

# Adverse Selection on Maturity: Evidence from On-Line Consumer Credit

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*Credit and Payments Markets Oct 2 2015*

# The role of financial markets

- ▶ A primary function that financial markets play is to provide insurance to risk averse households
  - ▶ Households subject to risk from: unemployment, illness, divorce, expenditure needs
- ▶ One of the key ways in which markets provide insurance is by offering long term contracts
  - ▶ Health insurance (Cochrane 1995, Finkelstein et al 2005), labor markets (Holmstrom 1983)

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  - ▶ Health insurance (Cochrane 1995, Finkelstein et al 2005), labor markets (Holmstrom 1983)
- ▶ In consumer finance insurance is provided through loan maturity

## Loan maturity and insurance: an example

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  - ▶ Alternately - rollover short term loan at 10%
- ▶ If income is low:
  - ▶ Short term loan: Lower consumption to \$90 or borrow again at interest rate above 10%
  - ▶ Long term loan: Lower consumption to \$142.38 or borrow smaller amount at rate above 10%

## Motivation: adverse selection in consumer credit

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- ▶ Asymmetric information leads to insurance rationing in competitive equilibrium (Rothschild and Stiglitz 1976)
- ▶ Rothschild and Stiglitz 1976 applied to insurance provided through loan maturity
  - ▶ If all households take long maturity loan it will be priced for the pool
  - ▶ Households less exposed to shocks will opt out of insurance provided by long maturity loan into short term loans

## This paper: Screening on maturity

- ▶ Do observationally equivalent borrowers self select into loans of different maturities based on their unobserved creditworthiness (ability to repay and/or exposure to shocks)

# Agenda

Measuring selection on maturity

Interpretation

## Measuring selection on maturity

## The Identification Problem: measuring unobservable creditworthiness

- ▶ Focus on ex-post performance (default) conditional on observable creditworthiness
- ▶ Simple correlation: suppose borrowers are offered two loans:
  - ▶ Short maturity at 10% APR
  - ▶ Long maturity at 13% APR
- ▶ Suppose default rate is higher for the long term loan (after controlling for observables)
  - ▶ Consistent with borrowers with (unobservably) lower ability to repay selecting into longer maturity loans
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- ▶ We isolate selection by comparing how selected and non-selected samples perform **under the same contract**

## Idealized experiment

- ▶ Consider two observationally identical groups of borrowers, A and B
- ▶ A borrowers only have the option to take a short term loan, while B borrowers can also take a long term loan
- ▶ Default rates for ST loan are  $\gamma_A^{ST}$  and  $\gamma_B^{ST}$  for groups A and B, respectively

Maturity APR	Short $r_{ST}\%$	Long $r_{LT}\%$
Group A	$\gamma_A^{ST}$	
Group B	$\gamma_B^{ST}$	$\gamma_B^{LT}$

## Idealized experiment

- ▶ Measure the difference in the default rate of Group A and Group B borrowers who took the short term loan:  $\gamma_B^{ST} - \gamma_A^{ST}$
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- ▶ If  $\gamma_B^{ST} - \gamma_A^{ST} < 0$ , less creditworthy borrowers select into the long term loan
- ▶ Important: in order to be able to measure selection, creditworthiness must be measured relative and specific to one contract; in Section 2 we interpret what this means more generally

# Setting: Lending Club

- ▶ Largest online U.S. consumer credit lending platform
  - ▶ Started operating in June 2007, recently went public (current enterprise value: \$7bn)
- ▶ Loans funded by individual investors, LC charges an origination fee
- ▶ Facilitated \$4.4bn loans in 2014 (roughly 3x the second biggest player, Prosper)

The screenshot shows the LendingClub website interface. At the top, there is a navigation bar with the LendingClub logo and links for Personal Loans, Business Loans, Patient Debtors, Investing, How It Works, and About Us. A search bar is located on the right side of the navigation bar.

The main content area features a large green banner with the headline "Better Rates. Together." and a "Get a Rate Quote" section. The "Get a Rate Quote" section includes a form with the following fields: "How much do you need?", "What is it for?", and "How to your credit?". Below the form is a "Check Your Rate" button and a note: "We'll request your credit score." To the left of the form is an illustration of four diverse people.

