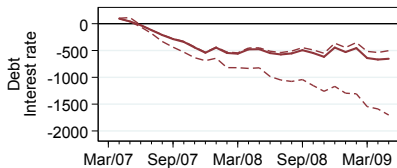
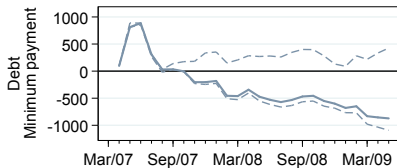
## Full-payers



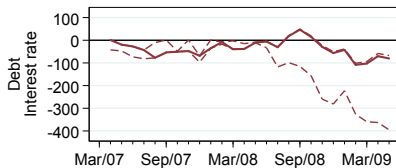
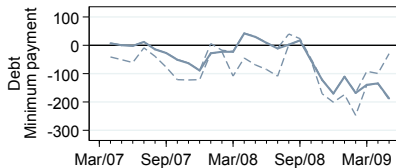
# Debt

[Return to results](#)

## Minimum-payers



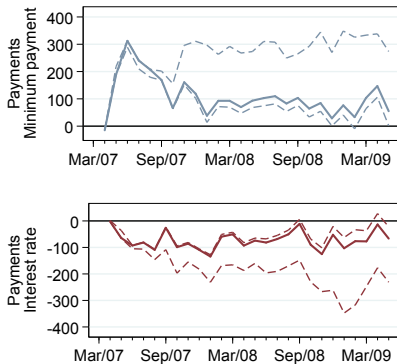
## Full-payers



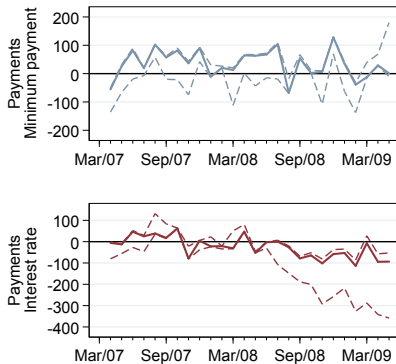
# Payment

[Return to results](#)

## Minimum-payers



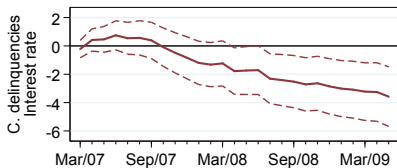
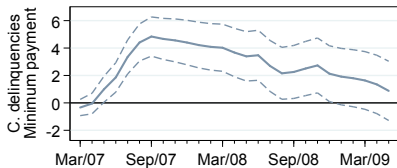
## Full-payers



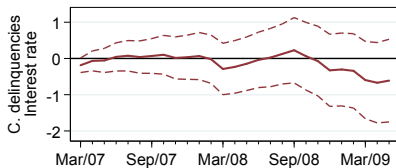
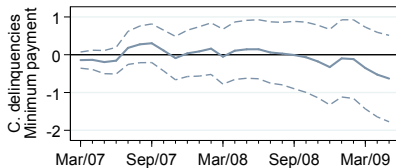
# Delinquencies

[Return to results](#)

