Do Banks Pass Through Credit Expansions to Consumers Who Want to Borrow? Evidence from Credit Cards

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Motivation

• In response to Great Recession, key policy objective was to provide banks with lower-cost capital and liquidity

• One motivation was to stimulate aggregate demand

  ↓ Cost of funds ⇒ ↑ Credit availability ⇒ ↑ Borrowing, spending, investment

• Challenging to analyze effectiveness of this “bank lending channel” using time-series analysis.

  • Changes in banks’ cost of funds are usually correlated with other forces that affect credit demand and supply.
Propose new approach to studying bank lending channel focusing on frictions in bank-borrower relationship (e.g., asymmetric information).

- Can be implemented using micro-data on lending + quasi-exogenous cross-sectional variation in contract terms
- Complements literature focusing on variation in bank capital

Use approach to study U.S. credit card lending during Great Recession.

- Marginal source of credit for most households
- Analyze forces that affected effectiveness of bank-mediated stimulus during this time period.
Our Approach

- Credit card market primarily adjusts through credit limits
- Aggregate impact of decrease in cost of funds \( (c) \) on borrowing \( (q) \):

\[
- \frac{dq}{dc} = \int_i - \frac{dCL_i}{dc} \times \frac{dq_i}{dCL_i}
\]

- Empirically Useful: Decomposes total effect into objects we can estimate quasi-exogenous variation.
- Conceptually Useful: At the margin, is total borrowing constrained by credit supply (low MPL) or credit demand (low MPB)?
- How does this differ across the population?
Our Approach

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• Aggregate impact of decrease in cost of funds \((c)\) on borrowing \((q)\):

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• **Empirically Useful:** Decomposes total effect into objects we can estimate quasi-exogenous variation.

• **Conceptually Useful:** At the margin, is total borrowing is constrained by credit supply (low MPL) or credit demand (low MPB)?
  
  • How does this differ across the population?
Our Approach

• Estimate heterogeneous MPBs and MPLs in U.S. credit card market

• Data: Universe of credit card accounts issued by 8 largest U.S. banks

• Research design:
  - Some banks set credit limits as step-function of FICO scores
  ⇒ 743 RDs in all parts of the FICO score distribution

• Directly estimate heterogeneous MPBs

• Simple model to express optimal MPL in terms of "sufficient statistics"
  • Quantify frictions in bank-borrower relationship (e.g., adverse selection)
  • Can be estimated using credit limit RDs.
Preview of Findings

- MPB decreasing in FICO score
  - Effect of $1 increase in credit limits on total borrowing after 12 months
    - FICO $\leq$ 660: 59 cents
    - FICO $> 740$: no response

- MPL increasing in FICO scores
  - Optimal response to 1 ppt reduction in banks’ (shadow) cost of funds, $c$
    - FICO $\leq$ 660: $239$
    - FICO $> 740$: $1,211$

- Highlights roles of credit supply vs. credit demand in constraining household borrowing at the margin during the Great Recession.
  - Supply important for low FICO scores, demand for high FICO scores
  - Mismatch: Banks don’t want to lend to those that want to borrow.
Outline

- Data
- Research Design
- Marginal Propensity to Borrow
- Marginal Propensity to Lend
Data

- OCC Credit Card Metrics
  - All credit cards issued by 8 largest U.S. banks
  - 400 million credit card accounts
  - Monthly data from January 2008 to December 2014
- Key variables
  - Spending and borrowing information ⇒ MPB
  - Interest payments, fees and chargeoffs ⇒ MPL
  - Merged in credit bureau information
- Sample restrictions
  - Focus on cards originated within our sample (since January 2008)
Outline

- Data
- Research Design
- Marginal Propensity to Borrow
- Marginal Propensity to Lend
Credit Limit Quasi-Experiments

- Credit card lenders assign credit limit based on FICO credit score
- Might also consider other factors (e.g., internal behavioral scores)
Credit Limit Quasi-Experiments

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- Might also consider other factors (e.g., internal behavioral scores)
Credit Limit Quasi-Experiments

- Identify 743 quasi-experiments between Jan 2008 and Jun 2013
- 8.5M accounts originated within 50 FICO points of experiments
  - Less than 5% of new cards
RD Estimator

