The Free Installment Puzzle

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George Washington University Microeconomics Seminar

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Road Map for Talk

- What is the "Free Installment Puzzle"?
- Exploratory Analysis of a New Credit Card Data Set
- Estimating the Demand for Credit: the Endogeneity Problem and Failure of Reduced-Form methods
- Exploiting Free Installments as "Quasi Random Experiments"
- Estimation Results
- Implications and Counterfactuals
- Conclusions

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"The $20 Bill Puzzle"

- In a perfect world with rational beings, $20 dollar bills should not be lying around on the sidewalk
- If the cost of bending down to pick them up is not too high, people who notice the $20 dollar bills will bend down and pick them up
- Ergo, we should not see many $20 bills lying on the ground
- In finance, an opportunity to take an interest free loan is the equivalent of a $20 bill lying on the ground
- In fact, for big purchases, the money saved or earned by an interest free loan of sufficient size can be significant
- Since we don't see many $20 bills lying on the ground, there actually is no "$20 bill puzzle"

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A New Credit Card Data Set

- We introduce a new micro data set on credit card usage
- The main way the credit card allows its customer to borrow is via *installment credit*
- Each time a customer makes a purchase, they choose whether to pay in full or in installments ranging from 2 to 12 months
- These individual "micro borrowing decisions" are made on a *transaction by transaction basis*
- For our sample we observe over *180,000* of these micro borrowing decisions
- To promote credit card usage the credit card company frequently offers *free installments.* These are opportunities to borrow up to a maximum duration $\delta \in \{2, \ldots, 12\}$ at a *zero percent interest rate.*

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- We find that though credit card customers are offered free installment opportunities in about 20% of all purchase transactions, they choose them less than 15% of time
- Further, of the minority of customers who do take free installment offers, they typically take them for *less than the maximum term* δ *that it offered to them*
- This *pre-commitment behavior* is puzzling, since it is hard to rationalize using standard time-separable models with geometric discounting
- It could be evidence of *time inconsistent* decision makers, who pre-commit to *ex ante* suboptimal choices as a *self-control device to control the temptation that too much current borrowing could be bad for their future selves.*

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Free installment puzzle vs the $20 bill puzzle

- As far as standard economic models are concerned, forgoing zero interest loan offers is akin to leaving $20 bills on the sidewalk
- This behavior is also puzzling since many credit card customers are perceived to be *liquidity constrained*
- At the same time as we observe a majority of customers passing over free installment offers, we also see the same customers also *paying very high interest rates, in excess of 15%, for installment loans*
- Customers are aware of the opportunity to borrow under installment since must make this choice at the checkout counter, each time they make a purchase
- They are also aware of the interest rates they face since the schedule is provided on each monthly statement

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Related credit puzzles

- Thus, it is hard to argue that customers are unaware or are uniformed about installment borrowing opportunities
- This is especially true of free installment offers, which are heavily promoted, including at the checkout counter
- Further, since installment borrowing can be done by indicating the desired term of the loan on a keypad at check out time, the transactions costs of purchasing under installment are designed to be very low
- It is also a puzzle why the credit card company pushes free installments so aggressively given that the response to them appears to be so weak

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When is Pre-commitment optimal?

- In general, a rational decision maker with time-separable discounted preferences exhibits *time-consistent behavior* and generally will not pre-commit *ex ante* to actions that limit their future options unless they are *compensated for the loss in future choice flexibility.*
- However work by Strotz (1955) Laibson (1997) and and Gul and Pesendorfer (2001) and others on hyperbolic discounting, temptation, and self-control have shown how "sophisticated" agents who are self-aware of their time-inconsistent behavior can find it optimal *ex ante to pre-commit to actions that restrain the options available to their "future selves"* because it makes them "unambiguously better off when ex ante undesirable temptations are no longer available" (p. 1406).

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Limiting current borrowing to preserve future flexibility

- The model predicts that as many as 88% of individuals who are offered (and chose) a 10 month free installment offer pre-commited at the time of purchase to pay the balance in *fewer* than the 10 installments allowed under the offer
- Why choose to limit your future options in this way?
- One explanation is individuals regard borrowing as a current temptation, and if they borrow too much today, they could get in over their head in debt over time
- If a customer does not have enough self-control to avoid paying on installment entirely, the next best option may be to borrow for less than the maximum term allowed

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Is the "free installment puzzle" really a puzzle?

- We believe this is the first study to provide credible evidence of low take up rates of free installment offers and a high incidence of pre-commitment behavior "in the wild"
- We are not aware of significant evidence of this kind in real-life settings. Previous evidence on pre-commitment behavior comes from *laboratory experiments*
- A 2009 study by Casari notes that "*Although the implications of naïveté or sophistication are profound, the behavioral evidence is still quite limited*" (p. 119).
- Casari's laboratory experiments revealed that "the demand for commitment was substantial" even though "Commitment always carries an implicit cost due to the uncertainty of the future." (p. 138).

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Other explanations for the free installment puzzle

- We refer to the borrowing behavior we infer as a “puzzle” since there are other possible explanations for it besides “time inconsistency”
- For example, *social stigma* could be another explanation for the low take up rate of installments, including free ones.
- Just before the period of our data set there was a major credit crisis in the country created by excessive credit card lending which lead to credit card debt to reach 15% of GDP at its peak in 2002!
- A wave of credit card defaults precipitated a national crisis and a government bailout of banks and credit card companies in 2003. This experience that may have “chastised” (or even *scarred*) the individuals in our sample to avoid the hazards of excessive borrowing.

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Credit Card Data

- We have access to *transaction by transaction* credit card data for sample of 993 customers of a large credit card company
- We see every transaction made on this credit card over a period of time from late 2003 to spring 2007
- We have used these data to construct an *unbalanced panel* of all credit card purchases, payments, cash advances, and installment transactions and dynamically track their balances over the period we observe them
- We also observe *credit scores* assigned by the company, late fees, penalties and number of late payments and so forth
- However we do not observe the type of employment, earnings, and personal information on these customers

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- We see every transaction made on this credit card over a period of time from late 2003 to spring 2007
- We have used these data to construct an *unbalanced panel* of all credit card purchases, payments, cash advances, and installment transactions and dynamically track their balances over the period we observe them
- We also observe *credit scores* assigned by the company, late fees, penalties and number of late payments and so forth
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Installment Loans

- Credit card customers of the credit card company we are studying have access to credit via an *installment purchase option*
- Revolving credit card accounts are a relatively recent phenomenon, introduced after 2005
- In the absence of revolving or installment credit, all credit card bills must paid in full at each statement date, otherwise the customer faces a late fee and a degradation of their credit score
- Of course, credit card “float” (the delay between when an item is bought, and when the customer pays the credit card at the next statement day, 1-30 days from the purchase date), is a type of interest free loan

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- However for nearly any purchase a customer makes, they can decide to pay the balance over several statements (months) ranging from 2 months to 12 months (or longer)
- Customers ordinarily face a customer-specific interest rate for the installment loan, which is *an increasing function of the duration of the loan*
- The installment interest rate also depends on the customer’s credit score and payment history. Having too many late payments recently results in significant increases in the installment interest rate that they are offered
- It is important to note that customers can make installment decisions on a *transaction by transaction basis* – at the cash register each time they buy an item

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Interest-Free Installments

- Many merchants, in concert with the credit card company, sometime offer customers *free installment loans*
- These free installment opportunities are not related to the characteristics of the customer: *any credit card customer who is in good standing can be eligible to receive a free installment offer, regardless of their credit score or payment history, provided they are not in actual default (credit card suspended)*
- Merchants sometimes negotiate with the credit card to offer free installments as a way to boost sales
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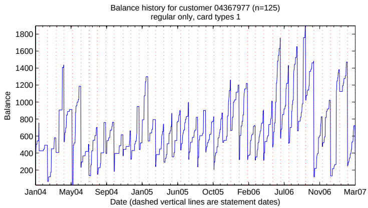
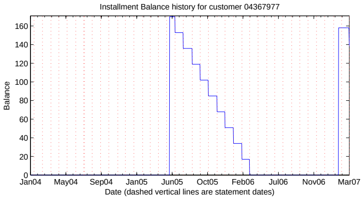
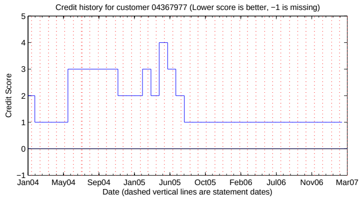
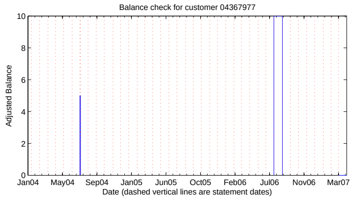
Account History for Customer 124

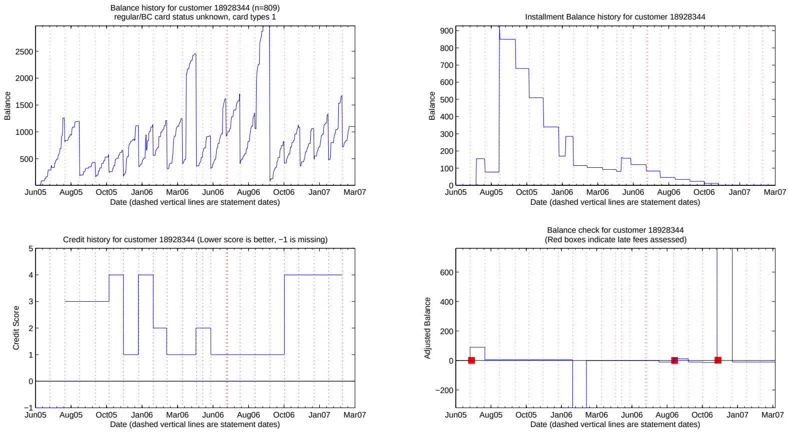




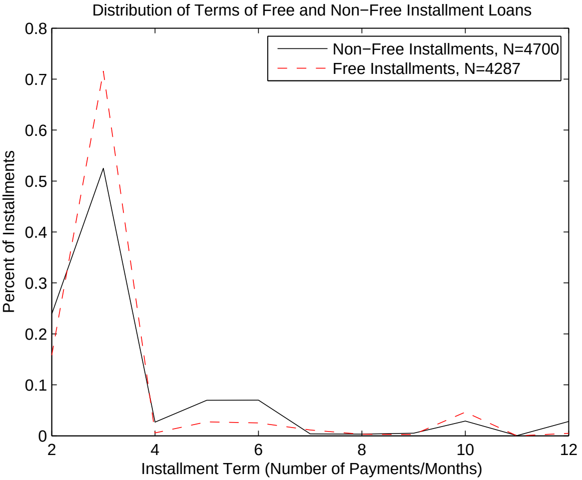




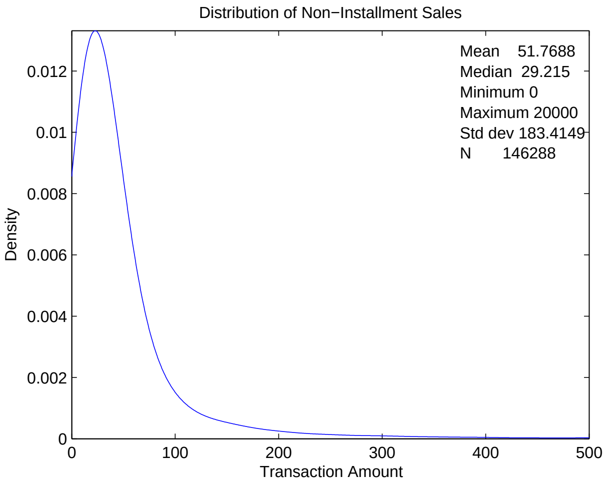
Account History for Customer 809



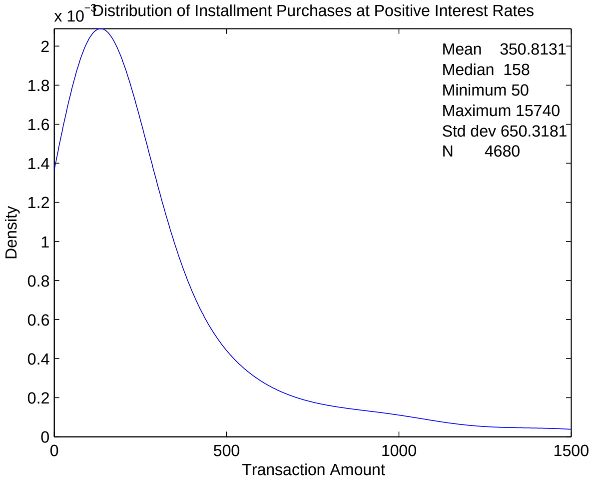
Durations of Free and Non-Free Installment Loans