## Minimum-payers



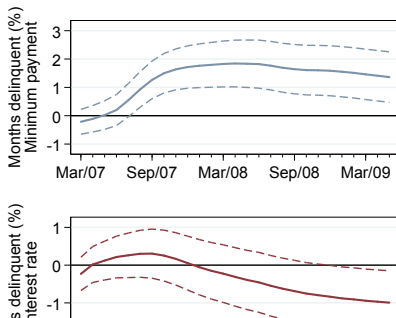
## Full-payers



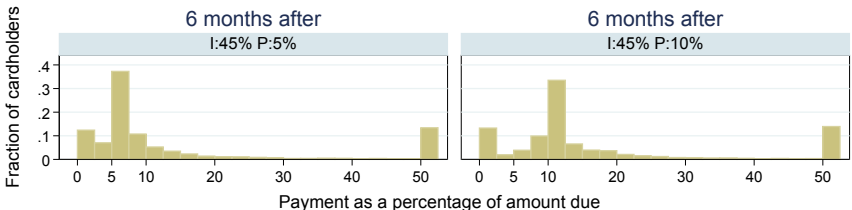
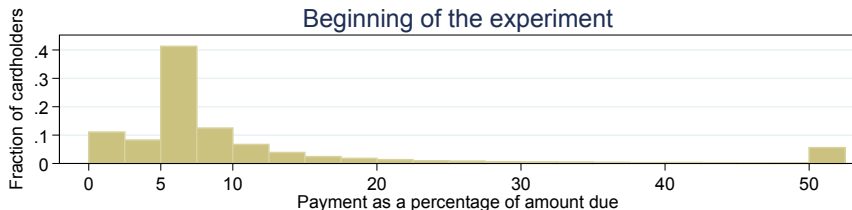
## Percentage of delinquent months

[Return to results](#)

- This measure has a similar trend to cumulative delinquencies, but different magnitudes.
- After 26 months of treatment:
  - Increasing **MP** leads to a 1.36\*\*\* pp increase (13%) in the percentage of months delinquent per account.
  - Decreasing **R** leads to a 1\*\* pp decrease (9%) in the percentage of months delinquent per account.



# Payment as a proportion of amount due

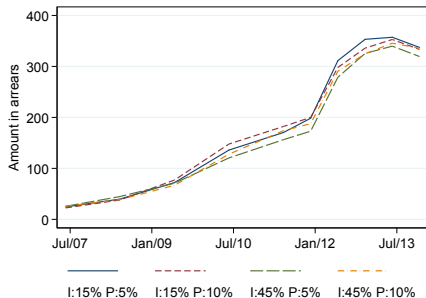
[Return to results](#)


Note:

- (1) Bins have a width of 2.5 pp each.
- (2) The rightmost bin of each graph includes those who pay more than 50 pp.

## Implications for Borrower Welfare

	(1) Arrears in telephone
I:15, P:5	1.1 (6.4)
I:15, P:10	6.1 (6.6)
I:25, P:5	-6.1 (6)
I:25, P:10	1.2 (6.5)
I:35, P:5	-3.1 (6.3)
I:35, P:10	2.4 (6.4)
I:45, P:10	-4.2 (6.4)
Cons (I:45, P:5)	71*** (4.4)
R-squared	0.0001
Observations	143,916
P-value of IR	0.656
P-value of MP	0.5446





## Implications for Borrower Welfare

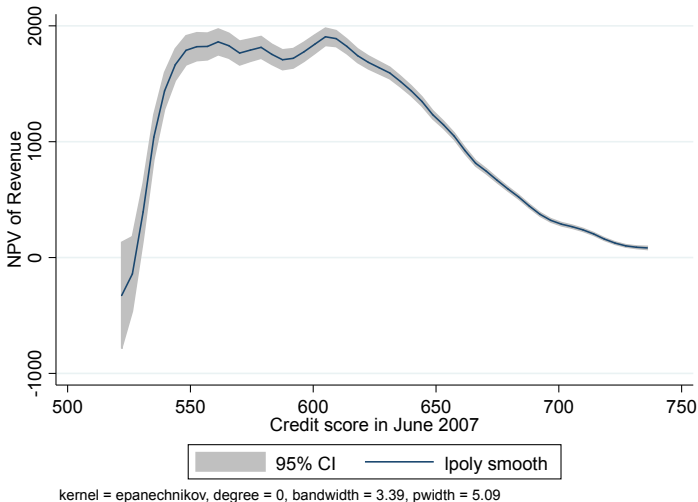
Dependent variable:	All type of loans		Only credit cards	
	At least one delinquent loan (1)	Total amount in arrears (2)	At least one delinquent loan (3)	Total amount in arrears (4)
I:15, P:5	-.0097 (.0066)	664 (536)	-.0028 (.0057)	447 (413)
I:45, P:10	-.012 (.0066)	-615 (492)	-.0044 (.0057)	-335 (384)
Cons (I:45, P:5)	.28*** (.0047)	9,450*** (351)	.19*** (.004)	6,741*** (272)
R-squared	0.0001	0.0001	0.0000	0.0001
Observations	143,916	143,916	143,916	143,916
P-value of IR	.5973	.3762	.9537	.4261
P-value of MP	.4656	.2098	.8831	.331

