Credit Cards and the Great Recession: The Collapse of Teasers

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Nov, 2018

The views expressed in this paper are those of the authors and do not necessarily reflect those of the Federal Reserve Bank of Philadelphia, Federal Reserve Bank of Boston, or the Federal Reserve System.
Prior to the crisis many borrowers relied on introductory promotional offers (a.k.a. “teaser rates”) to, in effect, borrow for the long term on promo rates:

- 43 percent of prime cc debt on promo APR in 2007
  - 10pp rate discount
  - 12 months median promo duration
- Refinancing volume via promo balance transfers ≈ expiring promo debt
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- 43 percent of prime cc debt on promo APR in 2007
  - 10pp rate discount
  - 12 months median promo duration
- Refinancing volume via promo balance transfers $\approx$ expiring promo debt
- Good fraction of cc debt was short term debt expected to be rolled-over
Questions We Ask & Answer

1. What should the distribution of interest rate burden be across periods?

2. Can theory quantitatively account for the prevalence of promos/refinancing?

3. Can prevalence of promos help understand substantive features of the data?
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1. What should the distribution of interest rate burden be across periods?
   - According to standard theory, intro rates should reflect current default risk.

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   - Yes. Empirically plausible naïveté quasi-geometric discounting does well.

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2. Can theory quantitatively account for the prevalence of promos/refinancing?
   - Yes. Empirically plausible naïveté quasi-geometric discounting does well.

3. Can prevalence of promos help understand substantive features of the data?
   - Yes. The 2008-14 deleveraging on credit cards consistent with a supply-driven shock.
Deleveraging on cc’s attributable to collapse of promo offers after 2008
OUTLINE

1. Data
2. Theory
3. Quantitative setup and calibration
4. Quantitative results
**Outline**

1. Data
2. Theory
3. Quantitative setup and calibration
4. Quantitative results
Data Sources and Description

1. Supervisory OCC/Y14M account level micro-data focusing on general purpose credit cards from 6 largest credit card lenders tracked between 2008 and 2017, and eight in total, having an approximate market share of over 50 percent in 2007.¹


¹The data is on an account level with a monthly frequency and is provided by bank holding companies subject to DFAST. The sample before 2013 is limited to several largest banks and it comes from OCC merged data with Y14M reporting. We focus on this sample here. Data after 2013 covers a broader sample of banks.

²The credit bureau data summarizes credit history of 200,000 credit market participants: the first 100,000 records are representative as of 2001 and the second one is representative as of 2013. We use observations from both panels.
1. **Supervisory OCC/Y14M account level micro-data** focusing on general purpose credit cards from 6 largest credit card lenders tracked between 2008 and 2017, and eight in total, having an approximate market share of over 50 percent in 2007.¹

2. **Mintel Compremedia, Inc. Direct Mail Monitor.**

3. **Experian credit bureau data** comprising of a representative panel of 200,000 credit records tracked between 2001 and 2013.²

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¹The data is on an account level with a monthly frequency and is provided by bank holding companies subject to DFAST. The sample before 2013 is limited to several largest banks and it comes from OCC merged data with Y14M reporting. We focus on this sample here. Data after 2013 covers a broader sample of banks.

²The credit bureau data summarizes credit history of 200,000 credit market participants: the first 100,000 records are representative as of 2001 and the second one is representative as of 2013. We use observations from both panels.
Snapshot Look at Credit Card Market in 2007

* At least a third of cc debt had introductory promo status back in 2007:

<table>
<thead>
<tr>
<th>Statistic</th>
<th>2008Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promo debt to total debt(^a) [%]</td>
<td>35</td>
</tr>
<tr>
<td>Promo debt with 670+ FICO to total debt [%]</td>
<td>43</td>
</tr>
<tr>
<td>Median duration of promo spell (all accounts) (^c) [months]</td>
<td>12</td>
</tr>
<tr>
<td>Average duration of promo spell (all accounts) (^c) [months]</td>
<td>16</td>
</tr>
</tbody>
</table>

\(^a\) Debt are credit card balances carried over for at least one billing cycle, hence 2008Q1 effectively starts in Feb.

\(^b\) Promo debt on low APR is the promo debt for which the promotional APR is lower than the step-up APR by at least 50 percent.