Below the banner, there are three sections:

- Financial Innovation:** A text block describing Lending Club's role in connecting borrowers and investors, highlighting its transformation of the banking system to make credit more affordable and rewarding.
- Invest:** A circular diagram showing the flow of money from Investors to Borrowers, with "Monthly Payments" returning from Borrowers to Investors.
- Featured Borrower:** A section featuring a borrower named Rebecca Cochran, NC, who has a Play Off Credit Cards with a \$5,000 limit at 9.99%.

At the bottom of the page, there are navigation icons for back, forward, and search.

## Lending process

- ▶ Prospective borrowers enter information in website
  - ▶ Social Security #: LC pulls full credit report (FICO score, length of credit history, number of open accounts, available credit, etc)
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- ▶ Algorithm classifies each borrower into one of 25 fine risk categories (A1 through E5): sub grades
  - ▶ Some applications are denied (e.g. LC requires  $FICO \geq 660$ )
- ▶ Borrower is offered a menu of amounts/maturities; **sub grades determine rates**
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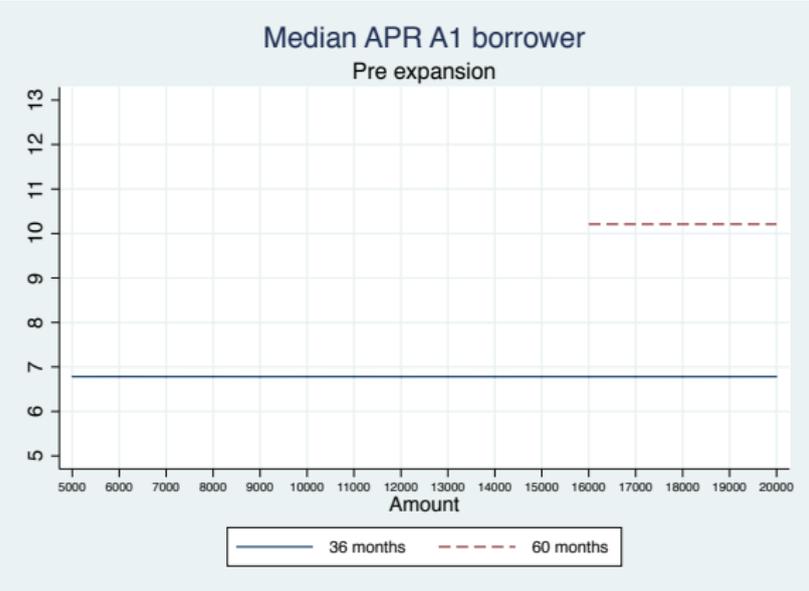
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- ▶ Terms: no collateral, fixed monthly payments, no prepayment penalty, collection agency handles defaults
- ▶ Investors in the platform can choose which pool of loans to invest in: all borrowers have their loan filled at rate determined by sub grade