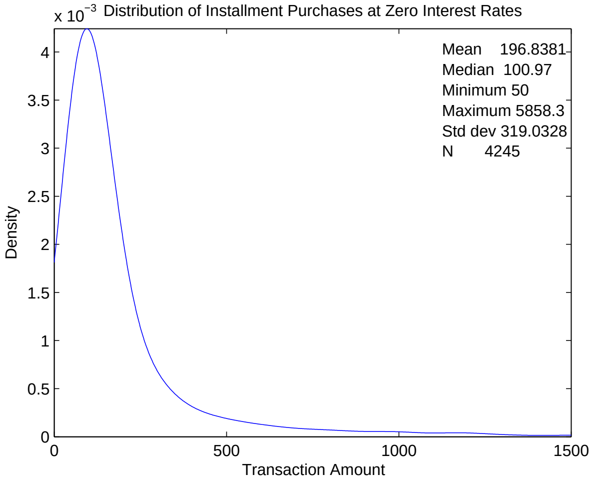
Distribution of Non-Installment Credit Card Purchases



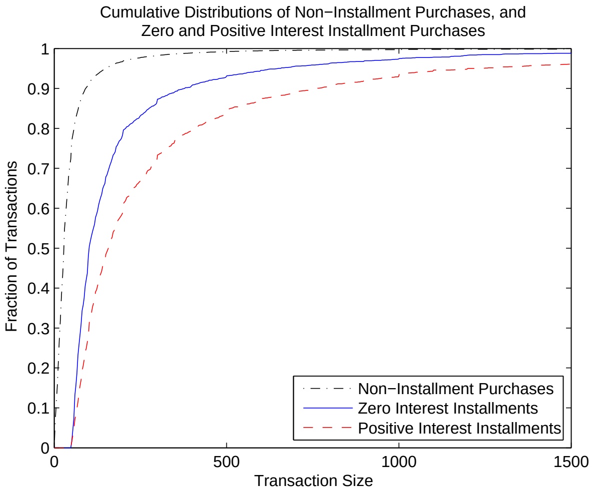
Distribution of Non-Free Installment Purchases



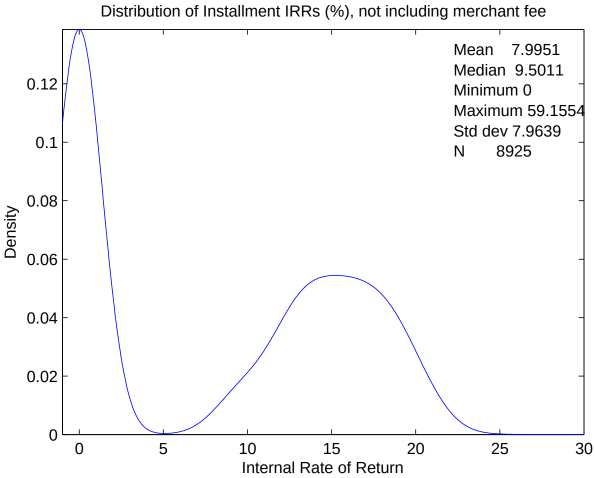
Distribution of Free Installment Purchases



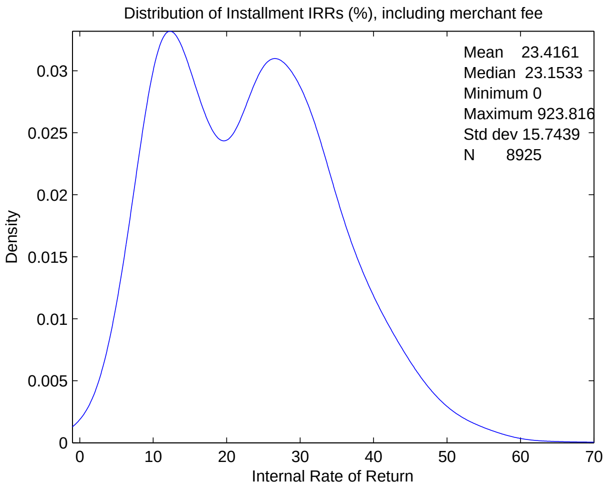
Cumulative Distributions of Transaction Amounts



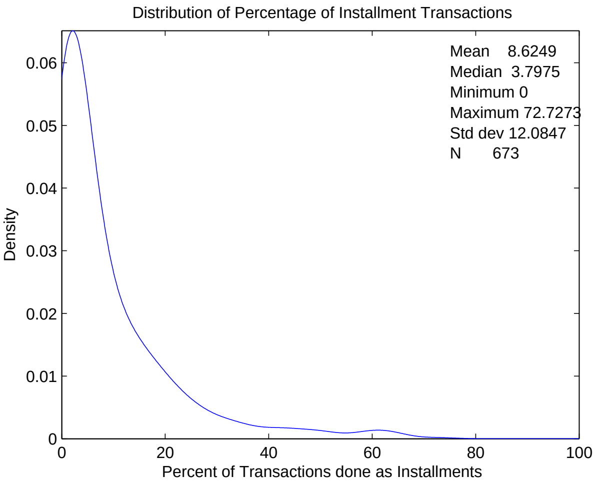
Returns on Installment Loans, net of merchant fee



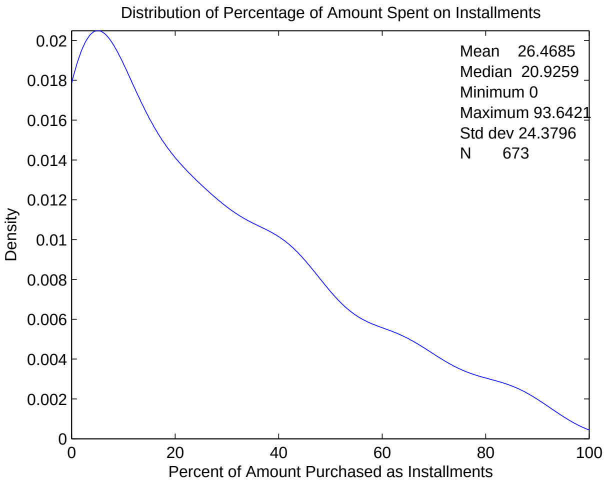
Returns on Installment Loans, including merchant fee



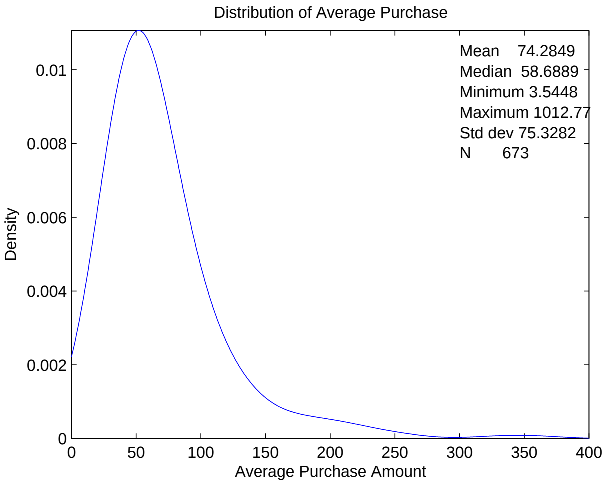
Fraction of Transactions Done on Installment



Share of Spending Done on Installment



Average Non-Installment Purchase Sizes



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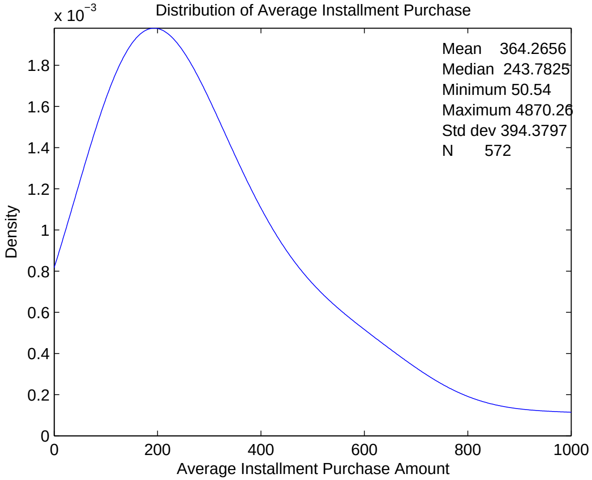

