MIT SLOAN SCHOOL OF MANAGEMENT
15.483 CONSUMER FINANCE:
MARKETS, PRODUCTS, AND FINTECH

SPRING 2018

PROFESSOR JONATHAN A. PARKER

Lecture Notes 6

Credit cards, big data, adverse selection and unravelling

© Copyright 2018 Jonathan Parker.
All Rights Reserved.

Lecture outline

1. Overview of credit card market
2. Market analysis and the failure of Citi "A deal is a deal" campaign
3. Credit market collapses

Credit Card Market Structure

- 700 mill. cards, 200-250 transaction/card/year on avg.
  - Half of users pay off balances regularly
- Roughly ¼ of all purchases in US by $
- Three types
  - Bank issued (VISA, M-card, by Chase, BofA, Etc.)
  - CC Company issued: AmEx, Discover
  - Store cards
- Rough market shares
  - VISA 45%, M-Card 35%, Amex 12%, Discover 8%

Credit Card Market Structure

- Fees:
  1. Swipe fees paid to card company by merchant
  2. Interchange fee: Typically 1 – 2%, set by issuer
     - 3/4 of fee paid to issuing bank
     - 1/4 of fee paid to merchant's bank
- Interest on overdue balances: 16% on avg.
- Costs for card companies
  - Marketing 40%
  - Cost of funds: 30%
  - Unrecovered default: 30%
  - Fraud: 1%

Credit Cards as Payment Technology…

….and Credit Cards as Credit

- Credit cards play a central role in the payments system
  - $2.5T in annual purchase volume
  - Used by 60-70% of consumers (CFPB 2015, SCPC 2016)
- Credit cards preferred for "convenience" & "speed"
- However access to credit cards is not universal
  - 90% of "super-prime" consumers
  - 30% of "deep subprime" consumers
- …and debit card use is slightly *higher* than credit card use, (80% vs. 70% in SCPC data)
  - Debit is especially popular among younger, lower income, lower credit-score, and lower education households (Koulayev et al., 2012)

Source: CFPB (2015), Greene, Schuh and Stavins (2016), Koulayev et al. (2012)

Credit Cards as Payment Technology…

….and Credit Cards as Credit

- Credit cards provide loans: 40% of credit card accounts are used for borrowing, a.k.a. revolving
  - "revolving" = not paying balance in full
- Fully 2/3 of *active* credit card accounts are revolving
- $3T in open credit line
- Notable heterogeneity in borrowing:
  - At a given point in time, 20% of super-prime (780+) credit cards are borrowing, while over 80% of deep subprime are borrowing
  - Additionally, many people borrow only occasionally but still rely on cards for credit

Source: CFPB (2015), Greene, Schuh and Stavins (2016)

