The Relationship Dilemma: Why Do Banks Differ in the Pace at Which They Adopt New Technology?

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The views expressed above are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.
Credit Scores in Retail Lending

- Introduced in India in 2007

- Inquiring for credit scores is a clear marker of technology adoption

- Study 2 main types of banks, accounting for over 90% of banking sector assets:
  - Public sector banks (PSBs) – except for State Bank of India, nationalized in two waves in 1969 and 1980 to promote inclusion
  - New private banks (NPBs) – typically set up post liberalization in 1990-91

- Have very different adoption patterns for inquiring from Bureau.

- Perhaps more remarkably, two types of loan applicants with different inquiry patterns
  - Prior clients
  - New customers
The puzzle in two pictures
Difference in Bureau Usage across bank types

Bureau Usage

- NPB
- PSB

But Difference Primarily for Prior Relationship Applicants
Findings

• Slow adoption of technology by PSBs
  – Primarily for borrowers with prior borrowing relationships from the bank
  – Reluctance to inquire fading over time

• Policy of requiring inquiries is valuable.
  – Associated with lower ex post delinquencies
  – Interviews suggest interest rates charged do not compensate

• Counterfactual
  • What if PSBs inquired more?
  • We obtain the scores they would have seen
  • Under a variety of plausible policy functions for using the score data, delinquency rates would be significantly lower.
• Establish the facts.
• Rule out the obvious suspects
  – Technology aversion? No.
    • New applicants vs prior relationships
  – Ownership? No.
    • OPBs of similar vintage as PSBs but private
• Offer a hypothesis why
  – Regulation in pre-liberalization era and resulting bank structures
  – Timing of entry and formation of managerial practices
• The legacy effects of past management practices as an impediment to development
Filtered applications $\equiv$ \# [inquiries] + \# un-inquired loans

Bureau Usage $\equiv$ \# inquiries/#filtered applications

Prior relation $= 1$ If the borrower associated with the loan/inquiry had at least one prior loan with the same bank since 2006
Master Data Files

- Transunion CIBIL

- Inquiry file: FID, bank, date

- Trade file: FID, bank, date, amount, product
  - Inquired: loan preceded by inquiry in [L, L-180]

- Delinquency file
  - LQ360 = 1 if DPD > 90 in [L, L+360]

- Point in time credit score for loans

- Geography indicators
  - Tiers

- 1,854 institutions, 255 million people, 472 million records
1% Working Sample

• 4.3 million “Filtered Applications”

• 3 million loans for INR 896 million ($14 billion)
  – No inquiry 2.3 million loans, INR 455 million
  – Inquiry 0.7 million loans, INR 441 million
  – Inquiry rate 23% (#), 51% (amount)