\(^c\) The spell is a number of months for which an account has a positive promotional balance, among accounts originated in 2008. We find equal median and higher mean for all accounts, which suggests accounts originated prior to 2008 had a longer promotional spell.
Promo debt provided ≈ 10pp discount to borrowers:

<table>
<thead>
<tr>
<th>Statistic</th>
<th>2008Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average promo APR [%]</td>
<td>4.3</td>
</tr>
<tr>
<td>Median promo APR [%]</td>
<td>3.5</td>
</tr>
<tr>
<td>Average step-up APR on promo accounts w/ debt [%]</td>
<td>17.3</td>
</tr>
<tr>
<td>Median step-up APR on promo accounts w/ debt [%]</td>
<td>16.0</td>
</tr>
<tr>
<td>Average non-promo APR [%]</td>
<td>15.5</td>
</tr>
</tbody>
</table>
Promo refinancing volume roughly equaled the flow of expiring promo debt:

<table>
<thead>
<tr>
<th>Statistic</th>
<th>2008Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance transfer (BT) volume per annum to stock of promo debt [%]</td>
<td>131</td>
</tr>
<tr>
<td>Promo BT to total BT [%]</td>
<td>92</td>
</tr>
<tr>
<td>Average transferred amount per BT [$]</td>
<td>$4,290</td>
</tr>
</tbody>
</table>
Collapse of Promo Borrowing After 2008
Promo activity collapsed after 2008; coincident with massive deleveraging:
Promo activity collapsed after 2008; coincident with massive deleveraging:

Source: Mintel Compremedia, Inc. Direct Mail Monitor.
Collapse of Promo Borrowing After 2008

- Decline in BT orthogonal to visible measures of default risk.
Outline

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ENVIRONMENT
**Environment**

- Three periods

- Two types of agents:
  - **Consumers**: start with some debt, face 2-state Markov income process $Y \in \{X, Y\}$ w/ switching prob. $p$, have quasi-geometric preferences, default only in low state
  - **Lenders**: access to funds at zero cost, compete to extend credit to borrowers (max $U$ s.t. zero pf)
ENVIRONMENT

- Three periods

- Two types of agents:
  - Consumers: start with some debt, face 2-state Markov income process $Y \in \{\underline{Y}, \overline{Y}\}$ with switching prob. $p$, have quasi-geometric preferences, default only in low state
  - Lenders: access to funds at zero cost, compete to extend credit to borrowers (max $U$ s.t. zero pf)

- Contract space restricted defaultable credit lines with a promo period:
  - $F$ - intro rate, $R$ - max reset rate, $L$ - credit limit
Three periods

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- **Consumers:** start with some debt, face 2-state Markov income process \( Y \in \{Y, \bar{Y}\} \) w/ switching prob. \( p \), have quasi-geometric preferences, default only in low state

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Contract space restricted defaultable credit lines with a promo period:

- \( F \) - intro rate, \( R \) - max reset rate, \( L \) - credit limit

Limited borrower commitment and lender commitment:

- Refinancing s.t. *procrastination*, term changes subject to **CARD Act** (new rates \( \leq R \), \( L \geq \text{debt} \))
Borrowers discount the future quasi-geometrically and are naive about it:

- Preferences as of *current* period $t$
  \[ u(c_t) + \eta \beta [u(c_{t+1}) + \beta u(c_{t+2}) + \beta^2 u(c_{t+3})] \]

- Actual preferences in future period
  \[ u(c_{t+1}) + \eta \beta [u(c_{t+2}) + \beta u(c_{t+3})] \]
**Key Feature: Quasi-geometric Discounting**

- Borrowers discount the future quasi-geometrically and are naive about it:
  - Preferences as of *current* period $t$
    \[ u(c_t) + \eta \beta [u(c_{t+1}) + \beta u(c_{t+2}) + \beta^2 u(c_{t+3})] \]
  - Actual preferences in future period
    \[ u(c_{t+1}) + \eta \beta [u(c_{t+2}) + \beta u(c_{t+3})] \]
  - $\Rightarrow$ Borrowers overestimate how fast their future self will pay down debt
Consumers start in high income state with some debt $B > 0$

Lenders: extend a credit line under Bertrand competition
(max $U$ s.t. zero pf subject to $0$ cost of funds)

consumption/borrowing/default

Period 1

Period 2
Timing

Consumers start in high income state with some debt B>0

Lenders: extend a credit line under Bertrand competition
(max U s.t. zero pf subject to 0 cost of funds)

consumption/borrowing/default

Second period income publicly revealed

(New) lenders compete to extend a refinance offer

Consumers choose to refinance (\(\lambda = 1\)) or stay with the incumbent (\(\lambda = 0\))