Typical Borrowing Costs and Durations

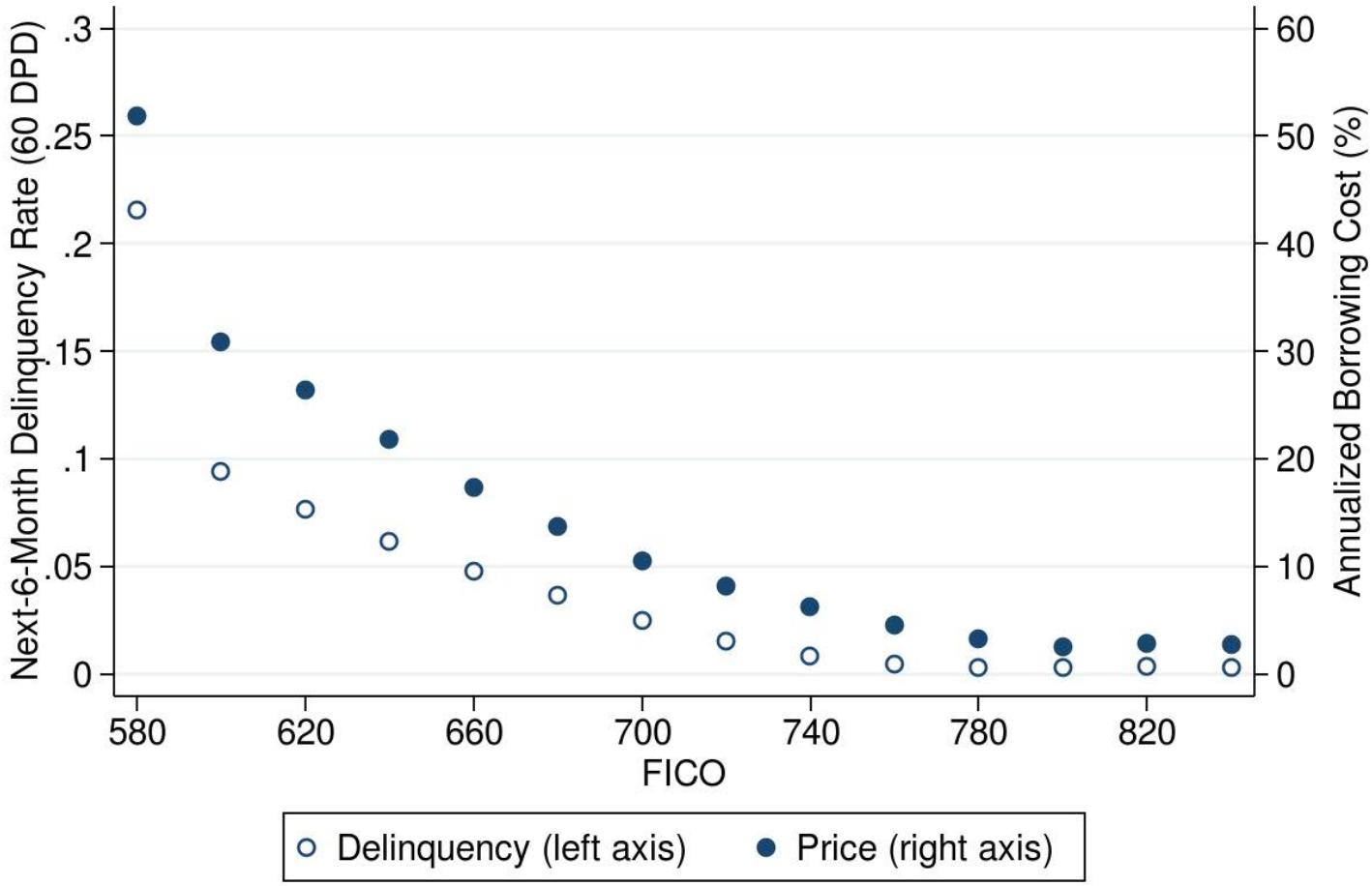
Mature Accounts, 2008-09

FICO Group	Duration of Borrowing (Cumul. Months per Year)	Share of Accounts	Int. Cost (Ann. %)	Fee-Inclusive Cost (Ann. %)		
			Mean	Mean	P25	P75
660 - 680	0	4.5%	.	.	.	.
	1 - 2	3.0%	14.10	23.73	8.03	30.07
	3 - 5	4.8%	13.09	18.99	5.62	26.51
	6 - 11	21.6%	13.60	17.28	6.76	24.63
	12	66.2%	15.81	17.84	9.90	24.63
780 +	0	36.0%	.	.	.	.
	1 - 2	15.6%	10.00	18.54	2.60	24.40
	3 - 5	10.2%	9.43	14.20	2.73	18.19
	6 - 11	17.2%	9.22	11.84	4.00	15.33
	12	20.9%	10.14	11.17	5.72	14.28

Note: Table shows average and upper/lower quartile borrowing costs by FICO group and by cumulative annual duration of borrowing. Fee-inclusive costs are defined by adding APR to annualized fee revenue as a share of outstanding balances.

Source: Nelson (2017)

Risk as a Driver of Credit Card Pricing



Plot shows 60-days-past-due delinquency rates (left axis) as well as annualized fee-inclusive borrowing cost (right axis), at each FICO score in 20-point bins. The R-squared of delinquency rates regressed on 20-point FICO score fixed effects is 63.29%, whereas for prices this R-squared is 28.73%

Source: Nelson (2017)

Other Price Drivers:
Evidence from Cardholder Agreements

Account and Agreement terms are not guaranteed for any period of time; all terms, including the APRs and fees, may change in accordance with the Agreement and applicable law. We may change them based on information in your credit report, **market conditions, business strategies, or for any reason**.

- Bank of America (April 2007)

We have the right to change the rates, fees, and terms at any time, for any reason… These reasons may be based on information in your credit report, such as your failure to make payments to another creditor when due, amounts owed to other creditors, the number of credit accounts outstanding, or the number of credit inquiries. These reasons may also include **competitive or market-related factors.**

- Citi (April 2007)

The APRs for this offer are not guaranteed; APRs may change to higher APRs, fixed APRs may change to variable APRs, or variable APRs may change to fixed APRs. We may change the terms (including APRs) at **any time for any reason**, in addition to APR increases for failure to comply with the terms of your account.

- AmEx (March 2007)

Source: http://www.consumer-action.org/news/articles/2007_credit_card_survey

Before the CARD Act: Some Less-Advertised Price Drivers

Risk-*Irrelevant* Behaviors

- What happens when a borrower pays late by only a few hours or days?
  - Default risk is *not* higher
  - And yet, "hair trigger" pricing → interest rate increases

Dependent Variable	Pre-CARD Act Sample (2008-2009) Mean of Dep. Var.	Paid Late by < 30 Days
$\Delta_{t-1:t}$(APR)	0.255	0.927***
		(0.00237)
Subsequent Default	0.130	-0.00119***
		(0.000306)

Notes: Table shows sample means and regression coefficents for the dependent account level indicator for a borrower's repayment being late by less than 30 day and contemporaneous FICO in 10-point bins.

- Why would lenders do this?