## Menu prior to expansion: Dec '12 - Feb '13

- ▶ Long maturity loan was rolled-out to lower amounts in two stages: pre-period

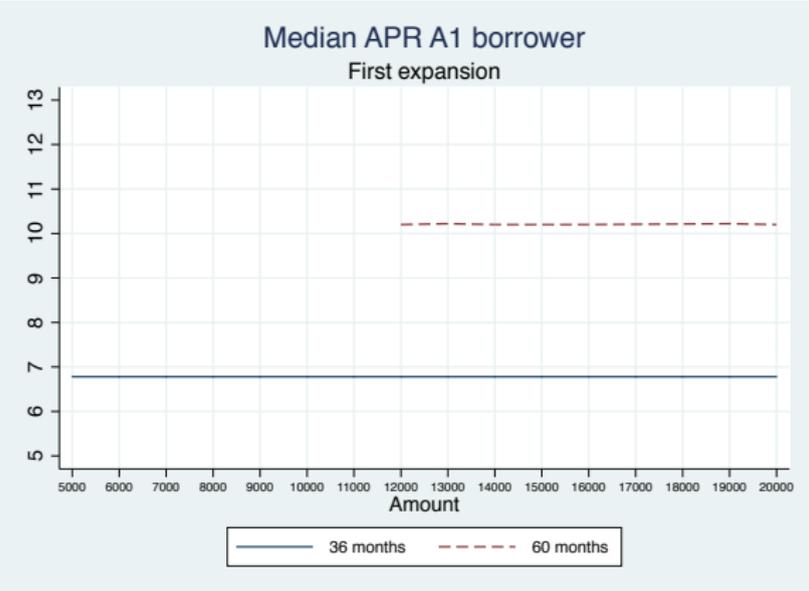
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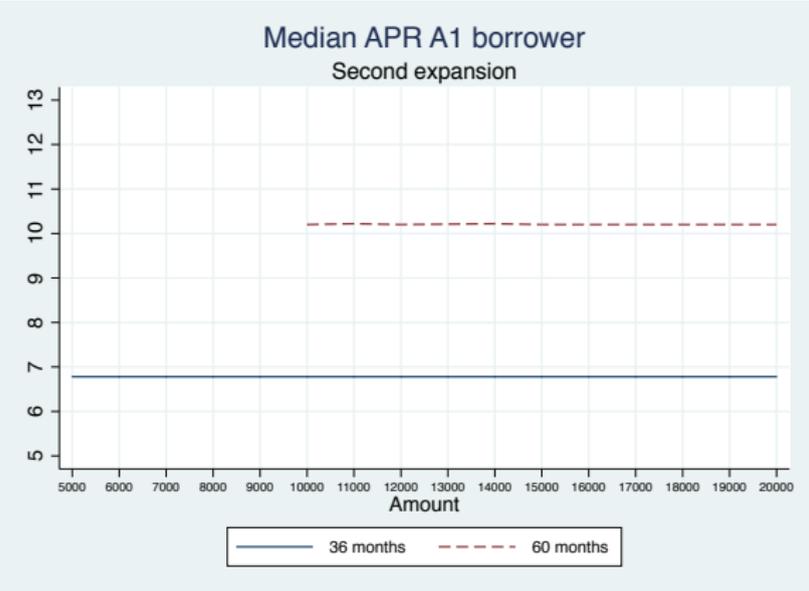
# Menu after first expansion: Mar '13 - Jun '13

- ▶ Long maturity loan was rolled-out to lower amounts in two stages: first to \$12k - \$16k