Incumbent reprices knowing \(\lambda\) (procrastination)

consumption/borrowing/default

....
**Consumer’s Payoff Tree and Decisions**

First period

- \( u(c_1) \)
- \( p \)
- \( 1 - p \)

Second period

- \( \beta u(c_2) \)
- \( \beta^2 u(c_3) \)
- \( p \)
- \( 1 - p \)

High income state:

Start with debt B

Decide

- Contract \( C = (F, R, L) \)
- First period borrowing \( b_1 \) and consumption \( c_1 \)
Consumer's Payoff Tree and Decisions

First period

\[ u(c_1) \]

\[ 1 - p \]

\[ p \]

High income state:

Start with debt B

Decide
- Contract \( C = (F, R, L) \)
- First period borrowing \( b_1 \) and consumption \( c_1 \)

Second period

\[ \beta u(c_2) \]

\[ 1 - p \]

\[ \beta^2 u(c_3) \]

\[ p \]

\[ \beta^2 u(c_3^d) \]

High income state:

Start with debt \( b_1 \) and contract \( C \)

Decide
- Refinance (\( \lambda = 1 \)) or stay with the incumbent (\( \lambda = 0 \)), who then reprice
- Second period borrowing \( b_2 \) and consumption \( c_2 \)
**Consumer’s Payoff Tree and Decisions**

Second period (ex post)

\[ \beta u(c_2) \]

\[ \text{High income state:} \]

- Start with debt \( b_1 \) and contract \( C \)

**Decide**

- Refinance \( (\lambda = 1) \) or stay with the incumbent \( (\lambda = 0) \), who then reprice
- Second period borrowing \( b_2 \) and consumption \( c_2 \)
Let $R^n_\lambda(R)$ be the expectation of repricing by incumbent when the agent refinances ($\lambda = 1$) / stays with incumbent ($\lambda = 0$)

**Lemma**

*On-equilibrium path: $R^n_\lambda(R) = R$.***

*typically this also will be the case off equilibrium path for $\eta < 1$.***
**Consumer Problem**

Consumers solve:

\[
U(F, R, L) := \max_{b_1 \leq L, b_2} u_1(c_1) + \eta(1 - p)[\beta u_2(c_2) + \beta^2(1 - p)u_3(c_3)]
\]

subject to

\[
c_1 := \bar{Y} - B + b_1 - Fb_1^+
\]

\[
c_2 := \bar{Y} - b_1 + b_2 - \left(1_{R_1^\eta(R)} > \bar{R}(\rho R_1^\eta(R) + p) + 1_{R_1^\eta(R) \leq \bar{R}} R_0^\eta(R)\right) b_2^+
\]

\[
c_3 := \bar{Y} - b_2
\]

and \(\bar{R}\) solves \(\rho \bar{R} + p = R_0^\eta(R)\).

*Note: In period 2, lenders always relax credit limit and new lenders zpf implies \(F = p\).*
Lender Problem

First period contract solves:

$$\max_{(F,R,L) \in \Theta} U(F, R, L)$$

subject to

$$\Pi(F, R, L) = (F - p)b_1^+ + (1 - p)(1_{R > \bar{R}}\rho R + 1_{R \leq \bar{R}}(R - p))b_2^{\eta+} = 0$$

where

$$b_2^{\eta+} = \arg \max_{b_2} \beta u(c_2) + \eta \beta^2 (1 - p)u(c_3)$$

subject to

$$c_1 = Y - B + b_1 - Fb_1^+$$
$$c_2 = Y - b_1 + b_2 - (1_{R > \bar{R}}(\rho R + p) + 1_{R \leq \bar{R}}R)b_2^+$$
$$c_3 = Y - b_2$$

and $\bar{R}$ solves $\rho \bar{R} + p = \bar{R}$, implying $\bar{R} = \frac{p}{1 - \rho}$.
Assume $R^\eta = R$ on- and off-equilibrium path; then $F, R, L$ solves:

$$\max_{(F, R, L) \in \Theta} U(F, R, L)$$

subject to

$$\Pi(F, R, L) = (F - p)b_1^+ + (1 - p)(1_{R > \bar{R}} \rho R + 1_{R \leq \bar{R}} (R - p))b_2^+ = 0,$$