• Fuzzy RD estimator for a given experiment

\[
\tau_j = \lim_{\text{FICO} \downarrow \text{FICO}} E[Y|FICO] - \lim_{\text{FICO} \uparrow \text{FICO}} E[Y|FICO]
- \lim_{\text{FICO} \downarrow \text{FICO}} E[CL|FICO] - \lim_{\text{FICO} \uparrow \text{FICO}} E[CL|FICO]
\]

• Causal interpretation requires two assumptions:

**A1:** Other contract & borrower characteristics trend smoothly through cutoff

**A2:** No strategic movement around cutoff
First Stage on Credit Limits

- Pooled across all quasi-experiments, centered around cutoff
- $1,472 higher average credit limit around our cutoffs
A1: Interest Rate (APR) Trends Smoothly

- No discontinuous change in interest rates around credit limit cutoffs.
A1: Borrower Characteristics Trend Smoothly

(a) Number of Credit Card Accounts

(b) Total Credit Limit ($)

(c) Age of Oldest Account (Years)

(d) # of Payments 90+ DPD (Ever)
A2: No Strategic Movement Around Cutoff

- Hard to precisely manipulate FICO score
- Credit supply function not known
- Credit limit unknown when consumer applies for card (no demand response).
Aggregating Across Experiments

- Estimate $\tau_j$ separately for each quasi-experiment $j$

  - Separate second-order local polynomial with Imbens-Kalyanaraman (2011) optimal bandwidth

- Recover average effect by FICO group with regression

  $$\tau_j = \sum_{k \in K} \beta_k FICO_k + X_j' \delta_X + \epsilon_j$$

  - $FICO_k$ are FICO group quartiles
  - $X_j$ are fully interacted bank $\times$ origination quarter fixed effects

- Standard errors constructing by bootstrapping over experiments
Outline

• Data
• Research Design
• **Marginal Propensity to Borrow**
• Marginal Propensity to Lend
MPB on “Treated” Card, After 12 months

- Pooled across all quasi-experiments, centered on cutoff.
- Summary stats
Quick response, gradual decline

Large heterogeneity by FICO score, even high FICO borrowers respond
• Lower-FICO borrowers: 1-for-1 increase in total borrowing

• FICO > 740: No response in total borrowing ⇒ balance shifting
MPB Takeaway

- Substantial heterogeneity in borrowing / spending behavior

- **FICO \( \leq 660 \)**
  - MPB of at least 50% on treated card
  - Not offset by decline on other cards
  - Corresponds to increase in spending on treated card

- **FICO \( > 740 \)**
  - MPB of \( \approx 15\% \) on treated card
  - Completely due to balance shifting
  - Zero MPB despite significant borrowing on average

⇒ Stimulating borrowing requires credit expansion to low-FICO households
Outline

- Data and Research design
- Marginal Propensity to Borrow
- Marginal Propensity to Lend
  - Model
  - Estimates
Marginal Propensity to Lend

- **MPL**: Effect on CL of a 1 ppt permanent reduction in cost of funds
- Cannot estimate using event-study approach.
  - Changes to Fed Funds rate typically correlated with macro shocks that shift bank expectations

**Our approach**: Simple model of optimal CL that characterizes MPL with two sufficient statistics we can estimate directly.

- Tradeoff: To overcome identification challenge we require that:
  - Bank lending responds optimally to changes in cost of funds
  - We can measure banks’ incentives to lend
Margin of Adjustment

- Do not have empirically tractable models of imperfectly competitive selection markets with multi-dimensional screening

  ⇒ Need to focus on markets with clear primary dimension (e.g., Einav Jenkins and Levin, 2012; Einav Finkelstein and Cullen, 2010)

- Build on literature that shows CL, not interest rates, is primary margin of adjustment for credit card lending

  - Pass-through evidence (e.g., Ausubel 1991; Agarwal, Chomsisengphet, Mahoney, and Stroebel, 2015)

  - Reasons: Low price-elasticity, tacit collusion, adverse selection (Ausubel, 1991; Calem and Mester, 1995; Stavins, 1996, Stango, 2000; Parlour and Rajan, 2001)
MPL

• Simple model of optimal $CL$ for observably identical borrowers:
  • $q(CL)$ is quantity of borrowing
  • $F(CL)$ is fee revenue
  • $C(CL)$ is net chargeoffs
  • $r$ is exogenously determined interest rate
  • $c$ is cost of funds

