Modeling the Credit Card Revolution: The Role of IT Reconsidered

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The Role of IT in Credit Markets

Time-varying Default Risk
(Asymmetric Information)

Credit Application → Credit Utilization (borrowing) → Debt Collection (repayment/default)
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Credit Scoring (access, pricing)
Behavior Scoring (change of terms)
Collection Scoring (collection strategies)

IT progress
(Continuous Risk Assessment)

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The Role of IT in Credit Markets

Time-varying Default Risk (Asymmetric Information)

Credit Application

Credit Utilization (borrowing)

Debt Collection (repayment/default)

Literature

Credit Scoring (access, pricing)

Behavior Scoring (change of terms)

Collection Scoring (collection strategies)

This paper
Missing Ingredient of Existing Theory

- Conventional view of consumer default on unsecured debt
  - court-based process, truthful revelation of state
  - exogenous eligibility defined by law

[1.] Dawsey & Ausubel (2004): >50% of $ defaulted on

[2.] vast resources involved in collection of unpaid debt
  - employment: 350k+ (≈ 30% share of cc-receivables)
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Basic Idea of the Paper

- In the model:

  - Enforcement by the lending industry with access to IT

    - enforcement $= \text{Ex post} \ ‘\text{State verification’ (solvency status)}$
    - IT $= \text{signal extraction technology}$
Basic Idea of the Paper

• In the model:
  ◦ Enforcement by the lending industry with access to IT
    - enforcement = Ex post ‘State verification’ (solvency status)
    - IT = signal extraction technology

• Comparative Statics Exercise: IT progress
  ◦ Increase in signal precision (main channel)
  ◦ Reduction in transaction costs
Basic Idea of the Paper

**Daily Scoring Directs Core Asset Collections**

- Account characteristics
- Demographic characteristics
- Supplemental data from external sources
- Responses to collection actions

Hundreds of thousands of data points are distilled to produce a likelihood of ability to contact and collect.

An ROI threshold is established.

Actions are taken to the extent warranted:

- Pursue legal collections
- Send a letter
- Make a phone call
- Do nothing

Signal of solvency: action or no action

PRA, Investor Presentation, 2011 Q3
Better enforcement technology implies

Net Credit Card Charge-off Rate

⇒ accounts for most puzzling development in cc-market
Better enforcement technology implies

Net Credit Card Charge-off Rate

charge-off rate = (net) debt discharged / total debt
CONSUMERS

\[ \text{distress shock } d=0,1 \text{ (unobservable to lenders)} \]

\[ B, Y \]

First sub-period

Second sub-period

LENDERS
Model

CONSUMERS

borrows/consumes

default at a penalty

distress shock
\( d = 0,1 \) (unobservable to lenders)

LENDERS

\( B, Y \) — First sub-period — Second sub-period
Model

CONSUMERS

- Distress shock \( d=0,1 \) (unobservable to lenders)
  - Borrowing/consumption
  - Default at a penalty
  - Consumption

LENDERS

- Monitoring
  - \( d=0 \): repay at penalty interest
  - \( d=1 \): no effect

\( B,Y \) — First sub-period — Second sub-period
Model

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- distress shock $d=0,1$ (unobservable to lenders)
  - borrowing/consumption
  - default at a penalty
  - monitoring
    - $d=0$: repay at penalty interest
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  - consumption

LENDERS

- lenders compete to extend credit lines $R,L,P(s)$

B,Y

First sub-period

Second sub-period

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$B,Y$ First sub-period

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monitoring

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lenders compete to extend credit lines $R,L,P(s)$

signal $s=0,1$ of shock $d$ (precision $\pi$)

consumption

Second sub-period

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CONSUMERS

- distress shock $d=0,1$ (unobservable to lenders)
  - borrowing/consumption
  - default at a penalty

LENDERS

- lenders compete to extend credit lines $R,L,P(s)$
- signal $s=0,1$ of shock $d$ (precision $\pi$)
- monitor defaulters according to $P(s)$

B,Y

First sub-period

- $d=0$: repay at penalty interest
- $d=1$: no effect on default at a penalty

Second sub-period

- monitoring
  - $d=0$: repay at penalty interest
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CONSUMERS

monitoring

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Equilibrium Contracts

- Three types of equilibrium contracts

  - $L \leq L_{\min}(d=1)$: Risk-free contracts (no default regardless of $d$)
  - $L > L_{\min}(d=1)$: Risky contracts (positive probability of default)
  - $L \in (L_{\min}(d=1), L_{\min}(d=0))$: Non-monitored contracts (default if $d=1$ for all $P(s)$)
  - $L > L_{\min}(d=0)$: Monitored contracts (default if $d=1$, or if $d=0$ and $P(s) < \bar{P}$)
Equilibrium Contracts

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Equilibrium Contracts

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Monitoring Strategies

- Two types of monitoring strategies for monitored contracts

  - Full monitoring: $P(s) = \bar{P}$ for all $s$ - prevents strategic default of non-distressed consumers - monitoring costs $\propto \bar{P}$

  - Selective monitoring: $P(0) = \bar{P}$ and $P(1) < \bar{P}$ - prevents strategic default of non-distressed consumers only for $s = 0$. - monitoring costs $\propto \bar{P} \times \text{Prob}(d = 1, s = 0) + P(1) \times \text{Prob}(s = 1)$
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    - monitoring costs \( \propto \bar{P} \times Prob(d = 1, s = 0) + P(1) \times Prob(s = 1) \)
      (decrease as \( \pi \) increases)
How Do Lenders Price Defaultable Debt

![Graph showing the pricing of defaultable debt](image)
How Does $\pi$ Impact Pricing?