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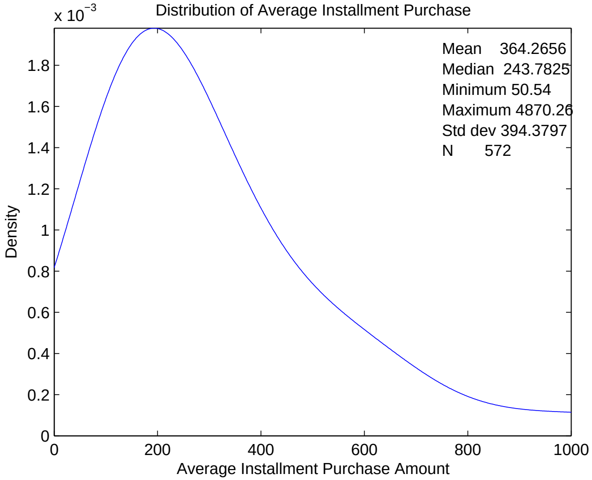
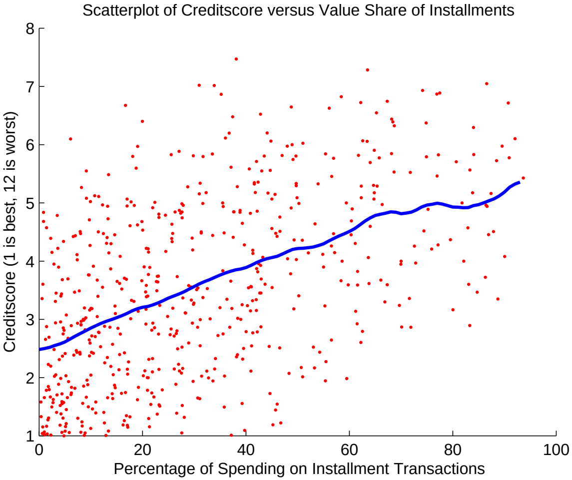
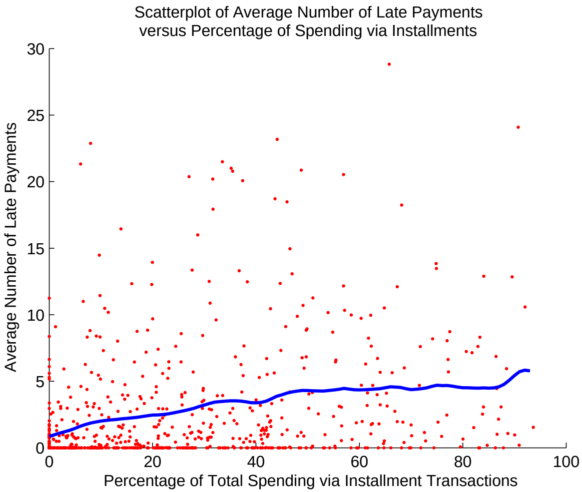


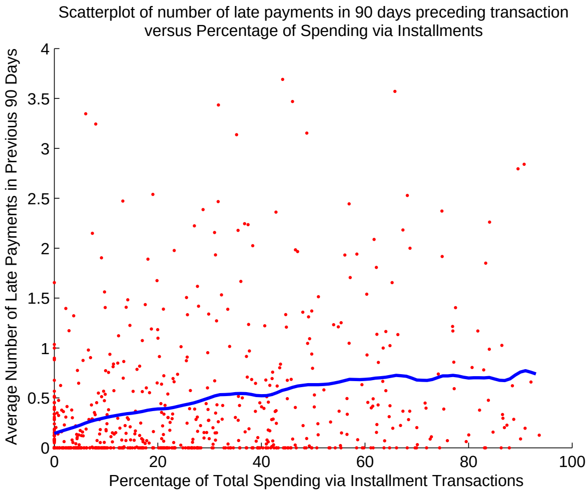
Credit Scores by Installment Share



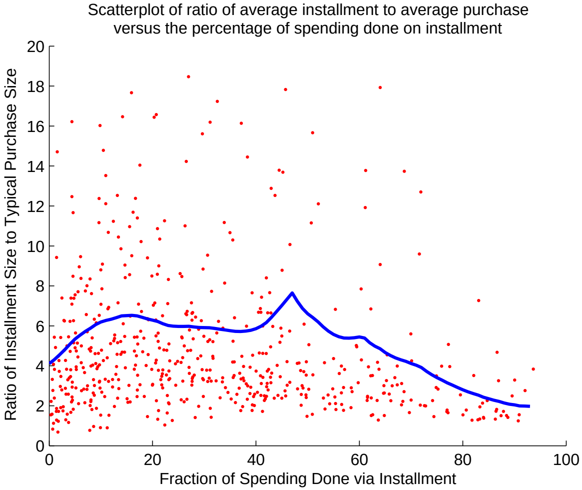
Number of Late Payments by Installment Share



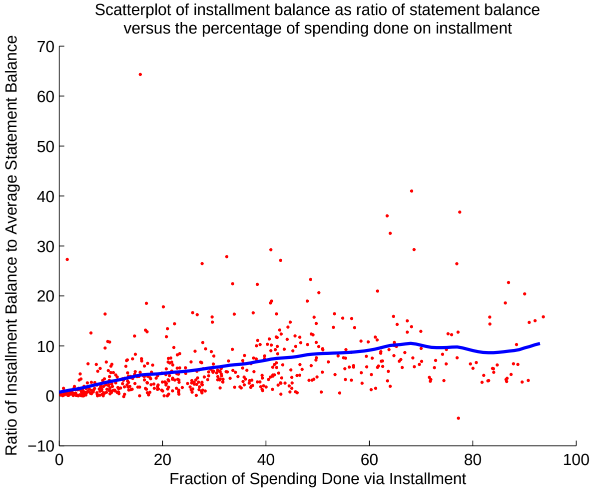
Seriously Late Payments by Installment Share



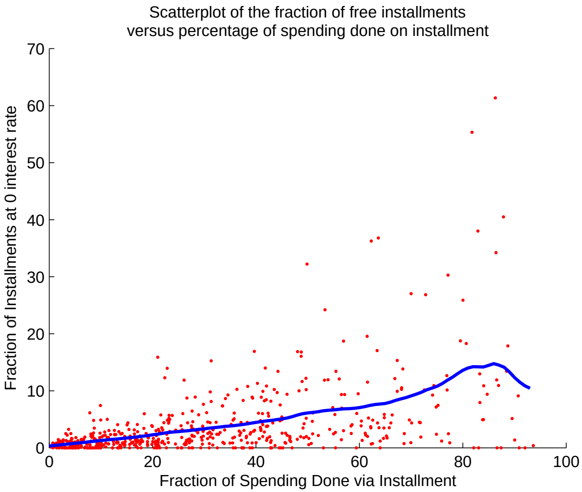
Installment/Purchase Ratio by Installment Share



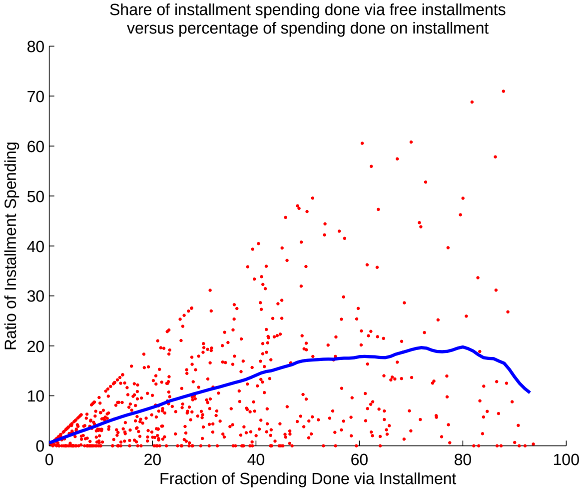
Installment Balance Ratio by Installment Share



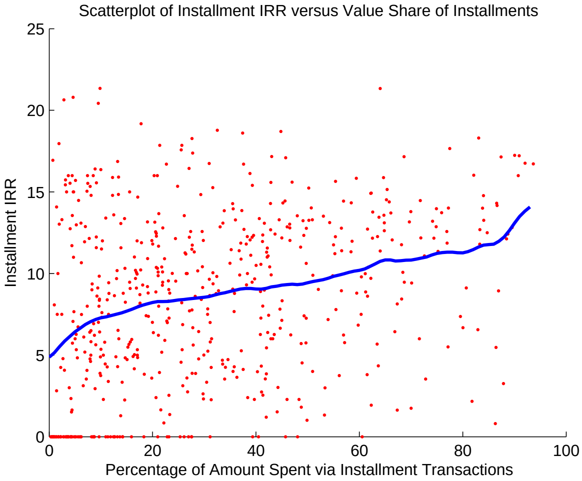
Fraction of Free Installments by Installment Share



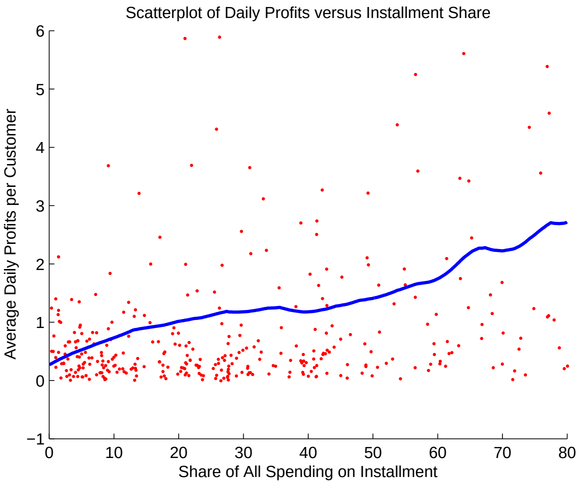
Share of Free Installments by Installment Share



Installment Returns by Installment Share



Customer-level Daily Profits by Installment Share



Findings

- The vast majority of all transactions (more than > 88% in full sample and 93% in our estimation subsample) are *not* done as installments
- The most likely duration of an installment loan is 3 months, but there is some chance of loans at 6, 10 and 12 months
- The distribution of terms for free installments is very similar to the distribution of positive interest installments
- The main difference between the two distributions is that free installments are more likely to be for 3 months than positive interest installments (70% vs 50%)

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Findings, continued

- The size of the average non-installment credit card purchase is $51 whereas the size of the average installment purchase is $350
- However the size of the average *free installment purchase* is only $196
- Why are free installment purchases smaller on average than positive installment purchases?
- This is a first indication of the free installment puzzle
- In fact, we showed that the distribution of positive installment purchase stochastically dominates the distribution of free installment purchases,which in turn stochastically dominates the distribution of non-installment purchases

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- We showed that roughly half of all installment purchases are at a 0% interest rates, i.e. *free installments*
- The mean interest rate conditional on it being positive, is about 15%
- However this is not accounting for the *merchant fee.* When we account for the merchant fee the mean rate of return on installments is 23%, and the mean for transactions done at positive interest rates is 31%
- We believe that merchant fees are a major component of the firm's profits, and due to network externalities the firm expected profits increase with its market share, the firm has high incentive to using marketing devices such as free installments to try to increase its market share

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- We showed that there is a great deal of *customer-specific heterogeneity* in credit card spending and borrowing decisions
- We found that *installshare,* the share of all credit card spending a consumer does via installment, is one of the most important correlates with a wide range of credit card spending patterns, but particularly the propensity to use free installments
- Customers with higher *installshare* have: 1) worse credit scores, 2) more late payments, 3) take more free installment offers, 4) pay higher rates of return on installments overall (even factoring the higher propensity to use free installments), and, 5) are more profitable

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Conditional Demand for Installment Credit

- We define the conditional demand for credit as the demand to finance a given credit card purchase through borrowing rather than to pay the amount purchased in full at the next purchase date.
- This demand is conditional on having made a decision to make a given purchase of a given size in the first place.
- We do not have the appropriate data that tells us a customers *full set of alternative credit options* and how interest rates cause them to switch between different payment/financing options
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Unconditional Demand for Installment Credit

- Let c denote the decision by the consumer to pay using the company’s credit card (as opposed to paying by cash, or using some other credit card).
- Let r be the interest rate charged to a customer with observed characteristics x for purchasing via installment credit. (r may also be an *interest rate schedule*)
- Let $ED(r, x, c)$ denote the (unconditional) expected demand for credit from credit card c by a single customer with characteristics x, where x includes variables such as the customer’s credit score, spending history, and might also include information on interest rates offered by competing credit cards or interest rates for other sources of credit.