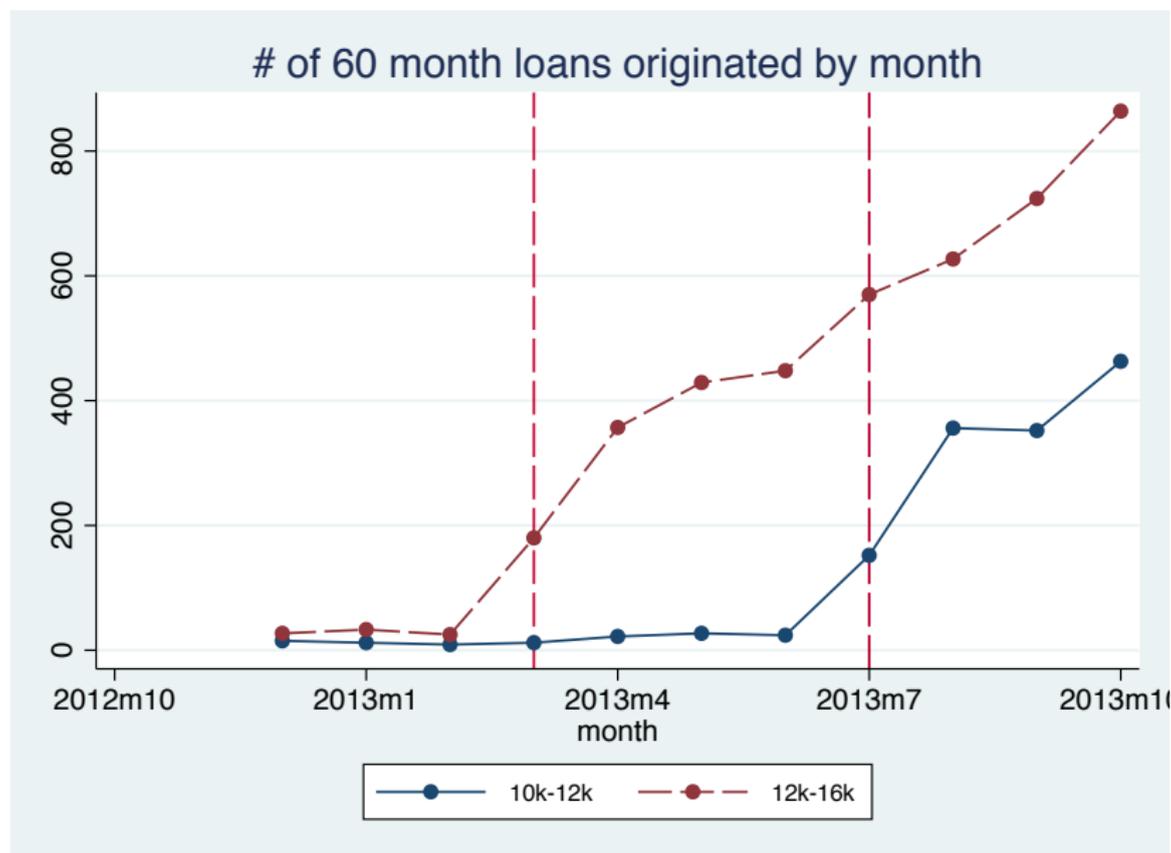


# Menu after second expansion: Jul '13 - Oct '13

- ▶ Long maturity loan was rolled-out to lower amounts in two stages: then to \$10k - \$12k



# Staggered expansion of long maturity loans



## Approximate the idealized experiment

- ▶ Study repayment of **36 month loans** between \$10k and \$16k issued **before** (non-selected) and **after** (selected) the staggered reduction in the 60 month threshold

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- ▶ However, we show that the bulk of selection occurred from short maturity “treated amounts”: \$10k to \$16k; no evidence from other amounts

# Sample

- ▶ 36 month loans originated by LC between December 2012 and October 2013 between \$5,000 and \$20,000 (N=60,514)
- ▶ For each loan we observe
  - ▶ Full set of observable borrower characteristics at origination (all info LC has)
  - ▶ Risk category and menu of contracts available to each borrower
  - ▶ Repayment history and latest FICO score up to April 2015

## Pre-period summary stats

	mean	p50	sd
Annual income (\$)	65,745	57,500	74,401
Debt payments / Income (%)	17.4	16.9	7.7
FICO at origination (high range of 4 point bin)	695	689	26
Home ownership (%)	55.5	100	49.7
Total debt excl mortgage (\$)	38,153	29,507	33,805
Revolving balance (\$)	14,549	11,592	12,719
Revolving utilization (%)	60.7	62.7	21.9
Months of credit history	182	164	84
APR (%)	16.3	16.0	4.1
Installment (\$)	379.9	360.9	125.1
For refinancing (%)	87.0	100	33.6
Default 120 days (%)	9.2		28.9
Prepaid (%)	37.6		48.4
N	12,091 (60,514 - Tot. Samp)		

## Regression: variable of interest

- ▶ Define a dummy variable for loans in the affected amounts after the expansion:

$$D_i = \begin{cases} 1 & \text{if } 12,000 \leq \text{LoanAmount}_i < 16,000 \text{ and } t_i \geq \text{Mar13} \\ 1 & \text{if } 10,000 \leq \text{LoanAmount}_i < 12,000 \text{ and } t_i \geq \text{Jul13} \\ 0 & \text{otherwise} \end{cases}$$

# Does the unobserved quality of 36-month borrowers change with selection?

- ▶ Run the staggered introduction regression at the loan level:

$$outcome_i = \gamma \times D_i + \beta_i^{1000bin} + \delta_i^{FICO \times subgrade \times month} + X_i + \epsilon_i$$

- ▶ Same definition of “staggered treatment” dummy  $D_i$

## Controls:

- ▶  $\beta_i^{1000}$ : \$1,000 bin
- ▶  $\delta_i^{FICO \times subgrade \times month}$ : month by 4-FICO bin by subgrade fixed effects
- ▶  $X_i$ : Controls (includes: state by month of origination fixed effects, income)

## Screening: long maturity borrowers default more



$$outcome_i = \gamma \times D_i + \beta_i^{1000bin} + \delta_i^{FICO \times subgrade \times month} + X_i + \epsilon_i$$

	<i>default</i>	<i>default</i>	<i>FICO</i>	<i>FICO</i>
$\gamma$	-0.0071** (0.003)	-0.0066* (0.003)	2.26** (1.1)	2.05* (1.0)
Obs	60,514	57,263	60,514	57,263
$R^2$	0.1110	0.125	0.259	0.283
Clusters	25	25	25	25