Source: Nelson (2017)

The 2009 CARD Act

- Clearer billing information
- Lots of elimination of ad hoc fees and fee traps
  - E.g. Holidays have to move credit card payments due dates back in time, never forward in time
  - No interest rate increases in first year (exceptions)
- Interest rate increases do not apply to existing balances
- Penalty rates expire 6 months after a delinquency cures
- Borrowers must opt-in for over-limit fees
- Fees in first year bounded by 25% of initial credit limit
- Late payment fees are capped at $25 (exceptions)

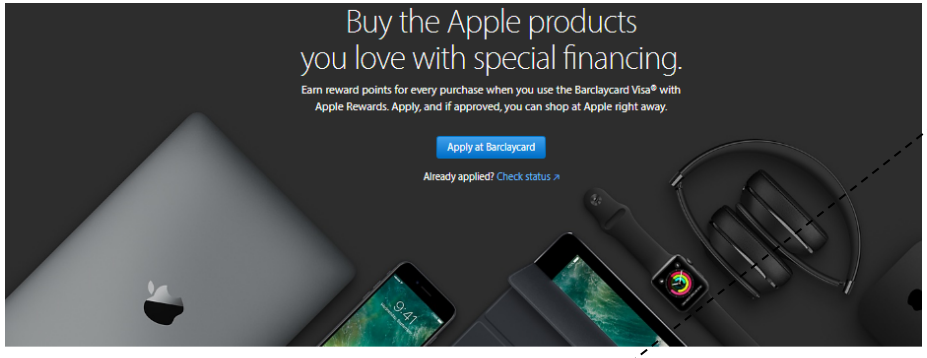
The Credit Card Market Today

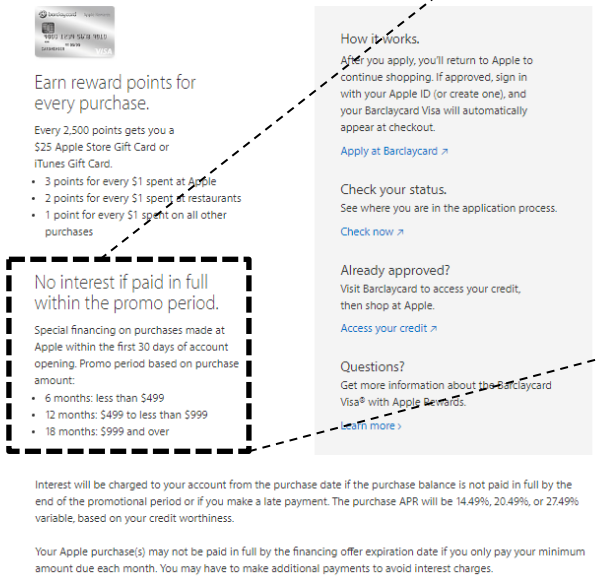
- Barriers to entry are low; many small banks, credit unions etc. still offer their own credit cards
- However, returns to scale in underwriting, account management, marketing → industry is dominated by a few large players

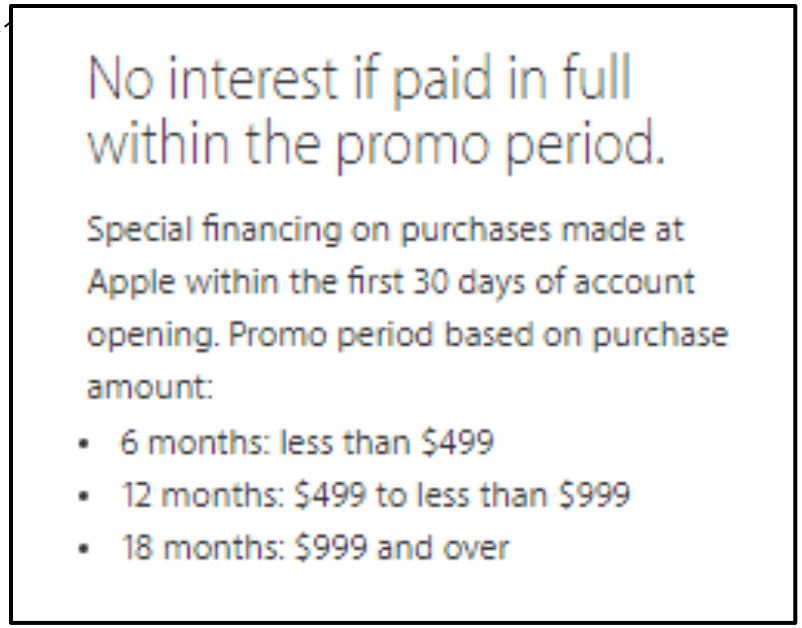
($ in millions)	Alliance Data Systems	American Express	Bank of America	Capital One	Citi	Discover	JPMorgan Chase	Synchrony	Wells Fargo	Average
Credit Card Loans										
Q4 2015	13,800	43,495	89,602	87,939	113,400	57,896	131,463	65,773	34,039	
Q4 2016	16,544	48,800	92,278	97,120	133,300	61,522	141,816	73,580	36,700	
%YoY	*+19.9%*	*+12.2%*	*+3.0%*	*+10.4%*	*+17.5%*	*+6.3%*	*+7.9%*	*+11.9%*	*+7.8%*	***+10.8%***
Credit Card Charge-Offs (net)										
Q4 2015	4.70%	1.40%	2.71%	3.75%	3.08%	2.18%	2.42%	4.23%	2.93%	
Q4 2016	5.50%	1.50%	2.52%	4.66%	3.07%	2.47%	2.67%	4.62%	3.09%	
%YoY	*+80 bps*	*+10 bps*	*-19 bps*	*+91 bps*	*0 bps*	*+29 bps*	*+25 bps*	*+39 bps*	*+16 bps*	***+30 bps***
Loan Loss Reserves (% of Loans)										
Q4 2015	5.37%	1.76%	3.27%	3.82%	3.97%	2.68%	2.61%	5.12%	4.15%	
Q4 2016	5.73%	1.87%	3.18%	4.35%	3.90%	2.91%	2.85%	5.69%	4.37%	
%YoY	*+36 bps*	*+12 bps*	*-9 bps*	*+54 bps*	*-7 bps*	*+23 bps*	*+24 bps*	*+57 bps*	*+23 bps*	***+24 bps***