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Unconditional Credit Demand Equation

- We can write $ED(r,x,c)$ as follows,

$$ED(r,x,c) = \left[\int_0^\infty a[1-P(1|a,r,x,c)]f(a|x,r,c)da\right]\pi(c|r,x)EN(x,r).$$

- a is the amount purchased
- $P(1|a,r,x,c)$ is the probability of paying a in full at the next statement date given the interest schedule r, consumer characteristics x and the decision to use credit card c to carry out the transaction.

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Unconditional Credit Demand, continued

- $\pi(c|r,x)$ is the probability of using credit card c to pay for the transaction
- $f(a|x,r,c)$ denote the density of the amount purchased using the company's credit card during any given shopping trip.
- $EN(x,r)$ denotes the expected number of shopping trips that the customer makes during the specified interval of time.
- Overall demand can be computed by summing the conditional expected demands over the distribution of customer characteristics, $\sum_x ED(r,x,c)g(x)$ where $g(x)$ is the number of customers of type x.

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Limits of our data

- The data we have are not sufficient to estimate the objects $\pi(c|r,x)$, $EN(x,r)$ or $g(x)$.
- Separate survey/diary data would have to be collected that would enable us to study the purchase habits of a sample of the company's customers, and how something like free installment offers during a given period of time might affect the number of shopping trips they make (thus enabling us to estimate $EN(x,r)$), and the likelihood that they will use the company's credit card c to pay for the purchase (thus enabling us to estimate $\pi(c|a,r,x)$).

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What we can do with our data

- However since we do observe all of the purchase amounts that a given consumer makes during any given shopping trip where the customer uses the company's credit card, we can potentially estimate $f(a|x, r, c)$.
- Further, since we also observe customers' choices of whether to purchase on installment or whether to pay the amount a in full at the next statement date conditional on having decided to use the company's credit card, we can potentially estimate the *installment choice probability* $P(d|a, r, x, c)$
- We can potentially estimate two conditional densities, $f_1(a|x, r, c)$ and $f_0(a|x, r, c)$ representing the distribution of purchase amounts for transactions done, and not done, under installment credit, respectively

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Defining the conditional demand for credit

$$\begin{aligned} f_0(a|x,r,c) &= \frac{P(1|a,r,x,c)f(a|x,r,c)}{\int_0^\infty P(1|a,r,x,c)f(a|x,r,c)da} \\ f_1(a|x,r,c) &= \frac{[1-P(1|a,r,x,c)]f(a|x,r,c)}{\int_0^\infty [1-P(1|a,r,x,c)]f(a|x,r,c)da}. \end{aligned} \quad (1)$$

- So we can use f_1 to define the *conditional expected demand for credit* $ED_l(r,x,c)$

$$ED_l(r,x,c) = \int_0^\infty a f_1(a|x,r,c)da.$$

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Does the conditional demand for credit fall with r?

- Just as we expect the unconditional demand curve to be a downward sloping function of r, we also expect the conditional demand for credit to be downward sloping in r
- Why? Because expect customers to borrow larger amounts on installment when the interest rate is lower.
- Even if the distribution of purchase a downward sloping demand chooses to pay the purchase amount a in full at the next statement date is an increasing function of r
- So we estimate the regression equation

$$\tilde{a}_i = ED_1(r, x, c) + \tilde{\epsilon}_i$$

and hope to find that $\frac{\partial}{\partial r} ED_1(r, x, c) < 0$.

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The per transaction demand for credit

$$ED_T(r,x,c) = [1-P(1|r,x,c)]ED_I(r,x,c) = \int_0^\infty a[1-P(1|a,r,x,c)]f(\quad (2)$$

- We will show that it is theoretically possible for $ED_I(r,x,c)$ to be *upward sloping* in r
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The Endogeneity of Customer-Specific Interest Rates

- However, when we regress the amount of an installment purchase on various variables including the installment interest rate, we get a *positive coefficient on the installment interest rate.*
- The explanation, is, of course, that the installment interest rate is *endogenously determined*
- Customers with worse credit scores are charged higher installment interest rates, but these are also the customers who tend to spend more on installment (liquidity constrained customers)
- As a result, OLS estimation of flexible, linear approximations to ED_1 result in *upward sloping demand curves* $\frac{\partial}{\partial r} ED_1(r, x, c) > 0$.

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The Failure of IV and the Weak Instrument Problem

- We tried *Instrumental variables* using the *CD-rate* and *call rate* as instruments for the endogenous interest rate charged to the company's customers
- However IV still does not work (and still results in a positive coefficient on the instrumented interest rate) because the CD and call rates are very *weak instruments.* In fact, they are *negatively correlated* with the interest rates the company charges its customers!
- However the correlation of these instruments with the endogenous interest rate is very weak and barely significant
- As a result, IV estimates also imply a positively sloped demand for installments

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Summary of IV Results

Table 1: Instrumental Variables-Fixed Effects Regressions of Conditional Demand for Credit
Dependent variable: $log(a)$ where a =amount borrowed. Amounts in parentheses are P-values for tests of the hypothesis that the coefficient/statistic is zero.

Item	Specification 1	Specification 2	Specification 3	Specification 4
Instruments	CD rate credit score	CD rate credit score	CD rate	CD rate
Fixed effects	yes	yes	yes	yes
Free Installments	yes	no	yes	no
Variable	Estimate	Estimate	Estimate	Estimate
r	0.965 (0.249)	-72.903 (0.591)	0.739 (0.382)	-102.20 (0.628)
σ_u	0.651	1.276	0.652	1.708
σ_ε	0.656	1.788	0.657	2.420
ρ	0.495	0.337	0.496	0.331
Sample size	8183	4109	8078	4049
F-test $(u_i = 0)$	$F(613) = 8.03$ (0.00)	$F(474) = 0.97$ (0.687)	$F(598) = 8.08$ (0.00)	$F(464) = 0.53$ (1.00)
Hausman test	$H(8) = 6.54$ (0.59)	$H(8) = 1.96$ (0.96)	$H(6) = 4.45$ (0.61)	$H(6) = 0.23$ (0.99)

Matching Estimators of Credit "Treatment Effects"

- Next, we attempted to estimate the "average treatment effect " (ATE) where the "treatment" in question is offering a customer a free installment borrowing opportunity, which we denote as $r = 0$.
- The ATE is defined as the difference in the expected borrowing between the treatment group $r = 0$ and control group $r > 0$

$$\text{ATE} = E\{a|r = 0\} - E\{a|r > 0\},$$

where a is the amount borrowed and r is the interest rate.

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Matching Estimators of Treatment Effects, continued

- Suppose we are able to match a sufficiently large number of customers in the treatment and control groups on a sufficiently narrow set of criteria x such that we can plausibly assume that the "assignment" of the "treatment" $r = 0$ is essentially random for the matched individuals/transactions,
- Then we can infer what the installment spending for a treated person would be by taking the mean installment spending for the matched individuals in the control group (and vice versa) and estimate the ATE as we would in a classical controlled randomized experiment.

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Using "Matching Estimators", continued

- The validity of this approaches depends on a conditional independence assumption known by the (unfortunate) name, "*the unconfoundedness assumption*" (or also, the "strong ignorability assumption").
- Some individuals do sufficient installment spending that we can use them as *self-controls,* comparing the mean of their interest-free installment transactions to the mean of the positive interest installment transactions
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Summary of Matching Estimator Results

Table 2: Effect of Free Installments: Results from Matching Estimators

Matching Criteria	Estimated ATE	Standard Error	P-value for H_o : ATE $= 0$
customer, credit score CD rate, merchant code	-\$56.60	\$15.20	0.000
customer, credit score merchant code	-\$69.51	\$16.45	0.000
customer, merchant code	-\$79.33	\$19.93	0.000
customer	-\$76.72	\$18.75	0.000
merchant code	-\$61.07	\$16.00	0.000

Why might matching estimators fail?

- The unconfoundedness assumption might not hold
- This is particularly true when we suspect that there is *selection on unobservables*
- Individuals are self-selecting the transactions that they pay for by installment, and even when offered the “treatment” of an interest-free installment, they don’t have to “take” this treatment
- So our results are akin to analysis of randomized experiments with *imperfect compliance* and we know that even classical randomized experiments can lead to misleading inferences when there is imperfect compliance

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Randomized Controlled Experiments (RCEs)

- Suppose we could to do a randomized (controlled) experiment
- The experiment would consist of offering customers in a treatment group interest-free installment options and those in a control group the regular (endogenously determined) interest rate the company normally charges its customers, we are likely to be able to consistently estimate their demand elasticity
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Quasi-Random Experiments

- However it seems plausible that we may be able to use the relatively randomly assigned free installment options that the company and various merchants provide to their customers as a sort of *quasi random experiment*
- Unfortunately, it is not a *controlled* experiment: we have no “control group” to compare to
- As we saw, while matching methods can potentially exploit free installments as quasi-random experiments, in practice they proved not to be useful for making sensible inferences about the demand for credit
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The Censoring Problem

- Our life would be quite easy if we were able to observe, in every case, 1) whether a customer was offered a free installment, and if so what the maximum term of it was and 2) which of the 12 payment options the customer chose
- However we have to confront a *censoring problem* in the way our data was recorded: *we only observe interest free installment options for those customers who chose them*
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Unobserved Choice Sets

- So estimating the effect of interest-free installment opportunities on the customer’s choice of installment term creates econometric problems that are akin to *choice-based sampling*
- Another way to state the problem is that for most customers (i.e. those who do not buy on installment) their *choice set is unobserved.*
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Solution to the Endogeneity and Censoring Problems

- Our structural approach potentially enables us to overcome both the endogeneity and censoring problems present in our data
- We can overcome the endogeneity problem by modeling the consumer's choice of installment term with and without the free installment option present, as a quasi-random experiment
- We can overcome the censoring problem by forming a *marginal likelihood function* that *integrates out* the event of whether a customer was offered a free installment or not

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- In the process, we can estimate the probability that a customer was offered an free installment option even though we only have access to a choice-based sample
- Further, the estimated model can enable us to estimate customer borrowing responses to changes in the interest rate they are offered
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A flexible structural model of installment choice

- We assume every purchase occasion using this credit card, a customer faces a discrete choice over a maximum of *12 alternatives* $d = 1, \ldots, 12$ where d is the duration of the installment loan, if any
- If $d = 1$, then the customer has chosen to pay the balance in full at the next credit card statement
- This is equivalent to a free installment loan of duration at most 30 days (on average 15 days)
- Choices $d = 2 \ldots, 12$ denote a decision to pay by installment, with payments made in $d > 1$ monthly installments

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Semi-structural model of installment choice

- If a consumer with characteristics x is not offered a free installment option, then the customer faces an *interest rate schedule* $r(d, x)$ that depends on the duration of the installment d and the customer's characteristics x.
- Via econometric analysis of the installment interest rates offered in 6244 installment transactions where customers were charged positive interest rates, we found the interest rate function has the following form

$$r(d, x) = \rho_0(x) + \rho_1(d)$$

$r(x, d)$ is the sum of a *consumer risk adjustment* $\rho_o(x)$ and a *duration premium* $\rho_1(d)$ that depends on the chosen duration of the loan *but is common across all customers.*