$$b_2^\eta = \arg \max_{b_2} \beta u(c_2) + \eta \beta^2 (1 - p)u(c_3)$$

and

$$U(F, R, L) := \max_{b_1 \leq L, b_2} u(c_1) + (1 - p)[\beta u(c_2) + \beta^2 (1 - p)u(c_3)]$$

$$c_1 := \bar{Y} - B + b_1 - Fb_1^+$$

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$$c_1 := \bar{Y} - B + b_1 - Fb_1^+$$
$$c_2 := \bar{Y} - b_1 + b_2 - (1_{R > \bar{R}}(\rho R + p) + 1_{R \leq \bar{R}} R)b_2^+$$
$$c_3 := \bar{Y} - b_2$$

Apply transformation: $R = \frac{1}{\rho} \max(\hat{R} - \frac{p}{1 - \rho}, 0) + \min(\hat{R}, \frac{p}{1 - \rho}), \bar{R} = p/(1 - \rho)$. 
**Equilibrium Contracting Problem**

- Assume $R^\eta_\lambda = R$ on- and off-equilibrium path; then $F, R, L$ solves:

  $$
  \max_{(F,R,L) \in \Theta} U(F, R, L)
  $$

  subject to

  $$
  \Pi(F, R, L) = (F - p)b_1^+ + (1 - p)(\hat{R} - p)b_2^+ = 0,
  $$

  $$
  b_2^\eta = \arg \max_{b_2} \beta u(c_2) + \eta \beta^2 (1 - p)u(c_3)
  $$

  and

  $$
  U(F, R, L) := \max_{b_1 \leq L, b_2} u(c_1) + (1 - p)[\beta u(c_2) + \beta^2 (1 - p)u(c_3)]
  $$

  \[ c_1 := \bar{Y} - B + b_1 - Fb_1^+ \]

  \[ c_2 := \bar{Y} - b_1 + b_2 - \hat{R}b_2^+ \]

  \[ c_3 := \bar{Y} - b_2 \]

  Apply transformation: $R = \frac{1}{\rho} \max(\frac{\hat{R} - \frac{p}{1-\rho}}{1-\rho}, 0) + \min(\hat{R}, \frac{p}{1-\rho}), \bar{R} = p/(1 - \rho)$. 

Assume $R^n_\lambda = R$ on- and off-equilibrium path; then $F, R, L$ solves:

$$
\max_{(F, \hat{R}, L) \in \Theta} U(F, \hat{R}, L)
$$

subject to

$$
\Pi(F, \hat{R}, L) = (F - p)b_1^+ + (1 - p)(\hat{R} - p)b_2^+ = 0,
$$

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$$

$$
c_1 := \bar{Y} - B + b_1 - Fb_1^+
$$

$$
c_2 := \bar{Y} - b_1 + b_2 - \hat{R}b_2^+
$$

$$
c_3 := \bar{Y} - b_2
$$
Assumption

Equilibrium contract is nondegenerate: Consumer borrowing $b_1(F, R, L)$, $b_2(F, \hat{R}, L)$ is decreasing in $F$ and $\hat{R}$, respectively, and lender profits are increasing in $F$ and $R$ at $F = R = p$ (L slack).
Geometric discounting \((\eta = 1)\)
Proposition

Equilibrium features: $F = p = R$, $L$ nonbinding, and no refinancing.
**Main Result (1/3)**

**Proposition**

*Equilibrium features: $F = p = R$, $L$ nonbinding, and no refinancing.*

First period

- $u(c_1)$
- $1 - p$
- $p$
- $\beta u(c_2)$
- MRS=MRT

Second period

- $\beta u(c_2)$
- $1 - p$
- $p$
- $\beta^2 u(c_3)$
- $\beta^2 u(c_3^d)$

Lender loses with probability $p$ and borrower consumes her endowment.
**Main Result (1/3)**

**Proposition**

*Equilibrium features: $F = p = R$, $L$ nonbinding, and no refinancing.*

Key intuition:

1. Constrained optimality requires $MRT = MRS$ in high state, where $MRT = -(1 - p)$ and $MRS = -(1 - p)\beta \frac{u'(c_2)}{u'(c_1)}$, which implies

   $$u'(c_1) = \beta u'(c_2).$$

2. Implementation boils down to $F = p$, since consumer’s Euler equilibrium is

   $$(1 - F)u'(c_1) = \beta (1 - p)u'(c_2)$$

3. Tricky part: CQ holds and binding $L$ suboptimal.
Quasi-geometric discounting \((\eta < 1)\)
Equilibrium features $F < p < R$. If $\frac{b_2}{b_1} \leq (1 - p)$ and $\rho$ sufficiently low, the consumer refinances.
Equilibrium features $F < p < R$. If $\frac{b_2}{b_2^\eta} \leq (1 - p)$ and $\rho$ sufficiently low, the consumer refinances.