Source: Issuer bank 8-K and 10-K filings

Recent trend: Deferred interest promotions





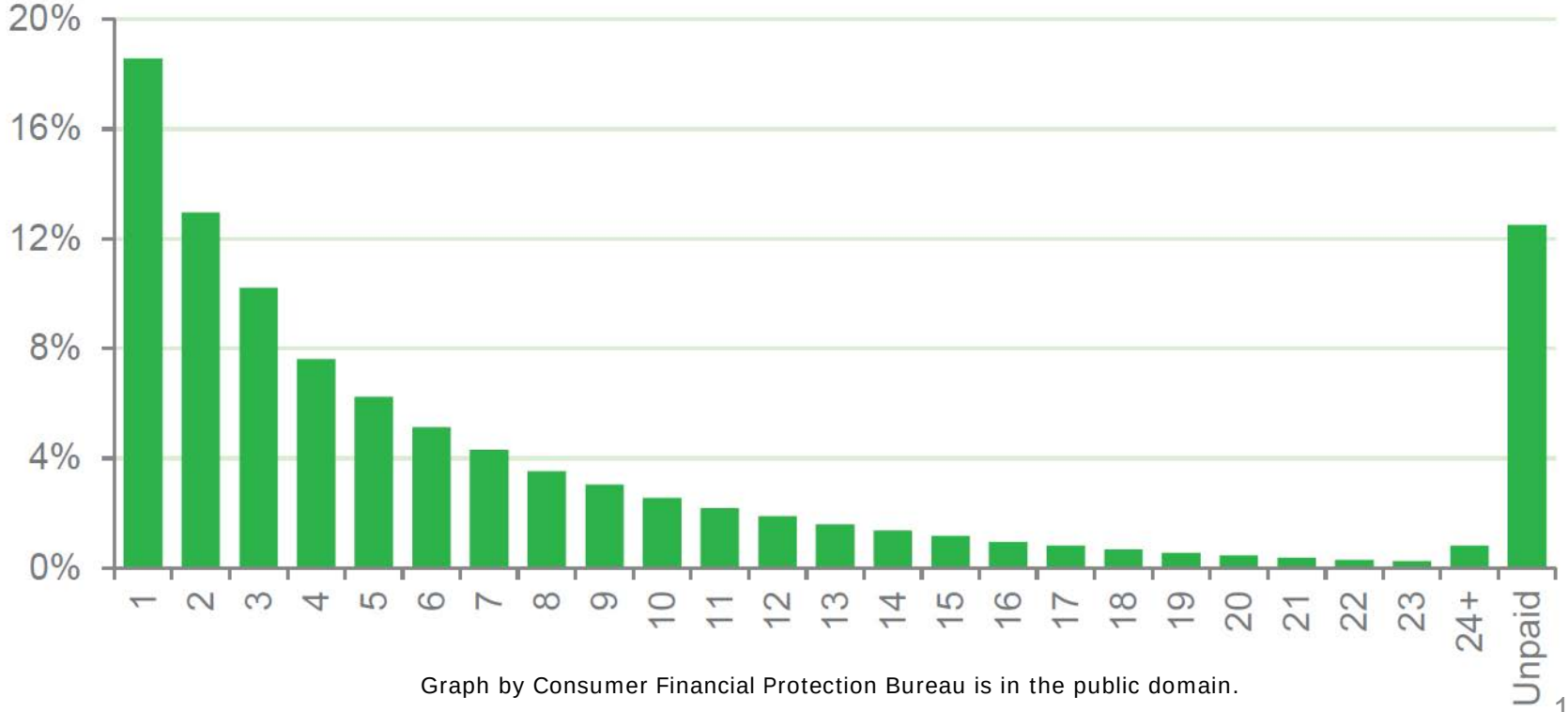


Screenshot © Apple, Inc. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/.