• We have two sub-samples
  – Sample with delinquency rates and scores: 2013 and 2014
    • Delinquency 2012-2014
    • Scores 2013-2015
<table>
<thead>
<tr>
<th>Year</th>
<th># Filtered Application</th>
<th># Inquiries</th>
<th># Loans No Inq</th>
<th># Loans Inq</th>
<th>Amount Total (INR bn)</th>
<th>Amount No Inq (INR bn)</th>
<th>Amount Inq (INR bn)</th>
<th>Bureau Usage</th>
<th>% Loans Inq</th>
<th>% Amt Inq</th>
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<tbody>
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<td>2006</td>
<td>190,264</td>
<td>17,382</td>
<td>172,882</td>
<td>5,150</td>
<td>38.9</td>
<td>35.9</td>
<td>3.0</td>
<td>9.1%</td>
<td>2.9%</td>
<td>7.6%</td>
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<td>2007</td>
<td>262,929</td>
<td>89,557</td>
<td>173,372</td>
<td>21,403</td>
<td>43.1</td>
<td>33.2</td>
<td>9.8</td>
<td>34.1%</td>
<td>11.0%</td>
<td>22.8%</td>
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<tr>
<td>2008</td>
<td>351,470</td>
<td>210,844</td>
<td>140,626</td>
<td>44,127</td>
<td>49.2</td>
<td>30.8</td>
<td>18.4</td>
<td>60.0%</td>
<td>23.9%</td>
<td>37.3%</td>
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<tr>
<td>2009</td>
<td>292,356</td>
<td>168,980</td>
<td>123,376</td>
<td>32,673</td>
<td>43.8</td>
<td>29.0</td>
<td>14.8</td>
<td>57.8%</td>
<td>20.9%</td>
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<td>2010</td>
<td>273,642</td>
<td>122,321</td>
<td>151,321</td>
<td>33,250</td>
<td>61.5</td>
<td>36.4</td>
<td>25.2</td>
<td>44.7%</td>
<td>18.0%</td>
<td>40.9%</td>
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<td>2011</td>
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<td>157,033</td>
<td>188,162</td>
<td>51,403</td>
<td>94.7</td>
<td>55.4</td>
<td>39.3</td>
<td>45.5%</td>
<td>21.5%</td>
<td>41.5%</td>
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<tr>
<td>2012</td>
<td>457,643</td>
<td>203,545</td>
<td>254,098</td>
<td>80,227</td>
<td>105.1</td>
<td>51.0</td>
<td>54.1</td>
<td>44.5%</td>
<td>24.0%</td>
<td>51.5%</td>
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<tr>
<td>2013</td>
<td>593,863</td>
<td>271,330</td>
<td>322,533</td>
<td>101,746</td>
<td>133.3</td>
<td>59.4</td>
<td>73.8</td>
<td>45.7%</td>
<td>24.0%</td>
<td>55.4%</td>
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<tr>
<td>2014</td>
<td>712,092</td>
<td>351,892</td>
<td>360,200</td>
<td>131,576</td>
<td>148.7</td>
<td>60.8</td>
<td>87.9</td>
<td>49.4%</td>
<td>26.8%</td>
<td>59.1%</td>
</tr>
<tr>
<td>2015</td>
<td>850,010</td>
<td>448,434</td>
<td>401,576</td>
<td>177,439</td>
<td>177.7</td>
<td>63.1</td>
<td>114.6</td>
<td>52.8%</td>
<td>30.6%</td>
<td>64.5%</td>
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<tr>
<td>Total</td>
<td>4,329,464</td>
<td>2,041,318</td>
<td>2,288,146</td>
<td>678,994</td>
<td>896.0</td>
<td>455.2</td>
<td>440.8</td>
<td>47.2%</td>
<td>22.9%</td>
<td>49.2%</td>
</tr>
</tbody>
</table>
Wide Variation in Bureau Usage across bank types

In % of filtered app

Bureau Usage (All loan types)

- PSBs
- NPBs

Why Large Difference in Technology Adoption?

I. Different kind of loans by PSBs
   ➢ Yes, but difference even after excluding gold + PSL
I. Wide Gap after Excluding Gold + PSL
Why Large Difference in Technology Adoption?

I. Different kind of loans by PSBs
   ➢ Yes, but difference even after excluding gold + PSL

II. Technology aversion?
   ➢ Gap driven by past relationships. No gap for new loans
No gap for new applicants

Bureau Usage By Applicants

Year


Bureau Usage

0.00% 20.00% 40.00% 60.00% 80.00% 100.00%

PSB New Applicants
NPB New Applicants
PSB Prior Relationship Applicants
NPB Prior Relationship Applicants
Why Large Difference in Technology Adoption?

I. Different kind of loans by PSBs
   - Yes, but difference even after excluding gold + PSL

II. Prior relationships of PSBs
   - Gap driven by past relationships. No gap for new loans

III. Non-availability of credit scores
   - Inquiry gap, even for scored population
III. Non-availability of Credit Scores? No, gap even for scored

Bureau Usage for Prior Relationships by Score

- ≤ 650
- 650-750
- ≥ 750
- All Scores
- No Score
- Total

PSB | NPB
Why Large Difference in Technology Adoption?