Bank objective function:

$$\max q(CL) (r - c) + F(CL) - C(CL)$$

First order condition:

$$q'(CL) r + F'(CL) = MR(CL) = q'(CL) c + C'(CL)$$

$$\iff MP(CL) = 0$$
MPL

- Simple model of optimal $CL$ for observably identical borrowers:
  - $q(CL)$ is quantity of borrowing
  - $F(CL)$ is fee revenue
  - $C(CL)$ is net chargeoffs
  - $r$ is exogenously determined interest rate
  - $c$ is cost of funds

- Bank objective function:
  $$\max_{CL} q(CL)(r - c) + F(CL) - C(CL)$$

- First order condition:
  $$q'(CL)r + F'(CL) = q'(CL)c + C'(CL) \iff MP(CL) = 0$$
MPL

• Define MPL as \(-\frac{dCL}{dc}\)

• Applying implicit function theorem to FOC yields

\[
MPL = - \frac{MPB}{MR'(CL) - MC'(CL)} = - \frac{MPB}{MP'(CL)}
\]
MPL

- Define MPL as $-\frac{dCL}{dc}$

- Applying implicit function theorem to FOC yields
  
  $$MPL = -\frac{MPB}{MR'(CL) - MC'(CL)} = -\frac{MPB}{MP'(CL)}$$

![Graph 1](Credit Limit on x-axis, MPL on y-axis, showing MPL as the negative of the ratio of MPB to the difference of MR' and MC'.)

![Graph 2](Credit Limit on x-axis, MPL on y-axis, showing MPL as the negative of the ratio of MPB to the difference of MP' and CL'.)
MPL

- Define MPL as $-\frac{dCL}{dc}$

- Applying implicit function theorem to FOC yields:

$$MPL = - \frac{MPB}{MR'(CL) - MC'(CL)} = - \frac{MPB}{MP'(CL)}$$
Economics Behind $MC'(CL)$

1. Adverse selection (changing marginal borrower)
   - Larger increases in borrowing by households with higher default probability

2. Direct effect of higher credit limits (keeping marginal borrower fixed)
   - Strategic models: Increased debt brings households closer to bankruptcy threshold (Fay, Hurst and White, 2002)
   - Myopia: Excess borrowing bc households don’t internalize future default risk

$\Rightarrow$ Slope of MC parameterizes the importance of these (and other) factors for pass-through
   - Sufficient statistic (Chetty, 2009)
Estimating $MC'(CL)$

- Estimate $MC'(CL)$ using the same RDs with costs as outcome variable
  - Standard approach used in empirical insurance literature

- Each experiment delivers two moments:
  1. Marginal costs at prevailing credit limit
  2. Average costs per dollar of credit limit

⇒ Two moments allow us to identify two-parameter curve for marginal costs
Estimating $MC'(CL)$

- Parametric assumption: Linear marginal costs

- $MC(CL) = \alpha + \beta CL$

- $AC(CL) = \frac{1}{CL} \int_0^{CL} MC(CL) \, dCL = \alpha + \frac{1}{2} \beta CL$

- Slope is therefore

$$\beta = \frac{2(MC(CL) - AC(CL))}{CL}$$

- Steep slope: $MC(CL) \gg AC(CL)$

- No slope: $MC(CL) = AC(CL)$
Outline

- Data and Research design
- Marginal Propensity to Borrow
- **Marginal Propensity to Lend**
  - Model
  - Estimates
Marginal Chargeoffs, At 48 Months

The graph shows the relationship between cumulative chargeoffs at 48 months and position relative to FICO score cutoff. The x-axis represents the position relative to the FICO score cutoff, while the y-axis represents the cumulative chargeoffs at 48 months. The data points are connected by a dashed blue line, indicating a downward trend as the position relative to the FICO score cutoff decreases.
Marginal Chargeoffs at 48 Months

- ≤ 660
- 661-700
- 701-740
- >740
Impact of $1K CL Increase on Marginal Chargeoffs

Marginal Chargeoffs

≤ 660  661-700  701-740  >740
Marginal Profits at 48 Months
Impact of $1K CL Increase on Marginal Profits