How do Consumers use DI?

- Up to 80% of consumers repay before the promotion expires (they borrow at 0%!)
- For everyone else, eclipsing the promotional period (even by one day) incurs interest charges for the *whole* period. And then…

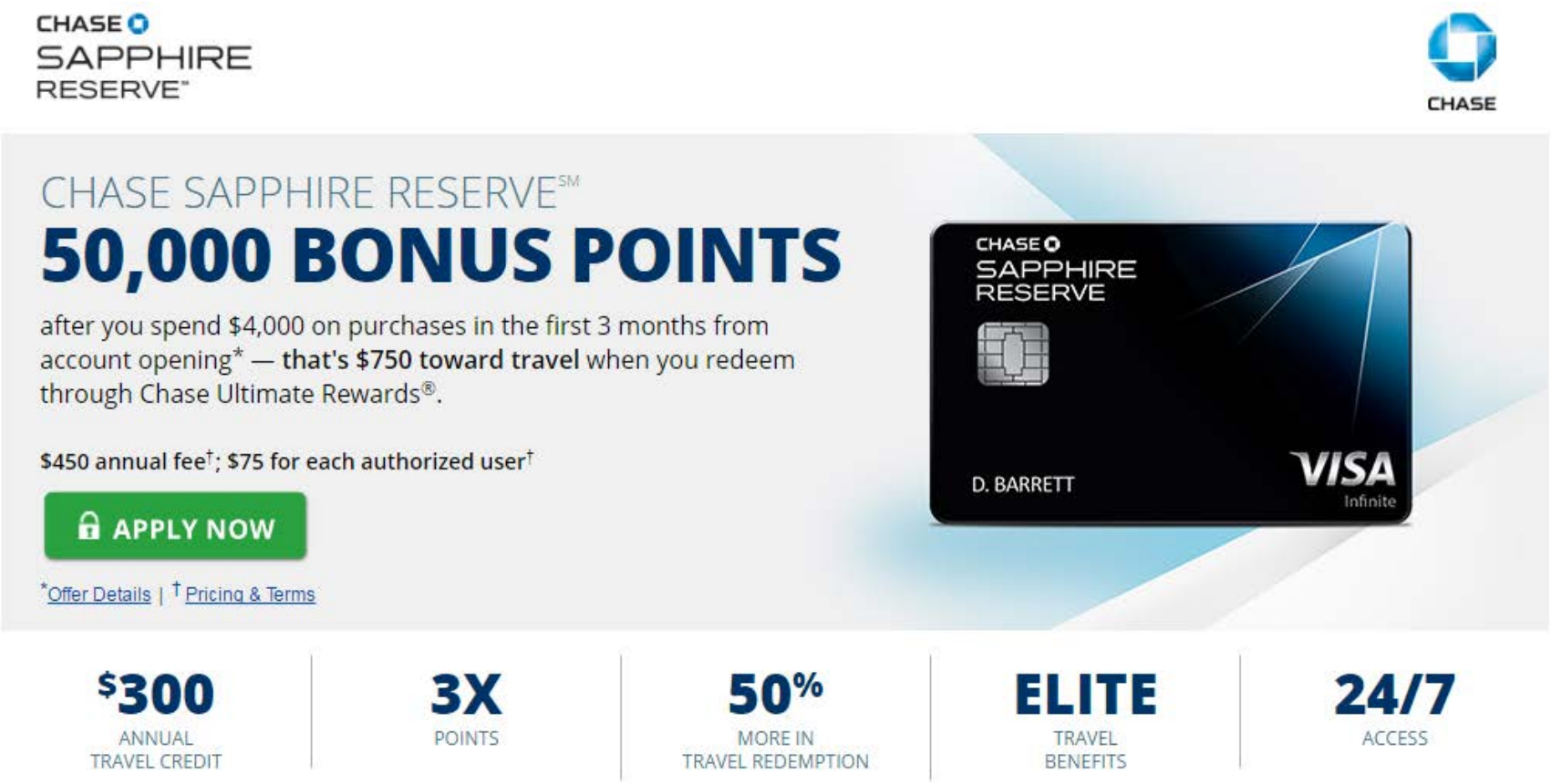
FIGURE 31: MONTHS TO REPAYMENT POST-PROMOTION, 2009-2011 (DI)



Graph by Consumer Financial Protection Bureau is in the public domain.

Source: CFPB (2015)

Recent Trend:
Aggressive Competition for Transactors



Screenshot © Chase Bank. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/.

Source: https://creditcards.chase.com/a1/sapphire/reserve

Who are Those Coveted Transactors?