- ▶ Columns 2 and 4:  $X_i$  contains full set of variables that LC observes at origination

# Robustness

- ▶ Results robust to narrower interval for controls ( $\pm\$2k$ )
- ▶ No difference in default in control group (borders of treated interval)
- ▶ Placebo shifted by 7 months: no effect, but interpret cautiously

## Evidence that borrowers selected away from treated loan amounts

- ▶ Collapse and count the number of 36 month loans at the sub grade  $j$  x \$1,000 amount bin  $k$  x month  $t$  level as  $N_{jkt}$
- ▶ Define:

$$D_{kt} = \begin{cases} 1 & \text{if } 16,000 > \text{LoanAmount}_k \geq 12,000 \text{ and } t \geq \text{Mar13} \\ 1 & \text{if } 12,000 > \text{LoanAmount}_k < 10,000 \text{ and } t \geq \text{Jul13} \\ 0 & \text{otherwise} \end{cases}$$

- ▶ Diffs-in-diffs specification:

$$\log(N_{jkt}) = \gamma' \times D_{kt} + \beta'_k + \delta'_t + \epsilon_{jkt}$$

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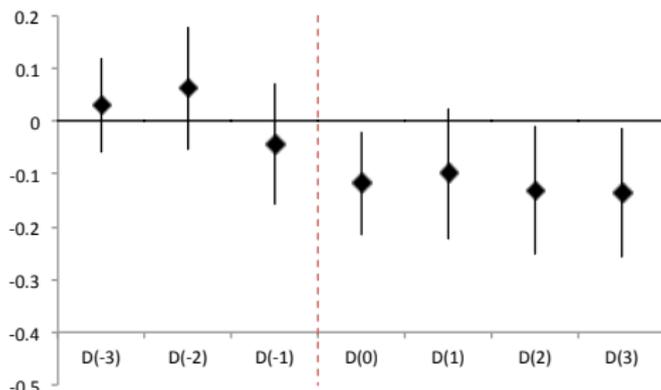
	<i>log (#loans)</i>	
	MAIN	PLACEBO
$\gamma'$	-0.1451*** (0.028)	-0.0441 (0.031)
Obs	3,663	3,861
$R^2$	0.817	0.862
Clusters	25	25

- ▶ Placebo: repeat analysis from July '13 to May '14 (after expansion)
- ▶ We see no substitution to the new long maturity loans from short maturity loans above \$16,000 or below \$10,000

# Testing for pretends

- ▶ We expand the definition of  $D_{kt}$  to form a series of dummies that become active  $\tau$  months after a 60-month loan is offered at each amount:

$$D(\tau)_{kt} = \begin{cases} 1 & \text{if } \$16,000 > \text{LoanAmount}_k \geq \$12,000 \ \& \ t = \text{Mar}2013 + \tau \\ 1 & \text{if } \$12,000 > \text{LoanAmount}_k \geq \$10,000 \ \& \ t = \text{Jul}2013 + \tau \\ 0 & \text{otherwise} \end{cases}$$



# Economic Magnitude

- ▶ Economic magnitude: average default rate for 36 month loans is 0.7% lower for borrowers who selected into the short term loan
- ▶ Implied default rate at the short maturity of borrowers who preferred to borrow long term (i.e., the 14%) is **5% higher** (=0.7%/14%)
  - ▶ Compare this to the average preperiod default rate of 9.2%

# Interpretation

# What is the private information?

- ▶ We have documented that borrowers who select into long maturity loans exhibit a higher default rate at short maturity loans
  - ▶ Limited definition of creditworthiness
- ▶ We argue that this difference stems from borrowers who privately observe that they are more exposed to shocks to their ability to repay selecting into long maturity loans