Marginal Profit

$\leq 660$

$661-700$

$701-740$

$>740$
Marginal Propensity to Lend

- Response to permanent 1 percentage point reduction in cost of funds:

\[ MPL = - \frac{dCL}{dc} = - \frac{MPB}{MP'(CL)} \]

- FICO \( \leq 660 \): $239
- FICO > 740: $1,211

- Fairly stable across time horizons
MPL × MPB Takeaway

(a) MPL

(b) MPB Across All Accounts, 12 Months

- Suppose calculate effect as avg MPL across FICO × avg MPB across FICO

⇒ Accounting for correlation reduces effect by 49%
Contributions

1. Propose new framework to estimate strength of bank lending channel
   - Combine a simple model of lending with quasi-exogenous variation in contract terms to estimate sufficient statistics.
   - Overcomes time-series identification challenge.

2. Our approach to estimating MPL highlights importance of frictions such as asymmetric information in the bank-borrower interaction.
   - Complements literature that has focused on levels of bank capital.

3. Examine roles of credit supply vs. credit demand in constraining borrowing at the margin during the Great Recession.
   - Supply important for low FICOs, demand for high FICOs
   - Mismatch: Banks don’t want to lend to those that want to borrow.
   - Similar mismatch likely in other credit markets.
Conclusion
Focus of Program

**Bush:** "[TARP to] supply urgently needed money so banks and other financial institutions can avoid collapse and resume lending. [This rescue effort] will help American consumers and businesses get credit to meet their daily needs and create jobs."

**ECB:** Because the TLTROs will involve targeted lending, they will be tied to lending to euro-area non-financial corporations and households (excluding loans to households for house purchase).

The **Bank of England** and HM Treasury launched the Funding for Lending Scheme (FLS) in order to encourage lending to households and companies. The FLS offers funding to banks and building societies for an extended period. And it encourages them to supply more credit by making more and cheaper funding available if they lend more. Easier access to bank credit should boost consumption and investment by households and businesses.
FICO Score, Population Distribution

Back to experiments
### Summary Statistics, At Origination

<table>
<thead>
<tr>
<th>Credit Limit on Treated Card ($)</th>
<th>Average</th>
<th>S.D</th>
<th>Total Balances Across All Credit Card Accounts ($)</th>
<th>Average</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pooled</td>
<td>5,265</td>
<td>2,045</td>
<td>Pooled</td>
<td>9,551</td>
<td>3,469</td>
</tr>
<tr>
<td>(\leq 660)</td>
<td>2,561</td>
<td>674</td>
<td>(\leq 660)</td>
<td>5,524</td>
<td>2,324</td>
</tr>
<tr>
<td>661-700</td>
<td>4,324</td>
<td>1,090</td>
<td>661-700</td>
<td>9,956</td>
<td>2,680</td>
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<tr>
<td>701-740</td>
<td>4,830</td>
<td>1,615</td>
<td>701-740</td>
<td>10,890</td>
<td>3,328</td>
</tr>
<tr>
<td>(&gt; 740)</td>
<td>6,941</td>
<td>1,623</td>
<td>(&gt; 740)</td>
<td>9,710</td>
<td>3,326</td>
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</table>

<table>
<thead>
<tr>
<th>APR on Treated Card (%)</th>
<th>Average</th>
<th>S.D</th>
<th>Credit Limit Across All Credit Card Accounts ($)</th>
<th>Average</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pooled</td>
<td>15.38</td>
<td>3.70</td>
<td>Pooled</td>
<td>33,533</td>
<td>14,627</td>
</tr>
<tr>
<td>(\leq 660)</td>
<td>19.63</td>
<td>5.43</td>
<td>(\leq 660)</td>
<td>12,856</td>
<td>5,365</td>
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<tr>
<td>661-700</td>
<td>14.50</td>
<td>3.65</td>
<td>661-700</td>
<td>26,781</td>
<td>7,524</td>
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<tr>
<td>701-740</td>
<td>15.35</td>
<td>3.11</td>
<td>701-740</td>
<td>32,457</td>
<td>8,815</td>
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<tr>
<td>(&gt; 740)</td>
<td>14.70</td>
<td>2.52</td>
<td>(&gt; 740)</td>
<td>44,813</td>
<td>12,828</td>
</tr>
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</table>