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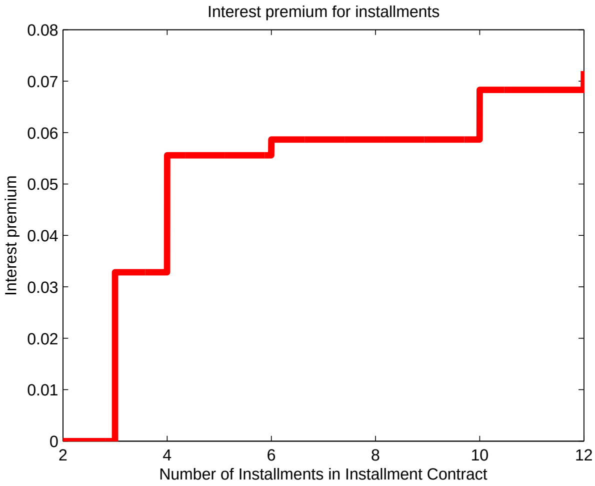
Duration Premium for Installment Loans



The Utility Model

- Assume that a consumer is not offered a free installment option. How does the consumer choose among the 12 alternatives $d = 1, \ldots, 12$?
- We assume that a consumer who has decided to make a credit card purchase of amount a with observed characteristics x and facing interest schedule r assigns a *value* $v(a, x, r, d)$ to each choice $d \in \{1, \ldots, 12\}$ and chooses the option with the highest value

$$v(a, x, r, d) = ov(d, a, x) - c(a, r(d, x), d) + \epsilon(d)$$

- We call $ov(d, a, x)$ the *option value* and $c(a, r, d)$ is *cost* of an installment loan, so we are formulating the choice as a simple cost/benefit tradeoff.

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The Cost of Installment Credit

- We measure the cost of an installment loan as the extra interest paid over the course of the installment loan compared to the zero interest a customer would pay if they paid the amount a in full at the next statement date (i.e. if they chose $d = 1$)

$$c(a, r, d) = a(1 - \exp\{-r(d - 1)30/365\})$$

Note that $c(a, r, d)$ can be approximated linearly as

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- We use a *flexible functional form approach* to specify $ov_0(d, a, x)$ in terms of a vector of parameters θ that we will attempt to estimate by maximum likelihood
- We assume we can write the option value *ov* as

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- This implies that *consumers will not want to pay for sufficiently small credit card purchases on installment since the benefit of doing this, $a\rho(x, d)$, is lower than the transactions cost $\lambda(x, d)$.*
- We can also think of λ as capturing potential “stigma costs” associated with purchasing on installment, as well as “mental accounting costs” such as that by adding to their installment balances customers increase their risk of making late payments on their accounts in the future, or worries that high loan balances will have adverse effects on their credit score, and so forth.

Specification of $\rho(x, d)$

- To understand the parameter estimates, note that we have specified $ov(a, x, d) = a\rho(x, d)$ where

$$\rho(x, d) = \frac{1}{1 + \exp\{h(x, d, \phi)\}}$$

where

$$h(x, d, \phi) = \phi_0 I\{d \geq 2\} - \sum_{j=3}^{12} \exp\{\phi_{j-2}\} I\{d \geq j\} + \phi_{11} ib +$$

$$\phi_{12} installshare + \phi_{13} creditscore + \phi_{14} nlate + \phi_{15} I\{r = 0\}.$$

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$$\lambda(x,d) = \exp(\phi_{16} I\{r=0\} + \phi_{17}\text{installshare} + \sum_{j=2}^{10} \phi_{16+j} I\{d=j\} + \phi_{27} I\{d>10\}).$$

- *creditscore* is the credit score for the customer at the date of the transaction
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Accounting for free installments

- Let δ be an indicator of the event that a customer is offered a free installment
- When the customer is offered a free installment, its duration $\delta > 1$ is chosen by the credit card company, not by the customer. If no free installment option is offered, then $\delta = 0$
- **Strong Dominance Assumption** *we assume that if a customer is offered a free installment option of duration* δ *the consumer will never choose a non-free installment option at a positive interest rate* $r(d, x)$ *for any duration* d *shorter than* δ*, other than the default choice* $d = 1$*.*
- Note that if $\delta > 0$, then $c(a, 0, d) = 0$.

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The Weak Dominance Assumption

- **Weak dominance** allows the possibility that a customer may choose to pay a purchase amount in full without any installment borrowing, even in the presence of a free installment offer
- It also allows the possibility that the customer might choose a positive interest installment loan for a *term longer than the maximum term allowed under the free installment offer* δ
- However weak dominance does imply that *whenever the customer chooses a free installment offer, they always choose the maximum term offered, i.e.* $d = \delta$ *whenever* $d > 1$ *and* $d \leq \delta$.
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Choice sets when there are free installments

- Suppose a customer is offered an interest-free installment option of duration δ. If we relax the dominance assumption, then this customer also has the same choice set $D = \{1, 2, \ldots, 12\}$ that a customer who was not offered a free installment offer faces
- The difference is that the interest rate on any choice $d \in \{1, \ldots, \delta\}$ is *interest free* whereas choices in the set $d \in \{\delta + 1, \ldots, 12\}$ carry positive interest rates
- When *strong dominance* holds, the choice set is $D = \{\delta, \ldots, 12\}$.
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Multinomial logit choice probabilities

- We assume the unobserved components of the utility of each installment duration alternative,$\epsilon(d)$, are *IID* Type I extreme value with scale factor $\sigma > 0$.
- This implies *multinomial logit probabilities for the installment choice*
- Let $P_+(d|a, r, x, \theta)$ be the logit probability (over the full choice set $D = \{1, 2, \ldots, 12\}$) when the customer is *not* offered a free installment option
- Let $P_0(d|a, r, x, \delta, \theta)$ be the logit probability over the same choice set D when the customer is offered a free installment option of duration $\delta > 0$ and we do not assume that either of the dominance assumptions hold.

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Probabilistic structure of free installments

- Let $\Pi(z_{it}, \alpha)$ be the probability that customer i is offered a free installment opportunity when using the credit card to make a purchase at date/time t
- From discussions with the credit card company executives, we know *a priori* that free installment offers are made to *all of its customers shopping at a particular store on a particular date* and hence *cannot depend on the customer's characteristics* x (provided the customer is in good standing, i.e. their credit card use is not suspended)
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Terms of free installments

- Let $f(\delta|z, \beta)$ be a discrete probability distribution over the set $\{2, 3, \ldots, 12\}$ giving the maximum allowed term of a free installment offer
- We treat (π, f) as *nuisance functions* and estimate them along with the *parameters of interest* $\theta = (\sigma, \phi)$ where σ is the extreme value scale parameter and ϕ are the parameters of $\rho(x, d)$ and $\lambda(x, d)$
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Building the likelihood function

- Let $L(\theta, \alpha, \beta)$ be the overall likelihood function we want to estimate.
- We assume that conditional on the customer's type τ, the decisions made at each purchase occasion are independent of each other
- Consider the likelihood function for a specific customer who makes purchases at a set of times $T = \{t_1, \ldots, t_N\}$.
- Of these times, there is a subset $T_0 \subset T$ where the customer purchased under installment, i.e. where $d = \delta > 1$.
- The complement $T_1 = T/T_0$ consist of times where the customer purchased without installment.

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The likelihood of free installment choices

Let T_0 be the subset of purchase dates T where the customer did choose the installment option and we observe that this was an interest-free installment option (we can determine this by observing that the consumer never made interest payments on the installments as described above). For this subset, the component of the likelihood is

$$L_0(\theta) = \prod_{t \in T_0} P(d_t | x_t, z_t, a_t, \theta)$$

where

$$P(d|x, z, a, \theta) = \sum_{\{\delta_0 | d \leq \delta_0\}} P_0(d|x, a, \delta_0, \phi) f(\delta_0|z, \beta) \Pi(z|\alpha)$$

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The likelihood of free installment choices, cont.

- If the dominance condition does not hold, then for each transaction in the set of times T_0, the chosen installment alternative d_t is less than or equal to the free installment (maximum) term $\delta_{0,t}$ offered to the customer under the interest-free installment option
- Of course we also have $d_t > 1$, otherwise the consumer would have chosen to pay the amount a_t in full at the next statement date.
- When the (weak) dominance assumption holds, we have $P_0(d_t|x_t, a_t, \delta_{0,t}, \phi) = 0$ if $d_t \in \{2, \dots, \delta_{0,t} - 1\}$, so $d = \delta_0$ and

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The likelihood of non-free installment choices

- Now consider the likelihood for the cases, $t \in T/T_0$, where we do not know for sure if the customer was offered the interest-free installment option or not.
- There are two possibilities here: a) the consumer chose not to purchase under installment, or, b) the consumer chose to purchase under installment but paid a positive interest rate, rejecting the free installment offer.
- Consider first the probability that $d = 1$. Let $P(1|x, z, a, \theta)$ denote the probability of this event, which is given by

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Likelihood of non-free installment choices, cont.

$$P(1|x,z,a,\theta) = \Pi(z|\alpha)\left[\sum_{\delta_0\in\{2,\dots,12\}} P_0(1|x,a,\delta_0,\phi)f(\delta_0|z,\beta)\right] + [1-\Pi(z|\alpha)]P_+(1|x,a,\phi).$$

- This formula accounts for the two ways in which we can observe the choice $d = 1$: 1) the customer was offered a free installment of term $\delta > 1$ but chose $d = 1$ instead, or, 2) the customer was not offered a free installment and chose $d = 1$.

Likelihood of non-free installment choices, cont.

$$P(1|x,z,a,\theta) = \Pi(z|\alpha)\left[\sum_{\delta_0\in\{2,\dots,12\}} P_0(1|x,a,\delta_0,\phi)f(\delta_0|z,\beta)\right] + [1-\Pi(z|\alpha)]P_+(1|x,a,\phi).$$

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Likelihood of non-free installment choices, cont.

- The other possibility is that the customer chose to pay under installment for a duration of d months, for $d \in \{2, \ldots, 12\}$ but at a positive rate of interest.
- In the case where $d = 2$, i.e. where the consumer pays a positive interest rate to pay the purchased amount a over two installments, we deduce that the customer could *not* have been offered a free installment opportunity of 2 or more months.
- This implies that $P(2|x, z, a)$ is given by

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Likelihood of non-free installment choices, cont.

- The other cases $d \in \{3, \ldots, 12\}$ are where the customer chose a positive interest rate installment option but we cannot be sure whether the customer was offered a free installment or not. Then we have

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Likelihood of non-free installment choices, cont.

- Let $L_1(\theta)$ denote the component of the likelihood corresponding to purchases that the consumer makes in the subset T/T_0, i.e. purchases either that were not done under installment, or which were done under installment but at a positive interest rate. This is given by

$$L_1(\theta) = \prod_{t \in T/T_0} P(d_t|x_t, z_t, a_t, \theta).$$

where $d_t = 1$ if the customer chose to purchase an item at time t without installment, and $d_t > 1$ if the customer chose to purchase via installment, but with a positive interest rate.