1. Unconstrained optimality now requires

$$u'(c_1) = \beta u'(c_2) \frac{b_2}{b_2^\eta}.$$ 

2. Implementability dictates $F < p$, since consumer’s Euler equation is:

$$(1 - F)u'(c_1) = \beta (1 - p) u'(c_2).$$

3. Tricky part: CQ holds, binding $L$ also implies $F < p$. 
**Numerical example**

**Figure:** A numerical example: Equilibrium contract as a function of $\eta$ ($\beta = 1$).

Notes: The figure illustrates equilibrium contract for a range of values of hyperbolic discount factor $\eta$, assuming $Y_l = 1/2$, $Y_h = 1$, $B = 1$, $\rho = .5$, $p = .1$, $\beta = 1$ and $u(c) = \log(c)$. $F$ is restricted to be non-negative. The shaded area indicates when refinancing occurs on the equilibrium path. The right panel shows the wedge between ex ante and ex post borrowing that creates incentives to set promotional terms.
"Chaining" results in promo offers. (See paper for more details.)

\[(1 - F - \rho R_{-1})u'(c_1) = \beta (1 - p)u'(c_2)\]
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Timing in Life-Cycle Model

Period $t$

Consumers

1. Markov random variable $s$ resolves all uncertainty within the period (income; arrival of offers)

2. Consumer receives market offer $M$

3. Consumer decides whether to accept or reject market offer $M$

4. Incumbent reprices $C$ to $I$

5. Consumers strategically decides whether to repay and chooses consumption $c$ and current borrowing $b$ accordingly

Period $t+1$

...
Consumer problem: refinancing decision $\lambda$

- Consumer first chooses whether to refinance or stay by solving:

$$V_t^n(C, B, s) = \max_{\lambda=0,1} U_t^n(M_t^n(C, B, s), I_t^n(C, B, s; M_t^n(C, B, s), \lambda), B, s; \lambda)$$

where

- $M_t^n(C, B, s)$ is market offer
- $I_t^n(C, B, s; M_t^n(C, B, s), \lambda)$ is incumbent's repriced offer

(Note: $\lambda = 0$ if refinancing option not available under $s$. )
**Consumer problem: default decision $\delta$**

- Consumer *strategically* plans default by solving:

$$U_t^n(C^n_M, C^n_I, B, s; \lambda) = \max_{\delta=0,1} U_t^n(C^n_M, C^n_I, B, s; \lambda, \delta)$$

where

- $C^n_I := I^n_t(C, B, s; \lambda) = (F^n_I, R^n_I, L^n_I)$ *repriced contract* from incumbent

- $C^n_M := M^n_t(C, B, s) = (F^n_M, R^n_M, L^n_M)$ *market offer* (active or inactive)

(Note: $\lambda = 0$ if market offer inactive.)
Consumer problem: consumption $c$ and borrowing $b$

- Consumer chooses consumption and current borrowing by solving:

$$U_t^n(C_M^n, C_I^n, B, s; \lambda, \delta) = \max_{(c,b) \in \Gamma} \{ u(c) - \chi(s) \delta +$$

$$\eta \beta \mathbb{E}_s [\delta V_{t+1}^1(C_{-1}, 0, s') + (1 - \delta)V_{t+1}^1(\lambda C_M^n + (1 - \lambda)C_I^n, b, s')] \}$$

subject to budget constraint given by

$$c \leq Y_t(s) - B + b - (1 - \delta) [(1 - \lambda)F_I^n + \lambda(\rho F_I^n + F_M^n)] b^+$$

$$b \leq (1 - \lambda) \min\{L_M^n, L_I^n\} + \lambda L_I^n$$

where $C_{-1} = (r_{-1}, 0, 0)$ exogenous seed contract.
Consumer problem: consumption $c$ and borrowing $b$