Statistics calculated on quasi-experiment-level dataset.
### Summary Statistics, At Origination

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>S.D</th>
<th></th>
<th>Average</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Credit Card Accounts</strong></td>
<td></td>
<td></td>
<td><strong>Number Times 90+ DPD In Last 24 Months</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled</td>
<td>11.00</td>
<td>2.93</td>
<td>Pooled</td>
<td>0.17</td>
<td>0.30</td>
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<tr>
<td>≤660</td>
<td>7.13</td>
<td>1.18</td>
<td>≤660</td>
<td>0.93</td>
<td>0.31</td>
</tr>
<tr>
<td>661-700</td>
<td>10.22</td>
<td>1.68</td>
<td>661-700</td>
<td>0.41</td>
<td>0.16</td>
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<tr>
<td>701-740</td>
<td>11.12</td>
<td>2.34</td>
<td>701-740</td>
<td>0.29</td>
<td>0.10</td>
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<tr>
<td>&gt;740</td>
<td>12.63</td>
<td>2.92</td>
<td>&gt;740</td>
<td>0.13</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>Age Oldest Account (Months)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pooled</td>
<td>190.1</td>
<td>29.1</td>
<td>Pooled</td>
<td>0.03</td>
<td>0.03</td>
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<tr>
<td>≤660</td>
<td>162.0</td>
<td>26.3</td>
<td>≤660</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>661-700</td>
<td>180.1</td>
<td>19.9</td>
<td>661-700</td>
<td>0.02</td>
<td>0.02</td>
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<tr>
<td>701-740</td>
<td>184.7</td>
<td>24.0</td>
<td>701-740</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>&gt;740</td>
<td>208.6</td>
<td>25.7</td>
<td>&gt;740</td>
<td>0.01</td>
<td>0.01</td>
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Statistics calculated on quasi-experiment-level dataset.
Persistence of Credit Limits
### Persistence of Credit Limit Effect

<table>
<thead>
<tr>
<th>FICO</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>48</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤660</td>
<td>0.93</td>
<td>0.92</td>
<td>0.93</td>
<td>0.93</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>[0.91 , 0.96]</td>
<td>[0.87 , 0.96]</td>
<td>[0.87 , 0.99]</td>
<td>[0.83 , 1.03]</td>
<td>[0.83 , 1.17]</td>
</tr>
<tr>
<td>661-700</td>
<td>0.94</td>
<td>0.90</td>
<td>0.85</td>
<td>0.78</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>[0.92 , 0.95]</td>
<td>[0.87 , 0.92]</td>
<td>[0.81 , 0.88]</td>
<td>[0.7 , 0.85]</td>
<td>[0.66 , 0.93]</td>
</tr>
<tr>
<td>701-740</td>
<td>0.95</td>
<td>0.93</td>
<td>0.89</td>
<td>0.82</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>[0.94 , 0.97]</td>
<td>[0.9 , 0.95]</td>
<td>[0.85 , 0.91]</td>
<td>[0.75 , 0.88]</td>
<td>[0.68 , 0.91]</td>
</tr>
<tr>
<td>&gt;740</td>
<td>0.95</td>
<td>0.92</td>
<td>0.91</td>
<td>0.88</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>[0.94 , 0.96]</td>
<td>[0.9 , 0.94]</td>
<td>[0.87 , 0.93]</td>
<td>[0.81 , 0.94]</td>
<td>[0.82 , 1.12]</td>
</tr>
</tbody>
</table>