## Credit score

	(1) Jun/07	(2) Jun/08	(3) Jun/09	(4) Jun/10	(5) Jun/11	(6) Dec/11	(7) Jun/12	(8) Dec/12	(9) Jun/13	(10) Dec/13	(11) Apr/14
I: 15, P: 5	0.26 (0.68)	-0.70 (1.02)	0.73 (1.18)	0.46 (1.26)	-0.18 (1.30)	-0.62 (1.33)	-1.19 (1.33)	-1.91 (1.31)	-1.52 (1.30)	-1.54 (1.31)	-1.44 (1.32)
I: 45, P: 10	0.45 (0.68)	1.55 (1.00)	1.79 (1.17)	2.38 (1.25)	1.47 (1.30)	0.90 (1.33)	0.58 (1.33)	0.18 (1.31)	-0.48 (1.30)	-0.32 (1.32)	-1.03 (1.32)
Constant (I:45, P:5)	668.19*** (0.48)	660.61*** (0.72)	649.88*** (0.84)	643.72*** (0.90)	639.85*** (0.93)	635.41*** (0.95)	635.90*** (0.94)	635.76*** (0.93)	638.38*** (0.91)	637.52*** (0.93)	639.20*** (0.93)
Observations	142,241	118,165	135,359	134,569	133,184	133,084	132,465	131,280	130,518	128,727	126,684
R-squared	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
P-value of IR	.9905	.6593	.7779	.7574	.96	.8148	.8369	.604	.64	.6225	.408
P-value of MP	.6658	.1683	.5642	.4158	.6875	.4582	.6504	.2888	.3743	.2844	.3632

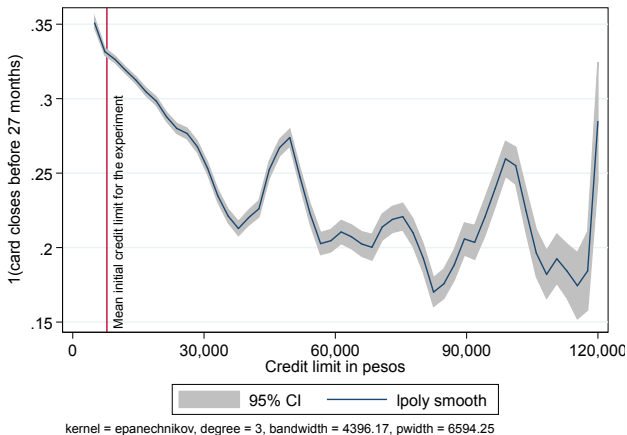
Return to slide

## Prediction of NPV of Revenue by Credit Score



## Credit limit and duration of the card in the market

Credit cards from all banks opened between 2004 and 2007



## Other Findings: Bank Revenues

- Consider the identity for month  $t$

$$Due_t = Due_{t-1} + Buy_t - Pay_t + (i/12) * Debt_t + Fees_t$$

where  $Debt_t$  is the average (over the month) of the daily amount due.

- Rewrite

$$Pay_t - Buy_t = Due_{t-1} - Due_t + (i/12) * Debt_t + Fees_t$$

- Consider an agent observed from  $t = 1$  and is in the experiment until  $T$  when the card exits or the experiment ends. Then, given a discount rate  $\beta$

$$\sum_{t=1}^T \beta^t (Pay_t - Buy_t) = \sum_{t=1}^T \beta^t (Due_{t-1} - Due_t) + \sum_{t=1}^T \beta^t ((i/12) * Debt_t + Fees_t)$$

- LHS is a measure of discounted net revenue accruing to the bank. We begin by analyzing this measure of revenue to the bank.