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Full Likelihood Function

- The full likelihood for a single consumer i is therefore $L_i(\theta) = L_{i,0}(\theta)L_{i,1}(\theta)$ where $L_{i,0}(\theta)$ is the component of the likelihood for the transactions that the consumer did under free installment offers (or $L_{i,0}(\theta) = 1$ if the consumer had no free installment transactions), and $L_{i,1}(\theta)$ is the component for the remaining transactions, which were either choices to pay in full at the next statement, $d_{i,t} = 1$, or to pay a positive interest rate for a non-free installment loan with duration $d_{i,t} > 1$.
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Model Identification

- While we have a very large sample size, $N = 167946$, the vast majority of observations are censored, $N_c = 161442$.
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Model Identification, continued

- We argue that the model is identified and we can sort out these two cases.
- If everyone is frequently offered free installments and they rarely take them, then the model predicts that they will almost never choose non-free installments. But we observe 4966 cases where consumers chose positive interest rate installments.
- However it is difficult to *globally maximize* the likelihood function. The mixture of logits appears to result in a fairly *non-concave* likelihood.
- Identifying the free installment loan duration probabilities $f(d|z, \beta)$ is more challenging than identifying the probability of being offered a free installment offer, $\Pi(z, \alpha)$

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Estimation Results, $\rho(x, d)$ (option value function)

$\rho(x,d,\phi)$ (option value)	Estimate	Standard Error
σ	0.066	3.97×10^{-4}
$\phi_0\ I\{d \geq 2\}$	-3.693	0.025
$\exp\{\phi_1\}\ I\{d \geq 3\}$	0.227	0.018
$\exp\{\phi_2\}\ I\{d \geq 4\}$	0.251	0.179
$\exp\{\phi_3\}\ I\{d \geq 5\}$	0.067	0.049
$\exp\{\phi_4\}\ I\{d \geq 6\}$	0.136	0.026
$\exp\{\phi_5\}\ I\{d \geq 7\}$	2.265×10^{-25}	0.072
$\exp\{\phi_6\}\ I\{d \geq 8\}$	4.430×10^{-14}	0.092
$\exp\{\phi_7\}\ I\{d \geq 9\}$	0.156	0.079
$\exp\{\phi_8\}\ I\{d \geq 10\}$	0.082	0.053
$\exp\{\phi_9\}\ I\{d \geq 11\}$	9.070×10^{-15}	0.180
$\exp\{\phi_{10}\}\ I\{d = 12\}$	0.281	0.180
ϕ_{11} (ib)	-0.087	0.001
ϕ_{12} (installshare)	-2.202	0.040
ϕ_{13} (creditscore)	-0.207	0.005
ϕ_{14} (nlate)	-0.015	0.002
ϕ_{15} $(I\{r = 0\})$	-2.166	0.061

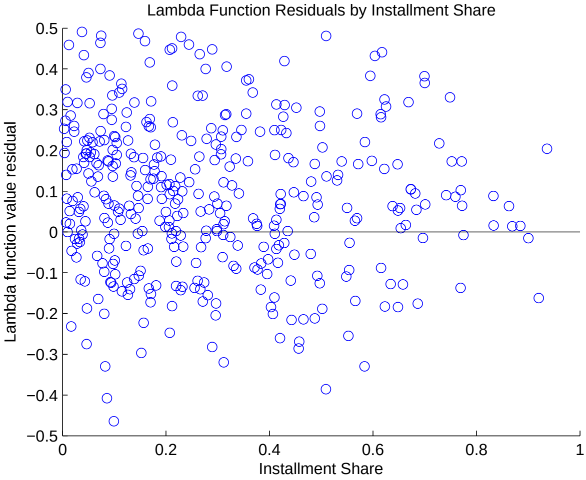
Estimation Results, $\lambda(x, d)$ (transaction cost function)

$\lambda(x, d, \phi)$ (fixed cost)	Estimate	Standard Error
ϕ_{16} (installshare)	-0.941	0.015
ϕ_{17} $(I\{r = 0\})$	-0.246	0.011
ϕ_{18} $(I\{d = 2\})$	-0.740	0.010
ϕ_{19} $(I\{d = 3\})$	-1.006	0.009
ϕ_{20} $(I\{d = 4\})$	-0.297	0.016
ϕ_{21} $(I\{d = 5\})$	-0.487	0.012
ϕ_{22} $(I\{d = 6\})$	-0.208	0.018
ϕ_{23} $(I\{d = 7\})$	-0.106	0.024
ϕ_{24} $(I\{d = 8\})$	-0.106	0.022
ϕ_{25} $(I\{d = 9\})$	-0.462	0.012
ϕ_{26} $(I\{d = 10\})$	-0.215	0.014
ϕ_{27} $(I\{d > 10\})$	-2.166	0.061

Estimation Results, $f(d|z,\beta)$ (duration distribution)

$f(d,\beta)$ (maximum installment term)	Estimate	Standard Error
$f(2,\beta)$	0.695×10^{-15}	0.003
$f(3,\beta)$	0.594	0.290
$f(4,\beta)$	1.717×10^{-12}	0.025
$f(5,\beta)$	5.362×10^{-13}	0.022
$f(6,\beta)$	1.356×10^{-14}	0.044
$f(7,\beta)$	3.314×10^{-14}	0.112
$f(8,\beta)$	2.358×10^{-16}	0.150
$f(9,\beta)$	1.565×10^{-11}	0.108
$f(10,\beta)$	0.256	0.425
$f(11,\beta)$	3.252×10^{-16}	0.436
$f(12,\beta)$	0.149	0.024
Log-likelihood, number of observations	$\log(L(\theta)) = -46561.3$	$N = 167,946$

Estimation Results, $\lambda(x, d)$ residuals



Comments on the Estimation Results

- We do not report the estimation results for $\Pi(z, \alpha)$ (probability of receiving free installment offer) due to the large number of parameters in α (26)
- However we note that the estimated probabilities of receiving a free installment offer $\Pi(z, \hat{\alpha})$ vary rather significantly over our sample, from a low of 1.41×10^{-4} to a high of 0.527.
- Over our entire sample, the average estimated probability that a given transaction was subject to a free installment offer is 17%.
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Comments on the Estimation Results, cont.

- However the implied “take up rate” of free installments is low: only 2.7% of the transactions in our estimation sample are free installments, while we estimate that on average free installments were offered to customers in 17% of all transactions that were made
- Thus, we infer that *on average only 15% of the individuals who are offered free installment opportunities actually take them.*
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Implied Pre-commitment behavior

- Via likelihood-ratio tests, we can decisively reject the hypothesis that either the strong or weak dominance assumptions hold
- Instead the model predicts that *pre-commitment behavior is very common:* i.e. in the cases where customers do accept free installment offers, they typically make an *ex ante* choice of a maximum loan term *d* that is *less* than the maximum term offered to them
- For example, the model predicts that 88% of individuals who were offered (and chose) a 10 month free installment offer pre-commited at time of purchase to pay the balance in *fewer* than 10 installments.

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- The model predicts that fewer than 1% of those offered 12 month loans, slightly over 2% of those offered 10 month loans, and approximately 10% of those offered 3 month free installment loans choose to take the loan for the maximum duration δ that was offered to them.
- To be clear, these are *ex ante choices:* and not reflective of *ex post* events that lead customers to pre-pay their installment balances
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Effect of r on purchase amount

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Effect of r on purchase amount: findings

- We found that the estimated coefficient of r is *very sensitive* to the inclusion of *time dummies* in the model
- We believe the inclusion of time dummies is justified since we have relatively few customer-specific variables that can capture time-varying effects on spending, such as income, unemployment, health shocks, and so forth
- With over 180,000 observations, estimating a model that has very few time varying covariates other than r puts us at risk of *omitted variable bias*
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Effect of *r* on purchase amount: findings

- We found that the estimated coefficient of r is *very sensitive* to the inclusion of *time dummies* in the model
- We believe the inclusion of time dummies is justified since we have relatively few customer-specific variables that can capture time-varying effects on spending, such as income, unemployment, health shocks, and so forth
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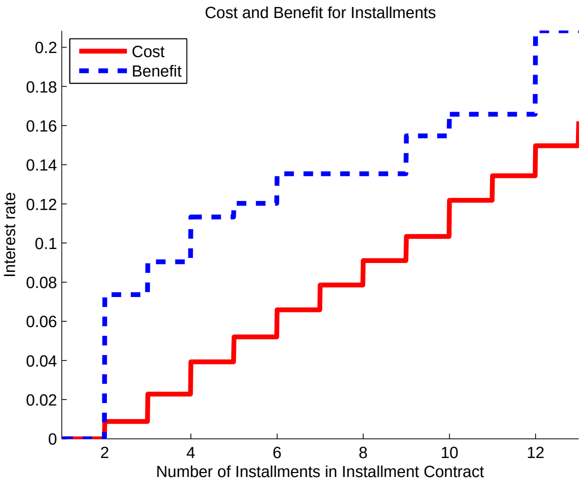
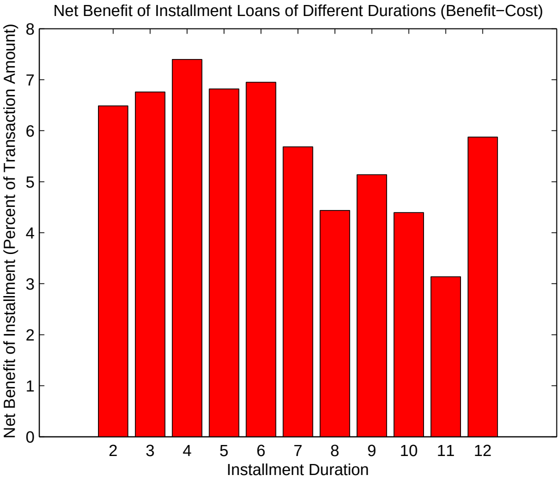
Estimated $\rho(x, d, \phi)$ and $c(a, r, d)$ functions



Estimated Net Benefit of Installment Credit



Implied breakeven thresholds for installments

- The relatively high transactions costs of choosing the "non-default" options $d \in \{2, \ldots, 12\}$ imply that small purchase amounts are unlikely to be done via installment
- Define the *breakeven threshold* $\overline{a}(x, d)$ by

$$\overline{a}(x, d) = \frac{\lambda(x, d, \phi)}{\rho(x, d, \phi) - c(a, r(x, d), d)}.$$

- We see that the model implies that *breakeven levels for free installments are significantly lower than for positive interest installments*
- This can explain our finding that the distribution of positive interest installments *stochastically dominates* the distribution of free installment purchase amounts