Back to distribution
## Validity of Research Design

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Limit</td>
<td>1,472</td>
<td>1,282</td>
<td>796</td>
<td>5,265</td>
</tr>
<tr>
<td>APR (%)</td>
<td>0.017</td>
<td>-0.005</td>
<td>0.388</td>
<td>15.38</td>
</tr>
<tr>
<td>Months to Rate Change</td>
<td>0.027</td>
<td>0.016</td>
<td>0.800</td>
<td>13.37</td>
</tr>
<tr>
<td>Number of Credit Card Accounts</td>
<td>0.060</td>
<td>0.031</td>
<td>0.713</td>
<td>11.00</td>
</tr>
<tr>
<td>Total Credit Limit - All Accounts</td>
<td>151</td>
<td>28</td>
<td>2,791</td>
<td>33,533</td>
</tr>
<tr>
<td>Age Oldest Account (Months)</td>
<td>1.034</td>
<td>0.378</td>
<td>11.072</td>
<td>190.11</td>
</tr>
<tr>
<td>Number Times 90+ DPD - Last 24 Months</td>
<td>0.010</td>
<td>0.002</td>
<td>0.111</td>
<td>0.169</td>
</tr>
<tr>
<td>Number Accounts 90+ DPD - At Origination</td>
<td>0.001</td>
<td>0.001</td>
<td>0.017</td>
<td>0.026</td>
</tr>
<tr>
<td>Number Accounts 90+DPD - Ever</td>
<td>0.004</td>
<td>0.003</td>
<td>0.095</td>
<td>0.245</td>
</tr>
<tr>
<td>Number of Accounts Originated</td>
<td>10.21</td>
<td>4.38</td>
<td>47.61</td>
<td>580.12</td>
</tr>
</tbody>
</table>

[Back to RD specification](#)
Details on Implementation

For each experiment, run second-order local polynomial regression.

\[
\min_{\alpha_y,D,\beta_y,D,\gamma_y,D} \sum_{i \in \mathbb{I}} \left[ y_i - \alpha_y,D - \beta_y,D (x_i - \bar{x}) - \gamma_y,D (x_i - \bar{x})^2 \right]^2 K \left( \frac{x_i - \bar{x}}{h} \right)
\]

Use triangular kernel: \( K \left( \frac{x_i - \bar{x}}{h} \right) \).

\[
\tau = \frac{\hat{\alpha}_{\text{Outcome},H} - \hat{\alpha}_{\text{Outcome},L}}{\hat{\alpha}_{\text{Credit Limit},H} - \hat{\alpha}_{\text{Credit Limit},L}}.
\]

Back to Research Design
# Summary Statistics, Post Origination

<table>
<thead>
<tr>
<th>FICO Score Group</th>
<th>Credit Limit ($)</th>
<th>Total Balances Across All Cards ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤660</td>
<td>661-700</td>
</tr>
<tr>
<td>After 12 Months</td>
<td>2,652</td>
<td>4,370</td>
</tr>
<tr>
<td>After 24 Months</td>
<td>2,414</td>
<td>4,306</td>
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<tr>
<td>After 36 Months</td>
<td>2,301</td>
<td>4,622</td>
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<td>After 48 Months</td>
<td>2,252</td>
<td>4,525</td>
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<tr>
<td>After 60 Months</td>
<td>2,290</td>
<td>4,449</td>
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<table>
<thead>
<tr>
<th>FICO Score Group</th>
<th>ADB ($)</th>
<th>Cumulative Purchase Volume ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤660</td>
<td>661-700</td>
</tr>
<tr>
<td>After 12 Months</td>
<td>1,260</td>
<td>2,160</td>
</tr>
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<td>After 24 Months</td>
<td>1,065</td>
<td>1,794</td>
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<td>After 36 Months</td>
<td>1,164</td>
<td>1,734</td>
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<td>After 48 Months</td>
<td>1,079</td>
<td>1,501</td>
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<tr>
<td>After 60 Months</td>
<td>1,050</td>
<td>1,465</td>
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</table>
• Own-card effect due to additional spending, not slower pay-down of debt.

• BUT: Do not have good measure of total spending ...
<table>
<thead>
<tr>
<th>FICO</th>
<th>Months After Account Origination</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>48</th>
<th>60</th>
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<tbody>
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<td></td>
<td>0.56</td>
<td>0.78</td>
<td>0.94</td>
<td>0.98</td>
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<td></td>
<td></td>
<td>[0.49, 0.66]</td>
<td>[0.64, 0.95]</td>
<td>[0.75, 1.14]</td>
<td>[0.78, 1.2]</td>
<td>[0.79, 1.21]</td>
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<td>0.35</td>
<td>0.52</td>
<td>0.58</td>
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<tr>
<td></td>
<td></td>
<td>[0.31, 0.4]</td>
<td>[0.45, 0.6]</td>
<td>[0.49, 0.68]</td>
<td>[0.5, 0.7]</td>
<td>[0.51, 0.73]</td>
</tr>
<tr>
<td>701-740</td>
<td></td>
<td>0.33</td>
<td>0.47</td>
<td>0.56</td>
<td>0.60</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.28, 0.38]</td>
<td>[0.4, 0.54]</td>
<td>[0.46, 0.63]</td>
<td>[0.5, 0.68]</td>
<td>[0.5, 0.7]</td>
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<tr>
<td>&gt;740</td>
<td></td>
<td>0.22</td>
<td>0.31</td>
<td>0.36</td>
<td>0.40</td>
<td>0.44</td>
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<td></td>
<td>[0.19, 0.26]</td>
<td>[0.25, 0.37]</td>
<td>[0.27, 0.44]</td>
<td>[0.32, 0.49]</td>
<td>[0.34, 0.54]</td>
</tr>
</tbody>
</table>