![Graph showing the impact of $\pi$ on pricing with risk-free, non-monitored, and monitored scenarios.](Diagram)

- **Risk-Free**: The pricing remains constant regardless of $\pi$.
- **Non-Monitored**: Pricing increases with $\pi$.
- **Monitored**: Pricing increases with $\pi$, but at a slower rate compared to non-monitored scenarios.

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How Does $\pi$ Impact Pricing?

$R$

$\pi \uparrow$

IT Progress

risk-free non-monitored monitored

IC'

$L$

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Quantitative Extension

- Life-cycle environment (27 periods)
- Analytic model embedded within each period
  - baseline period length (1 sub-period) = 1 year
- $B$ endogenous
- $Y$ stochastic
- $E = (Y < .25\bar{Y}) +$ medical bills + divorce + unwanted pregnancy
- Only medical shock assumed directly defaultable $\rightarrow$ low $\phi$
Model Accounts for Both Trends and Levels

- information precision x3 over the 90s

- transaction cost declines by 20% (Berger, 2003)
### Why Model Matches Trends?

<table>
<thead>
<tr>
<th></th>
<th>Benchmark Model</th>
<th>Decomposition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90s</td>
<td>00s</td>
</tr>
<tr>
<td>(in % unless otherwise noted)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC Debt to Med. Income</td>
<td>9.0</td>
<td>15.1</td>
</tr>
<tr>
<td>CC Charge-off Rate</td>
<td>3.5</td>
<td>5.4</td>
</tr>
<tr>
<td>Defaults (per 1000)</td>
<td>4.5</td>
<td>10.8</td>
</tr>
<tr>
<td>- fraction monitored</td>
<td>30</td>
<td>18</td>
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<tr>
<td>- fraction strategic</td>
<td>0.0</td>
<td>19</td>
</tr>
<tr>
<td>Frequency of Risky Cont.</td>
<td>21.4</td>
<td>36.6</td>
</tr>
<tr>
<td>- fraction fully monitored</td>
<td>100</td>
<td>1</td>
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<tr>
<td>- fraction sel. monitored</td>
<td>0</td>
<td>99</td>
</tr>
<tr>
<td>Discharge to Income</td>
<td>74</td>
<td>89</td>
</tr>
<tr>
<td>CC Interest Premium</td>
<td>6.5</td>
<td>4.4</td>
</tr>
</tbody>
</table>
Why Model Matches Levels?

Standard model:

\[ L_{min}(d = 0) \]

(d=0)
Non distressed:
No default

(d=1)
Distressed:
No default

Default

\[ L_{min}(d = 1) = \theta Y - \phi E \]
Why Model Matches Levels?

Our model:

(d=0)  Non distressed:
- No default
- $L_{\text{min}}(d = 0)$

(d=1)  Distressed:
- No default
- $L_{\text{min}}(d = 1) = \theta Y - \phi E$

- Default if not monitored
- No default if monitored
Conclusions

• Complementary mechanism of IT-driven expansion of credit card lending
  ○ departure motivated by:
    - prevalence of informal bankruptcy
    - involvement of lenders in debt collection

• Addresses Achilles’ heel of existing models
THE END
Literature: Unsecured Credit and IT

- Adverse Selection and Ex-ante Role of IT

  Narajabad (2012), Athreya, Tam and Young (2008), Sanchez (2012)
  Livshits, MacGee and Tertilt (2011)

- Informal Bankruptcy

  Benjamin and Mateos-Planas (2011), Athreya, Sanchez, Tam and Young (2012), Chatterjee (2010)

- Standard Modeling Frameworks

  Livshits & MacGee and Tertilt (2006, 2010), Chatterjee, Corbae, Nakajima and Rios-Rull (2007), Athreya (2003) etc...