Consumer chooses consumption and current borrowing by solving:

$$U_t^n(C_M^n, C_I^n, B, s; \lambda, \delta) = \max_{(c,b) \in \Gamma} \{u(c) - \chi(s)\delta + \eta \beta \mathbb{E}_s [\delta V_{t+1}^1(c-1, 0, s') + (1 - \delta)V_{t+1}^1(\lambda C_M^n + (1 - \lambda)C_I^n, b, s')]\}$$

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Consumer problem: consumption $c$ and borrowing $b$

Consumer chooses consumption and current borrowing by solving:

$$U_t^n(C^n_M, C^n_I, B, s; \lambda, \delta) = \max_{(c,b) \in \Gamma} \{u(c) - \chi(s)\delta + \eta(1 - \delta) \sum_{t=1}^\infty \rho^t \left( \delta V_{t+1}^1(C_{-1}, 0, s') + (1 - \delta) V_{t+1}^1(\lambda C^n_M + (1 - \lambda) C^n_I, b, s') \right) \}$$

subject to budget constraint given by

$$c \leq Y_t(s) - B + b - (1 - \delta) \left[ (1 - \lambda) F^n_I + \lambda (\rho F^n_I + F^n_M) \right] b^+$$
$$b \leq (1 - \lambda) \min\{L^n_M, L^n_I\} + \lambda L^n_I$$

where $C_{-1} = (r_{-1}, 0, 0)$ exogenous seed contract.

Lemma

$L^n_I$ never binds following $\lambda = 0$ and $L^n_M$ can be assumed tight without loss.
Consumer problem: consumption $c$ and borrowing $b$

- Consumer chooses consumption and current borrowing by solving:

$$U_t^n(C_M^n, C_I^n, B, s; \lambda, \delta) = \max_{(c, b) \in \Gamma} \{u(c) - \chi(s)\delta + \eta \beta \mathbb{E}_s [\delta V_{t+1}(C_{-1}, 0, s') + (1 - \delta)V_{t+1}(\lambda C_M^1 + (1 - \lambda)C_I^1, b, s')] \}$$

subject to budget constraint given by

$$c \leq Y_t(s) - B + b - (1 - \delta) [\lambda F_M^n + (1 - \lambda)(\rho F_I^n + F_M^n)] b^+$$

$$b \leq (1 - \lambda)L_M^n + \lambda L_I^n$$

where $C_{-1} = (r_{-1}, 0, 0)$ exogenous seed contract.

**Lemma**

$L_I^n$ never binds following $\lambda = 0$ and both $L_I^n$, $L_M^n$ can be assumed tight without loss.
Lender Problem: Market offer $M$

- The equilibrium *market offer* solves:

$$M_t^n(C, B, s) = \arg\max_{C_M^n} U_t^n(C_M^n, I^n_t(C, B, s; C_M^n, 1), B, s; 1)$$

subject to

$$\Pi_t^M(C_{M}^n, I_t^n(C, B, s; C_{M}^n, 1), B, s) = 0$$

where $C_{I}^n$ is equilibrium repriced offer (simultaneous game).
The equilibrium *repriced offer* solves:

\[ I_t^n(C, B, s; C_M^n, \lambda) = \arg\max_{C_I^n} \Pi_t^I(C_M^n, C_I^n, B, s; \lambda) \]

subject to

\[ R_I^n \leq R, \quad F_I^n \leq R, \quad L_I^n \geq B \]

and

\[ U_t^n(C_M^n, C_I^n, B, s; \lambda) \geq U_t^n(C_M^n, C_I^n, B, s; \lambda) \]

where \( C_I^n = (R, R, B) \) and \( C_M^n \) is equilibrium repriced offer.
LENDER PROFIT FUNCTION II

Omitted.
Recursive equilibrium comprises consumer’s policy functions

\[ c_t^n, b_t^n, \delta_t^n \]

lender pricing policies

\[ M_t^n, I_t^n \]

and consumer and lender value functions

\[ V_t^n, U_t^n, \Pi_t^I, \Pi_t^M \]

such that they are consistent with consumer problem and lender problem.
Quantitative Setup and Calibration