The new Sapphire Reserve customers we are acquiring have attractive characteristics

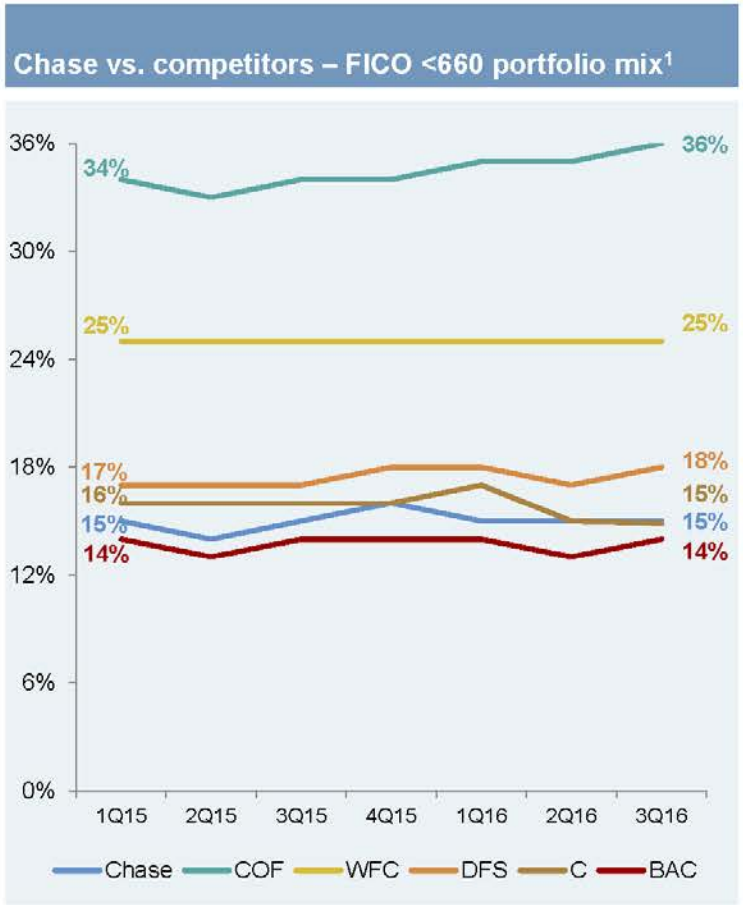
Early adopter profile of Sapphire Reserve customers as of December 2016	
Average income[1]	>$180K
Average Deposit & Investment wallet	>$800K
Average FICO score	>785
Lift in On Chase spend[2]	>50%

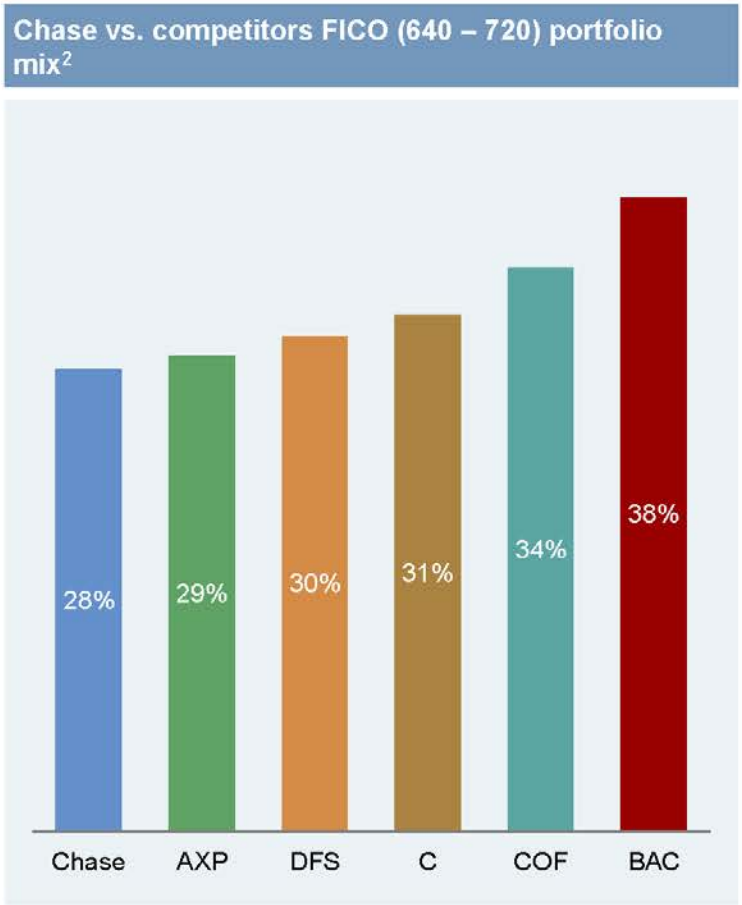
[1] Reflects self-reported income at time of application
[2] Compares July 2016 and December 2016 credit card spend (Pre-Reserve vs. Post-Reserve acquisition for existing Chase card customers only). Excludes December acquisitions

Chart © JPMorgan Chase. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/.