## Evidence: propensity to prepay conditional on no default

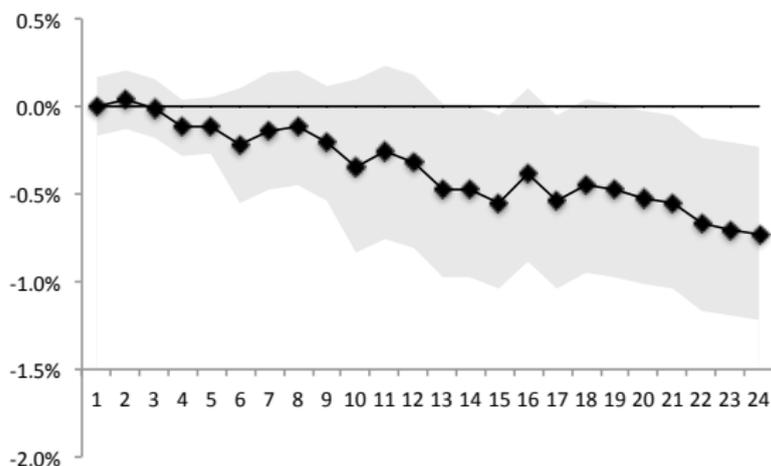
$$\text{prepaid}_i = \gamma \times D_i + \beta_k + \delta_{FICO \times \text{subgrade} \times \text{month}} + \delta_{\text{state} \times \text{month}} + X_i + \epsilon_i$$

	<i>prepaid</i>   <i>default</i> = 0
$\gamma$	-0.0120* (0.006)
Obs	55,784
$R^2$	0.164
Clusters	25

- ▶ Conditional on not defaulting borrowers who selected into long term loans also pre-pay short-term loans at a higher rate
  - ▶ Magnitude:  $1.2\% / 14\% = 8.57\%$  higher propensity to pre-pay relative to 38% baseline

## Differential propensity to be in default by month since origination

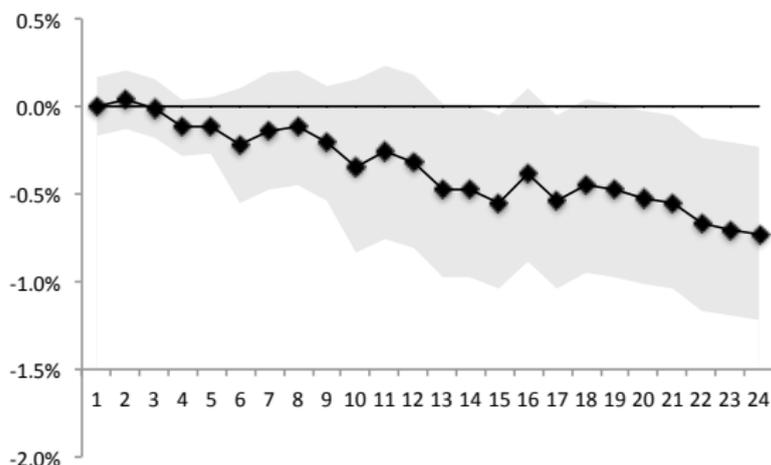
- ▶ We run our main regression replacing the outcome for default measured as of April 2015, conditional on the last payment occurring  $m$  months after origination: plot coefficients vs  $m$



- ▶ Lower credit quality does not manifest in the first year of a 36 month loan (hazard rate: defaults peak around 13 months)

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# Conclusion

- ▶ Borrowers with lower repayment capacity/ability self-select into longer maturity loans
  - ▶ May explain equilibrium positive correlation between maturity and risk (and rates) in consumer credit markets
- ▶ Policy implication for mortgage length regulation:
  - ▶ US: Qualified mortgages capped at 30 years
  - ▶ Canada: lowered cap to 25 in 2008
- ▶ Evidence of adverse selection in markets where insurance is provided through contract length
- ▶

# Email Solicitation: Slash Years off Your Debt



Check Your Rate Now

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## Let Us Help You Achieve Your Financial Goals

Dear Andrew,

Did you know that it could take you over two decades to pay off your high interest credit cards if you are only making the minimum payments each month? That means that your credit card company will collect thousands of dollars in interest from you for many years to come!

There is a better way. With a personal loan through Lending Club, you can responsibly borrow up to \$35,000 to immediately pay off your high interest cards and start saving immediately. Imagine being debt free in just three years!

Loans via Lending Club all feature low, fixed monthly payments. Rates are often substantially lower than those charged by credit cards, and they will never go up. Plus, you can choose to save even more by repaying your loan early, with no prepayment penalties or fees.

It only takes two minutes to check your rate online, with no impact to your credit score. You'll be instantly presented with multiple loan offers if you qualify.

Thanks

Thank you!