- Log-utility, hyperbolic discount from Ausubel and Shui (2005): $\eta = 0.81$
- Cost of defaulting is parameterized by $\chi_0$: $\chi(y) = \chi_1 \max(y - \chi_0, 0)$.
- Income of a working age in economy state $\omega = \{R, E\}$ is:
  $$y_t(\omega) = e_t k_t z_t(\omega)$$
  where
  - $y_t$ - agent's income at age $t$
  - $e_t$ - deterministic age-dependent income profile
  - $k_t$ - a 3 state discrete i.i.d. process
  - $z_t(\omega)$ - 6x6 state Markov process that depends on $\omega$
- Individuals start life at the age of 24 years, retire at the age of 65 year, and die at the age of 80 years and period length is $l$ (parameter we calibrate)
- Demographics simulated starting from 2010 population structure and using death probability tables and .9 population growth
## Calibration

**Table**: Data targets and calibrated values of jointly selected parameters.

<table>
<thead>
<tr>
<th>Parameter Description</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Targeted moments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Credit card debt of card holder to median personal income [%]</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>2. Net charge-off rate [%]</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3. Average duration of promo offers [months]</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>4. Average step up rate on promo accounts [%]</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>5. Average rate on credit card debt [%]</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>B. Jointly calibrated parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount factor $\beta$</td>
<td>0.926</td>
<td></td>
</tr>
<tr>
<td>Cost of defaulting $\chi_0$</td>
<td>0.867</td>
<td></td>
</tr>
<tr>
<td>Period length $l$ [months]</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Refinance delay $\rho$</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Lender cost of funds $r$</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>C. Preset parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperbolic discount factor $\beta$</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>Income process (see Online Appendix and supp. files)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OUTLINE

1. Data
2. Theory
3. Quantitative setup and calibration
4. Quantitative results
Can the model account for prevalence of promo debt?
Classification of promo accounts in the model:

As a fraction of accounts with F<R [in %]

Promo discount size: 1-F/R [in %]

Classified as promotional in the model
Model matches key moments we did not target reasonably well:

**Table:** Data targets and calibrated values of jointly selected parameters.

<table>
<thead>
<tr>
<th>Statistic (in percent % unless otherwise noted)</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promo debt as a fraction of total debt</td>
<td>35</td>
<td>33</td>
</tr>
<tr>
<td>Annual balance transfers as a fraction of debt</td>
<td>39</td>
<td>44</td>
</tr>
<tr>
<td>Average interest rate on promo debt (data+3)</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Median interest rate on promo debt (data+3)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Share of revolvers among card users</td>
<td>59</td>
<td>60</td>
</tr>
</tbody>
</table>
Can the model account for 2009-14 deleveraging on cc’s?
Model recession as a switch to “recession time income process” (as in Guvenen et al 2007)

Introduce MIT shock to model collapse of promos:

- Permanent shock: permanent decline in refinancing probability by 30 percent (expected upon occurrence)
- Transient shock: unexpected residual decline to account for the evolution of share of promo debt
**Calibration of collapse of promo shock**

![Graph showing collapse of promo shock](image)

**Figure:** Collapse of promotional activity: model via-à-vis the U.S. data.

Notes: The figure illustrates the decline in the share of promotional credit card debt to total debt (left panel) and the collapse of balance transfers (promotional balance transfers) as a fraction of debt. Solid lines correspond to the model and the dotted line is the data. We consider three models that incrementally add shocks. The total contribution of the collapse of promo shock is the difference between green line with circles and the orange line with squares.
The figure illustrates deleveraging on credit cards relative to median income and in absolute terms (in data real value detrended using the 1996-2006 linear trendline). Solid lines correspond to the model and the dotted line is the data. We consider three models that incrementally add shocks. The total contribution of the collapse of promo shock is the difference between green line with circles and the orange line with squares.
**THEORY CONSISTENT WITH AGGREGATE DATA ON CHARGE-OFF RATE AND INTEREST RATE ON CCs**

**Figure:** Charge-off rate and interest rate on card debt: model via-á-vis the U.S. data.

Note: The figure illustrates the net charge-off rate on card debt (fraction of debt defaulted on) and the average interest rate paid on credit card debt estimated using our account level dataset. Solid lines correspond to the model and the dotted line is the data. The charge-off rate is for all banks and comes from FRB. We consider three models that incrementally add shocks. The total contribution of the collapse of promo shock is the difference between green line with circles and the orange line with squares.
SUMMARY

- Document prevalent use of promo offers prior to the crisis and the collapse of promo offerings during the crisis.

- Develop a new theory of promo pricing and show new theory can quantitatively match the data prior to the crisis.

- Show deleveraging on credit cards consistent with a supply-driven decline in availability of promotional offers during the crisis.