Source: JPMC Investor Relations (2017 Investor Day)

Market Segmentation





[1] Source: "U.S. Cards Subprime Plateau," Autonomous sell-side research report, 11/3/2016. Leveraged peers' Form10-Q/K disclosures and incorporates their own internal estimates. Credit card loans without a FICO score included in FICO <660 category

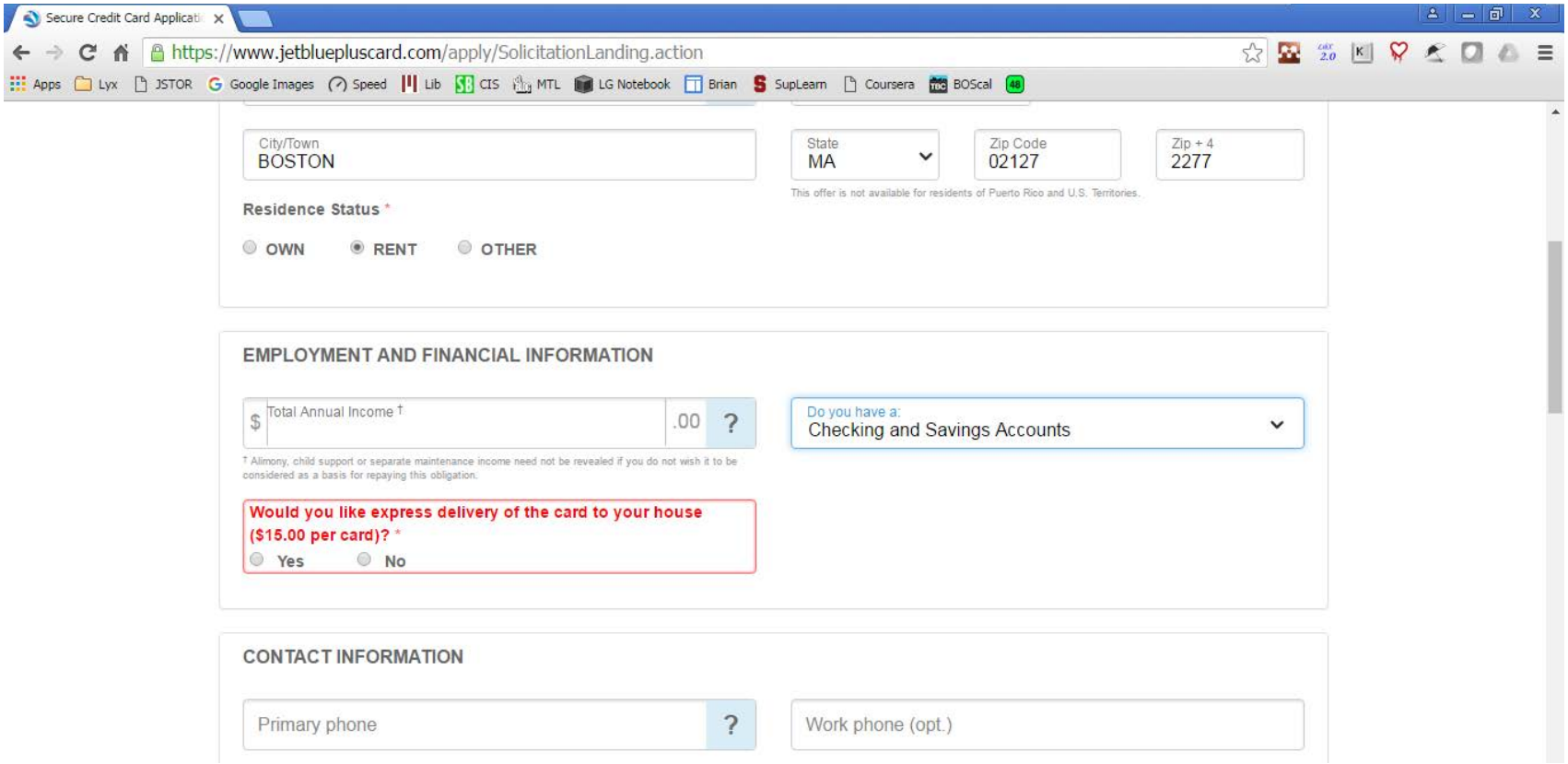
[2] Based on Lightspeed Behavioral Tracking Panel data for sample of existing portfolios' customers polled during 3Q16. Data represents FICO scores from 640 – 719

Chart © JPMorgan Chase. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/.

Source: JPMC Investor Relations (2017 Investor Day)

Creative Underwriting

- See BarclayCard's offer of express delivery below – any idea why they may be doing this?



Screenshot © BarclayCard. All rights reserved. This content is excluded from our Creative Commons license. For more information, see https://ocw.mit.edu/help/faq-fair-use/.