**Panel C: Cumulative Purchase Volume**

*Back to MPB*
Credit Limits and Cost of Funds in Time Series

(a) FICO ≤ 620
(b) 621 - 660
(c) 661-720
(d) 721-760
(e) 762-800
(f) FICO > 800
## Summary Statistics, Post Origination

<table>
<thead>
<tr>
<th>FICO Score Group</th>
<th>≤660</th>
<th>661-700</th>
<th>701-740</th>
<th>&gt;740</th>
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<tbody>
<tr>
<td><strong>Cumulative Total Costs ($)</strong></td>
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<tr>
<td>After 12 Months</td>
<td>122</td>
<td>172</td>
<td>169</td>
<td>147</td>
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<tr>
<td>After 24 Months</td>
<td>281</td>
<td>451</td>
<td>433</td>
<td>304</td>
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<tr>
<td>After 36 Months</td>
<td>459</td>
<td>710</td>
<td>644</td>
<td>395</td>
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<td>After 48 Months</td>
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<td>845</td>
<td>808</td>
<td>488</td>
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<tr>
<td><strong>Cumulative Total Revenue ($)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 12 Months</td>
<td>233</td>
<td>192</td>
<td>181</td>
<td>175</td>
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<tr>
<td>After 24 Months</td>
<td>474</td>
<td>503</td>
<td>439</td>
<td>347</td>
</tr>
<tr>
<td>After 36 Months</td>
<td>740</td>
<td>793</td>
<td>663</td>
<td>449</td>
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<td>After 48 Months</td>
<td>953</td>
<td>971</td>
<td>863</td>
<td>563</td>
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<tr>
<td><strong>Cumulative Chargeoffs ($)</strong></td>
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<td>After 12 Months</td>
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<td>After 48 Months</td>
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<tr>
<td><strong>Cumulative Interest Charge Revenue ($)</strong></td>
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<td>52</td>
<td>42</td>
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<td>After 24 Months</td>
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<td>295</td>
<td>243</td>
<td>159</td>
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<tr>
<td>After 36 Months</td>
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<td>520</td>
<td>420</td>
<td>243</td>
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<tr>
<td>After 48 Months</td>
<td>625</td>
<td>669</td>
<td>578</td>
<td>340</td>
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<td><strong>Cumulative Prob 60+ DPD ($)</strong></td>
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<td>6.4%</td>
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<td>12.0%</td>
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<tr>
<td>After 36 Months</td>
<td>15.1%</td>
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<td>After 48 Months</td>
<td>16.5%</td>
<td>13.6%</td>
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<td><strong>Cumulative Fee Revenue ($)</strong></td>
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<td>After 24 Months</td>
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<td>129</td>
<td>121</td>
<td>101</td>
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<tr>
<td>After 36 Months</td>
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<td>116</td>
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<td>After 48 Months</td>
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<td>187</td>
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<td><strong>Cumulative Cost of Funds ($)</strong></td>
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<td>31</td>
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<td><strong>Cumulative Profits ($)</strong></td>
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<td>46</td>
</tr>
<tr>
<td>After 36 Months</td>
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<tr>
<td>After 48 Months</td>
<td>365</td>
<td>126</td>
<td>55</td>
<td>75</td>
</tr>
</tbody>
</table>
MPL at 12 to 48 Month Time Horizons

Change in Credit Limits (Log Scale)

- ≤ 660
- 661-700
- 701-740
- >740

Back to MPL