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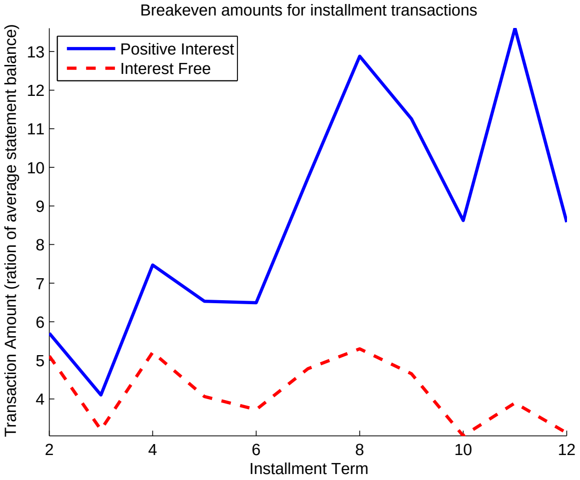
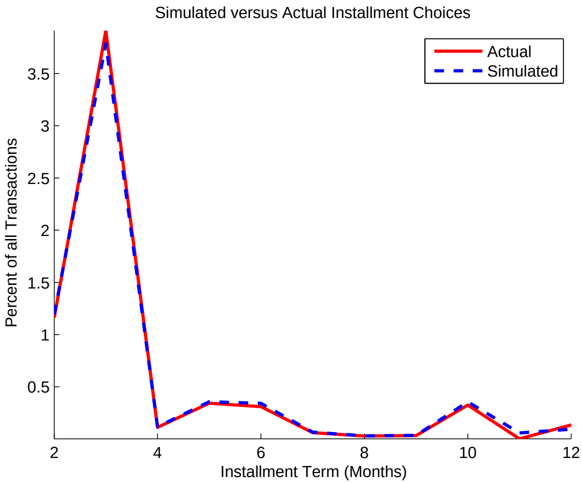


Predicted vs. Actual Installment Choices



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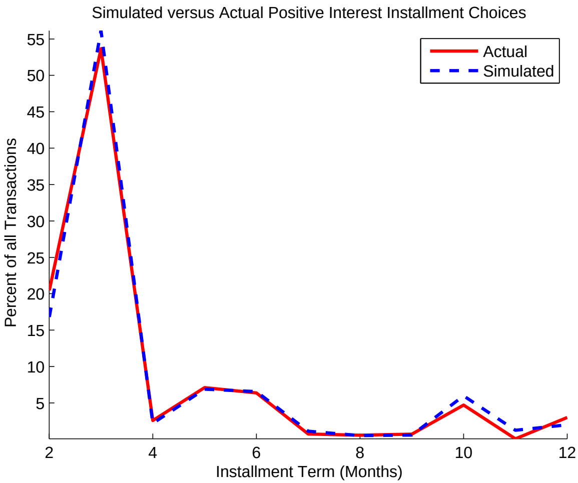
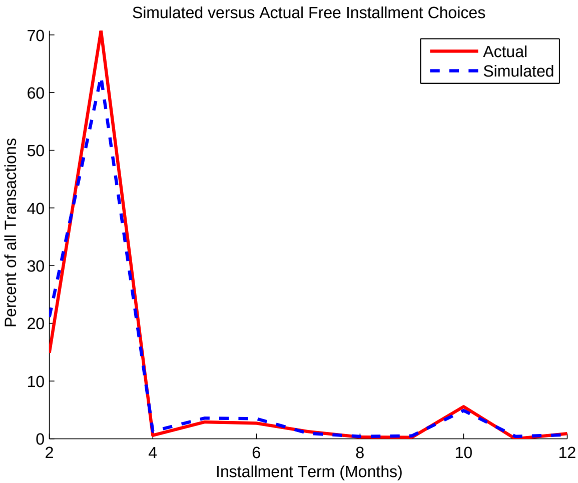


Predicted vs. Actual Free Installments



Chi-square goodnesss of fit tests

- The figures above compare predicted versus actual choices for various subsets of transactions in our sample
- We can provide these comparisons for many other subsamples, such as for various partitions of transactions based on transaction size, by date of purchase, by customer type, and so forth
- When we make these comparisons, the model predictions are very close to the actual choices for nearly all partitions we investigated
- We calculated the *random cell Chi-square test statistic* based on Andrews (1988) and for the partitions we tried, were unable to reject the model (i.e. *P*-values of the Chi-square test were all well above a 5% critical threshold for rejection of the model).

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Counterfactual Experiments

- It is useful to illustrate how the model predicts consumers will react to the presence or absence of free installment offers
- Our estimated model exhibits substantial *customer-specific heterogeneity* thanks to the inclusion of the *installshare* variable
- This variable captures most of the variation in customer purchase and borrowing behavior that we observed in our exploratory analysis of the data
- We are tempted to conclude that individuals with high values of *installshare* are likely to be *liquidity constrained*, but instead we refer to them as *installment addicts*

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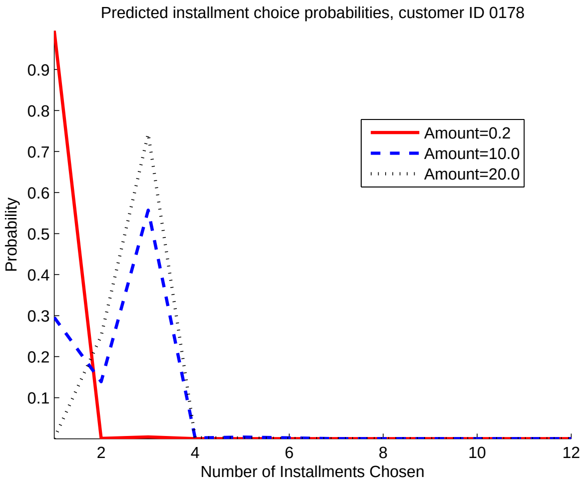
“Installment Avoider”, No Free Installment



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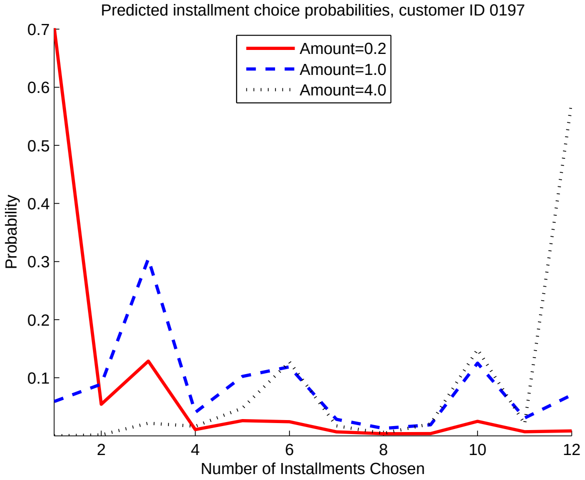

Differential Response based on *installshare*

- We see that the “installment avoider” is not tempted into purchasing on installment, even for very large purchase amounts. When this person does make installments, they are of short duration: 2 or 3 months.
- The “installment addict” on the other hand, is much more likely to purchase items using installment, and also to make use of *longer installment terms.*
- For the largest purchases, the installment addict nearly always chooses to purchase the item using the longest installment term allowed, 12 months, despite the significantly higher interest rate it carries.

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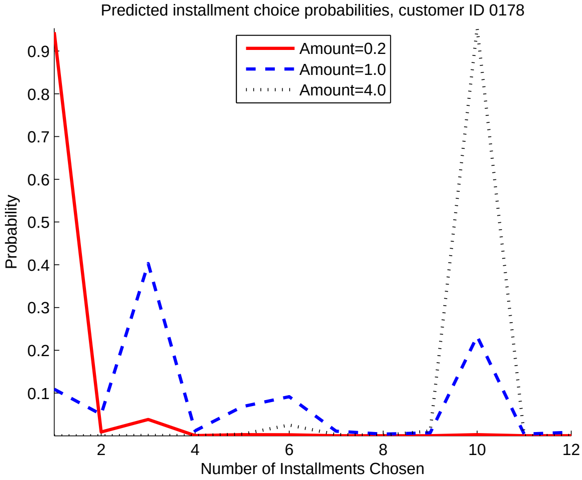
"Installment Avoider", 10 Month Free Installment



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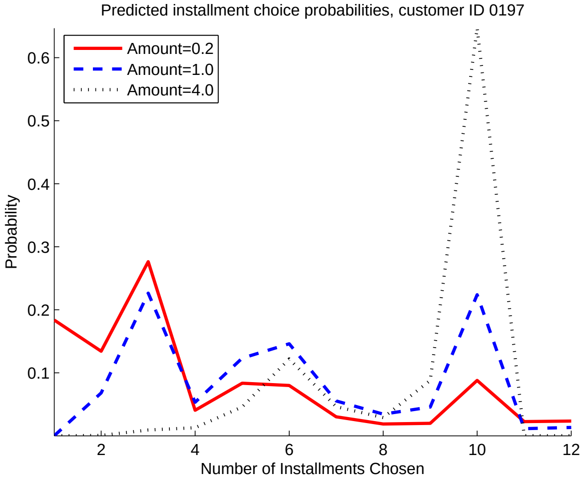

Differential responses to free installments

- We see that when the “installment avoider” is offered a 10 month free installment offer, this person can be tempted into taking it to finance large purchase amounts
- For a purchase that is 4 times as large as this person’s average credit card statement amount, this person chooses to borrow under the full 10 month term offered, *so for these very large purchases, this person is not predicted to pre-commiting to an installment of shorter duration than the 10 months offered*
- However for smaller sized purchases, we see much more significant pre-commitment behavior, and in only about 20% of these transactions does this person choose the full 10 month loan term offered

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- We see that when the “installment addict” on the other hand, is uniformly more likely to take the free installment offer, including at the smaller transaction sizes
- For example, for a purchase that is only 20% of the size of this customer’s typical credit card statement amount, the model predicts that this customer has less than a 20% chance of paying for the purchase in full and not taking the free installment (i.e. $P(1|a,x,r) < 0.2$).
- Interestingly, the installment addict is predicted to be much more likely than the installment avoider to choose the free installment offer, *and more likely to pre-commit to a term that is shorter than the 10 month maximum offered.*
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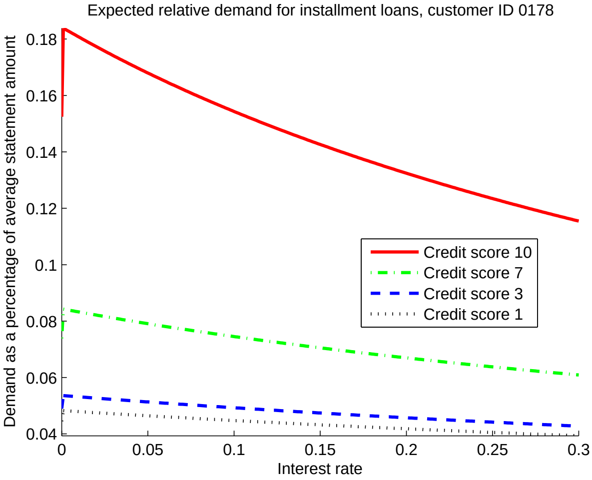
Estimated $ED_T(r, x, c)$ function, "Installment Avoider"