Lecture outline

1. Overview of credit card market
2. Market analysis and the failure of Citi "A deal is a deal" campaign
3. Credit market collapses

The assignment covers the biggest issue in lending markets: adverse selection

"Better Tomorrow" is a credit card issuer giving people credit to borrow to spend today, and repay when they have income in the future

1. When people have certain incomes in the future
   - When income certain, no default
   - Competitive interest rate is the cost of lending, r=1%, and people borrow 493, pay back 498, and get to spend 502 in the second month

Lending with default

2. For a customer with a 20% chance of no income in the second month

- With default profits:

$$= 0.8[(1+r)b_1 - b_1] + 0.2[-b_1]$$
$$= 0.8(1+r)b_1 - b_1$$

- So competition drives r=25%
- And spending in the first month is 444
- If optimistic, they borrow $355 – less that if realistic!
- Lesson: high-default borrowers want to borrow more
- Suggests a mechanism for screening if do not know prime/subprime but borrowers do: different credit limits so that high-risk choose high limit (& high interest rate)

Lending with different borrowers that the lender can observe

3. Half of BT's customers are prime and have no default, half are subprime and have 40% chance of no income in the second month

- For prime, just like part 1: no default, r=1%
- For subprime, profits: $= 0.6[(1+r_s)b_1 - b_1] + 0.4[-b_1]$
  $= 0.6(1+r_s)b_1 - b_1$
- So r=67%
- Compare to part 2, where no-one knew who was 40% likely to default and who was 0% likely
- Prime are better off but subprime are worse off

Lending before knowing who is who and committing not the adjust rates

4. Setting card terms *before* people learn who is likely to default and who is unlikely to default
   - Would borrowers like this outcome?
   - The interest rate would be set at 25%
   - Borrowers like the "insurance" against being subprime – they prefer to have lenders not use FICO
   - Goes against the big data and more information used in lending

Citi Cards "A Deal is a Deal"

5. Setting card terms before people learn who is likely to default and who is unlikely to default and holding them fixed in the face of competition
   - What is the problem?
   - Prime borrowers switch cards to 1% interest rates and the Citi card ends up with all subprime borrowers but a 25% interest rate
   - Should have set a 67% interest rate, but then no borrower would have taken the card
   - Other issues: optimists especially stay away, known prmie stay away, known sub-prime can be screened,…

Lecture outline

1. Overview of credit card market
2. Market analysis and the failure of Citi "A deal is a deal" campaign
3. Credit market collapses

Credit markets and information

Model of a credit market with big data

- Borrowers:
  - Looking for loan of size P>1
  - In return for borrowing P, will pay D over time in interest and fees and interchange fees,
  - Random, uncorrelated across assets: $E[D]>R$
- Lenders:
  - Competitive, risk-neutral (financial) investors
  - Two types . . .

Two types of lenders

Unsophisticated Lenders

- Compete to lend without information

Sophisticated Lenders with big data etc.

- Can pay cost c
- Which reveals a signal about the future payoff from this loan, either good or bad
- Share good: $\lambda \in (0,1)$
- (Not enough to fund quite all the borrowers)

$$D^b = E[D|bad]$$

$$D^g = E[D|good]$$

Suppose only unsophisticated lenders

They compete for borrowers, paying present value of stream of payments

$$P = E[D]/R$$

As long as P>1

(Figure 1 on board)

© Copyright 2018 Jonathan Parker. All Rights Reserved.

Add sophisticated lenders

They pay c

Don't lend to bad borrowers

Lend to good borrowers

Profits: $= -c + \lambda(\frac{D^g}{R} - \max[P^U, 1])$

Profits up as price from unsophisticated lenders falls

So only make profits when unsophisticated (market) price is low enough relative to cost

© Copyright 2018 Jonathan Parker. All Rights Reserved.

What is the market price?

If we start with the unsophisticated lenders in the market, the price is high, and no one sophisticated lenders enter unless:

$$c \geq \lambda(1-\lambda)\frac{D^g - D^b}{R}$$

(Figure 2 on board)

But if they all enter, then they leave mainly bad borrowers for the unsophisticated lenders, so that the price they can offer falls to (or below) 1 so that they are driven out of the market (Figure 3 on board)

© Copyright 2018 Jonathan Parker. All Rights Reserved.

See figures and explanations in "Valuation, Adverse Selection, and Market Collapses," with M. Fishman, Review of Financial Studies, 28(9), 2015, 2575-2607.

Credit market dynamics

1. What happens as the cost of more information declines over time?
2. What happens as the share of good projects declines?

Big data and valuation and lending

More data and cheaper valuation can make markets function worse due to an externality: valuation creates information on which adverse selection can occur

Multiple possible outcomes for a market: sudden, unexplained credit crunches

- Lenders compete on valuation, unsophisticated leave
- Valuation by sophisticated earns profits, hurts borrowers

Regulation:

- Make valuation observable or public (credit registry)

- Commitment and price subsidy by large unsophisticated investor (Fannie and Freddie)

Conclusion

1. The credit card market features
   - Large, Segmented into transactors and borrowers, regulated
   - Strategies on risk-pricing and behavioral biases (mistakes)
2. Citi promotion caused a problem of adverse selection: lost good credit borrowers to competitors
3. Collapse can come from more information
   - Big data poses major challenges for credit (and insurance) markets

MIT OpenCourseWare
https://ocw.mit.edu/

15.483 Consumer Finance: Markets, Product Design and Fintech
Spring 2018

For information about citing these materials or our Terms of Use, visit: https://ocw.mit.edu/terms.