  ⇒ define modeling issues / challenges
Lenders: Contract Assignment

- Choose \( K = (R, L) \) & \( P(s) \) to maximize

\[
\max_{K, P} V(K, P)
\]

subject to

\[
\mathbb{E}\Pi(I, K, P) - \lambda \sum_{I = (d, s)} \delta(I, K, P)P(s)\text{Prob}(I) \geq 0,
\]

where \( I \equiv (d, s) \) and ex-post profit function \( \Pi(I, K, P) \) given by

\[
\Pi(I, K, P) = \begin{cases} 
R \max\{b(I, K, P), 0\} & \text{if } \delta(I, K, P) = 0 \\
- L + L(1 + \bar{R})(1 - d)P(s) & \text{if } \delta(I, K, P) = 1 
\end{cases}
\]
• Choose $\delta \in \{0, 1\}$ to maximize

$$V(K, P) \equiv \mathbb{E} \max_{\delta \in \{0, 1\}} [(1 - \delta)N(I, K, P) + \delta D(I, K, P)]$$

where $I = (d, s)$ and

$N(\cdot)$ is indirect utility fcn. associated with repayment

$D(\cdot)$ is indirect utility fcn. associated with default
Consumers: Indirect Utility from Repayment

• Under repayment, choose $b, c, c'$ to maximize

$$N(I, K) \equiv \max_{b \leq L} U(c, c')$$

subject to

$$\begin{cases} c = Y - B + b - \rho(K, b) \\ c' = Y - b - dE - \rho(K, b) \end{cases}$$

where $I = (d, s)$ and

$$\rho(K, b) = R \max\{b(I, K, P), 0\}/2$$
Consumers: Indirect Utility from Default

- Under default, choose $b, c, c'$ to maximize

$$D(I, K, P) \equiv \max_{-L \leq b \leq 0} \mathbb{E}_I U(c, c')$$

subject to

\[
\begin{aligned}
    c &= Y - B + L + b \\
    c' &= (1 - \theta)Y - (1 - \phi)dE - b - mX(d)
\end{aligned}
\]

where $I = (d, s)$ and

$$X(d) = (1 - d)((\theta - \theta)Y + L(1 + \bar{R}))$$

$$\theta Y + \bar{R}L \text{ s.t. } d=0\text{-consumer does not default if } P = 1$$
Definition of Equilibrium

- **Equilibrium is:** indirect utility functions

  \( V(\cdot), N(\cdot), D(\cdot) \)

  and decision functions

  \( \delta(\cdot), b(\cdot), K(\cdot), P(\cdot) \)

  s.t. consistent with problems defined above.
Parameterization

- Calibrated independently: $Y_{6 \times 6}$-Markov, $E = 0.4$, $p = 0.1$, $\phi = 0.25$
Parameterization

- Calibrated independently: $Y$ 6x6-Markov, $E = 0.4$, $p = 0.1$, $\phi = 0.25$

- Choose $\beta$, $\bar{\theta}$, $\theta$, $\pi$, $\lambda$
  
  - indebtedness for 2004: 15%
  
  - charge-off rate for 2004: 5%
  
  - discharge to income of bankruptcy filer in the 90s
  
  - 3 fold increase in $\pi$ centered around 0.5
  
  - $\lambda = 0.3$ to get regime switch around $\pi = 0.5$
Parameterization

- Calibrated independently: $Y_{6 \times 6}$-Markov, $E = 0.4$, $p = .1$, $\phi = .25$

- Choose $\beta$, $\bar{\theta}$, $\theta$, $\pi$, $\lambda$
  
  - indebtedness for 2004: 15%
  
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  - 3 fold increase in $\pi$ centered around .5

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- Decline of transaction cost by 20% (consistent with Berger, 2003)
Direct Impact of IT-Based Solution

- In early 90s, GE capital developed PAYMENT; first comprehensive solution (Markuch et al., 1992) to direct collection resources:
  - Markov model of evolution of delinquent debt as a function of possible actions taken by collectors
  - systematic comparison of accounts treated vs non-treated
    - report 7-9% gain in overall effectiveness and improved borrower goodwill
    - explicit mention that most gains due to more frequent selection of no action
    - as for first implementation of this sort of system this is big number
Direct Impact of IT-Based Solution

- Banerjee (2001) directly looks at yield from litigation on cc-receivables:
  - yield from litigation boosted from 24% to 40% by IT!
Other industry studies report even higher numbers:

- PRA, major debt collection agency, reports 120% gain in debt recovered per dollar spent on collection over the years 1997-2004 (Annual Report, 2011)

- Trustmark National Bank, discussed adoption of Fair ISAAK debt collection system in late 90s: 35-58% gain on consumer receivables with same staff
Other Important Evidence

• In 90s all 3 major credit bureaus started offering collection scores, marketed to debt collection industry; this accounts for 7% of their revenue, which suggests:
  
  ◦ 1. these scores aid collection by segmenting/prioritizing debtors
  
  ◦ 2. segmentation and prioritization is of first order importance
Comparison to the Model

- IT progress rate in the ballpark of assumed numbers:
  
  - in model 33% gain in efficiency, industry data report vary between 9%-120%

- Cost of monitoring on the high side, but not unreasonable:

  - pre-PAYMENT GE spent $150 million on final write-offs $400 million
    
    - suggests $150/(400/.74) = .28 as upper bound on monitoring cost (we use .3)
    
    - aggregate costs also consistent with the model’s implication: data: 350k*$50k*30% -2% x $800 billion on 5% x 800 billion aggregate charge-offs