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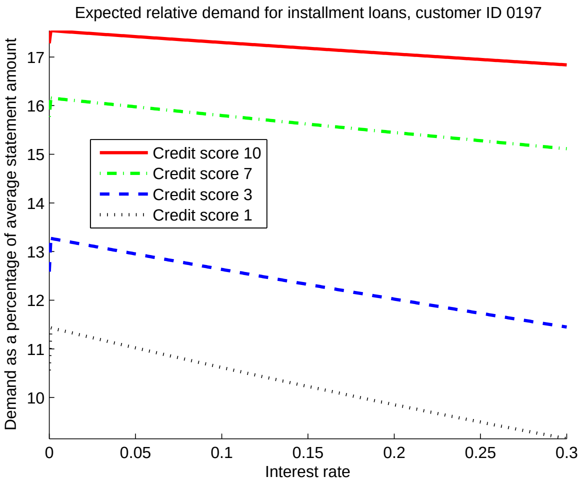

Estimated $ED_I(r, x, c)$ function, "Installment Avoider"

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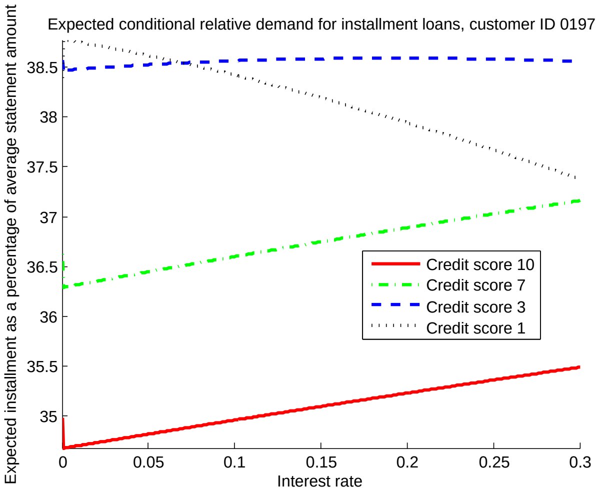

Implied Demand Curves, Installment Avoider

- We see that the estimated model does imply *downward sloping conditional expected demand curves for credit.*
- However the *elasticity of demand is very low for both the installment avoider and the installment addict.*
- We see that the demand for installment credit by the installment avoider is very small, less than 0.2 percent of the amount of the transaction amount.
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- We see that not surprisingly the demand by the installment addict is much higher, ranging from 9 to 18 percent of the purchase amount, depending on the credit score and interest rate
- However the installment addict also has relatively more *inelastic* demand for credit than the installment avoider.
- For the customers illustrated, we calculate a demand elasticity of -0.074 at $r = 0.15$ for the installment addict, versus and elasticity of -0.11 for the installment avoider
- The figure below plots the distribution of calculated demand elasticities for the customers in our sample at $r = 0.15$.We see very substantial customer-specific heterogeneity in credit demand elasticities, though demand is quite inelastic for the majority of customers.

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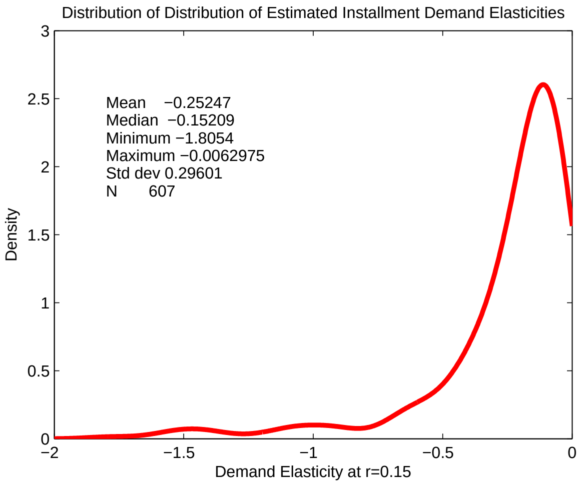
Distribution of Demand Elasticities



Counterfactual interest rate schedules

- We conduct a final counterfactual exercise, namely to test the "efficiency" of the company's particular choice of interest rate schedule for its customers
- Recall that while the *intercept interest rate* $\overline{r}(x, 2)$ does depend on customer-specific characteristics x, we found the *interest premium* for installments that are longer than $d = 2$ is *common to all customers and an increasing function of* d.
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We solved the following constrained optimization problem

$$\max_{r_2,\ldots,r_{12}} \int_0^\infty \sum_{d=2}^{12} [c(a,r_d,d) - c(a,\bar{r},d)] P_+(d|a,x,r_2,\ldots,r_{12}) f(a|x) da$$

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$$\max_{r_2,\dots,r_{12}} \int_0^\infty \sum_{d=2}^{12} [c(a, r_d, d) - c(a, \bar{r}, d)] P_+(d|a, x, r_2, \dots, r_{12}) f(a|x) da$$

subject to:

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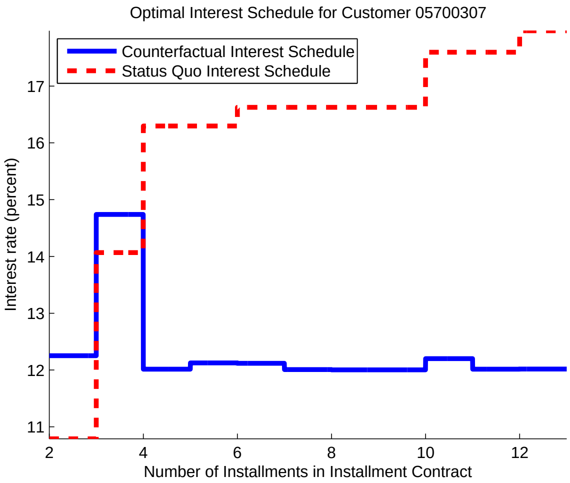
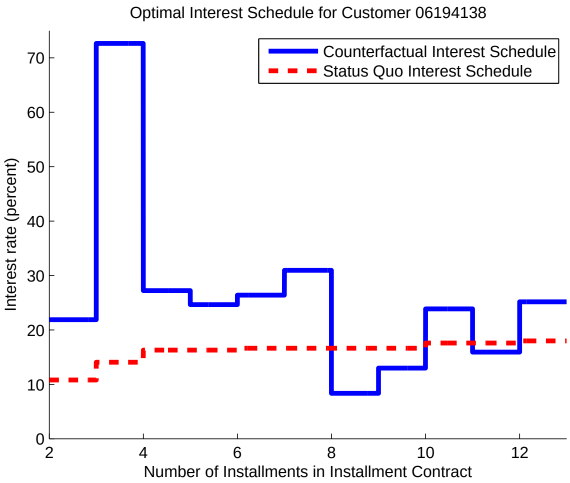
Counterfactual interest schedule: "Installment Avoider"



Counterfactual interest schedule: “Installment Addict”



Counterfactual interest rate schedules

- We find that it is optimal to *lower* interest rates offered to the installment avoider by significant amounts,
- except to *raise* the interest rate at this person's most popular borrowing term, 3 months
- The counterfactual schedule is not monotonic, and creates significant incentives for the customer to borrow at longer durations relative to the *status quo*
- However the profits one can earn from this customer are very small due to the low general level of installment borrowing even at the lower counterfactual interest rates
- So though the counterfactual schedule increases profits, these profits are still very small for this customer

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- We find that it is optimal to *raise* interest rates offered to the installment addict by significant amounts, particularly at the customer's most popular borrowing term, $d = 3$
- However the counterfactual schedule *lowers* interest rates at terms of $d = 8, 9, 11$. The lower rates at these borrowing terms insure that this customer is as well off under the counterfactual as under the *status quo.*
- The counterfactual schedule is not monotonic, and creates significant incentives for the customer to borrow at longer durations relative to the *status quo*
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Summary

- We analyzed unique set of credit card data to infer customers’ *demand for installment credit*
- Our data enables us to identify the *customer-specific* interest rate schedules that the credit card company charges.
- Unfortunately, due to endogeneity in the setting of customer-specific interest rate schedules (i.e. consumers with worse credit scores who often have the highest need and demand for credit also are assigned the highest interest rates), we found that the traditional “reduced form” econometric methods produced non-sensical estimates of the demand for credit, including *upward sloping* demand functions of the interest rate r.

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Conclusions

- We found that instrumental variables did not solve the problem. The credible instruments at our disposal (e.g. the CD rate or other measure's of the company's cost of credit) are extremely *weak instruments*
- In order to obtain more credible estimates of the demand for credit we exploited a novel feature of our data: *the company's frequent use of free installment offers.*
- We argued that the quasi-random way in which these offers are made to the company's customers makes them extremely useful "instruments" an approach that treats free installments as *quasi random experiments* that create extra variation that is helpful in identifying the slope of the demand for credit.

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- In response to these problems we introduced a flexible discrete choice model of the decision to purchase under installment credit.

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- The discrete choice model can account for the free installment opportunity as a modification to the customer’s choice set. It aslo accommodates that customers do not face a *single* interest rate r, but rather an entire *schedule of interest rates* with higher interest rates charged for borrowing at longer terms
- The model posits that individuals make simple *cost benefit tradeoffs* when they make their purchase decisions.
- They weigh benefits of installment credit (reflected by the *option value function*) against the cost of this credit.
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- The estimated model yields a downward sloping demand for credit (ED_T function), even though for certain parameter values the model can predict that consumers should *always* take free installment opportunities when they are offered (and for the maximum duration offered),
- Surprising, *for some* customers (the most installment prone/liquidity constrained) the conditional demand function ED_I *can* be upward sloping in r.
- However the model predicts that most customers are quite averse to installment borrowing in general and would be even willing to pass up many free installment offers.

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- We showed that it is possible to solve a major econometric challenge confronting the estimation of the model: namely, that our credit card data are heavily *censored*
- Even though it would seem impossible to separately identify the probability of being offered a free installment from the probability of choosing it, we showed that we can indeed separately identify these probabilities.
- What we found was surprising: even though only 2.7% of the transactions in our data set were done as free installments, the model predicts that consumers face free installment offers in approximately 20% of all the transactions they make.

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- The *free installment puzzle* results from this key finding, namely that customers in our data set are predicted to frequently pass up "free" borrowing opportunities.
- Further, we also showed that in the minority of cases (15%) where customers did choose the free installment offer, there was a very high probability (approximately 88% for a 10 month free installment offer) that the consumer would pre-commit to a choice of a loan duration that is *shorter* than the maximum duration allowed under the offer. These decisions present a challenge to traditional economic models of rational, time-separable discounted utility maximization.

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- While the model does raise new puzzles, it also resolves others. For example, it provides an explanation for the counterintuitive estimated treatment effects from the matching estimators in section 2.
- The model predicts that free installment offers significantly lower the threshold at which consumers are willing to make an installment purchase, thereby lowering the average size of a free installment transaction.
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- Besides time-inconsistent preference explanations, there are other potential “behavioral” explanations for these choices, including social stigma against the use of installment credit and the scarring effect of past overuse of installment credit.

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Directions for future research

- Hopefully this is just a starting point for additional research, which could convince the credit card company gather more data and *conduct experiments*
- With more and better data, we can overcome some of the important limitations to our analysis resulting from our data set that only follows customer transactions on a single credit card. Of course, customers have a choice of many different ways to pay at the check out counter, including using cash or other credit cards.
- There are much more difficult issues to confront about how the credit card company should go about advertising, charging interest and setting credit policies, as well as *merchant fees* to maximize its profits in a highly competitive landscape.

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