I. Different kind of loans by PSBs
   ➢ Yes, but difference even after excluding gold + PSL

II. Prior relationships of PSBs
    ➢ Gap driven by past relationships. No gap for new loans

III. Non-availability of credit scores
    ➢ Inquiry gap, even for scored population

IV. PSBs generally more aggressive in lending
    ➢ No. Conditional on inquiry and score, seem less willing to grant credit.
They are more conservative lending to new applicants.
Are PSBs more aggressive lenders to inquired prior borrowers? No, except when no score.
But they inquire prior borrowers less, so…

Loan per filtered application for prior borrowers

- ≤ 650
- 650-750
- ≥ 750
- All Scores
- No Score
- Total
Why Large Difference in Technology Adoption?

I. Different kind of loans by PSBs
   - Yes, but difference even after excluding gold + PSL

II. Prior relationships of PSBs
    - Gap driven by past relationships. No gap for new loans

III. Non-availability of credit scores
    - Inquiry gap, even for scored population

IV. PSBs generally more aggressive in lending
    - No. Conditional on inquiry and score, seem less willing to grant credit.

V. PSBs charge more to prior borrowers.
   - No. Interviews suggest loan officers do not have much leeway over pricing.
Inquiries Associated with Lower Delinquency

PSBs have relatively low delinquency conditional on inquiry and non-inquiry.

But have low inquiry so overall default rate is higher.
Inquiry reduces delinquency rates even for unscored except...

Inquiry associated with substantially lower delinquency rates for all unscored except PSB prior applicants
Why inquiry may affect loan outcomes?

1. “Hard” inquiry information disciplines loan officer
   - PSBs are more conservative in lending than NPBs on inquiry except for unscored prior borrower
2. Inquiry signals due diligence by bank
   - Even for unscored, inquiries lower default
   - Act of inquiry indicates loan officer due diligence
3. Adds credit information about borrower – HARD TO ESTABLISH
   - High scores ↓ Delinquency rate
   - Inquiry (bank + borrower information) ↓ DR
   - But banks may already have the information
What is going on? State Ownership?

• 14 Old Private Banks
  – Formed at same time as PSBs, median age 89 years (87 and 21 for PSBs and NPBs respectively),
  – Smaller than PSBs (too small to be nationalized)
  – Privately owned like NPBs

• Do OPBs behave like PSBs or NPBs?
  – If NPB, perhaps ownership drives adoption
  – If PSB, ownership and size do not drive adoption
OPBs similar to PSBs: Prior relationships

In % of filtered apps

Bureau Usage


OPBs  NPBs  PSBs
What is going on? Hysteresis

II. Legacy of past regulation and different entry dates?

- Past pro-inclusion regulation
  - Branching requirements in 1970s and 1980s mandated many rural branches
  - More informality, less “hard” information in rural areas even today
  - Optimal to offer loan officers more discretion (Stein (2002))
  - Hard to fine tune discretion – share of rural business affects overall bank-wide policy on discretion
- NPBs entered when branching requirements were diluted and ICT was stronger, so need for discretion much diminished.
What is going on? Hysteresis contd.

- Organization structures and management practices have staying power
- Implications
  - More rural-focused banks should allow loan officers more discretion (less mandated inquiry)
  - This policy should be especially pronounced in older banks like PSBs and OPBs
The Reserve Bank of India (RBI) classifies each locality as belonging to one of six “tiers” based on population in 2001.

- Tier 1 includes the most populous metropolitan areas (towns greater than 100,000 people).
- Tier 6 includes the least populous rural areas (less than 5000 people).
- We define Tier 1 and Tier 2 as urbanized and Tier 3-Tier 6 as non-urbanized.
- Using the credit bureau mapping of individuals to the tiers they reside in, we measure a bank’s non-urban focus as the share of the bank's total loans to Tier 3-6 borrowers in 2012.
Banks with more rural branches have more borrowers in Tier 3-6
Less formal data on non-urban borrowers

Fraction of filtered applications that are unscored by tier

- Tier 1: 30
- Tier 2: 40
- Tier 3: 50
- Tier 4: 60
- Tier 5: 70
- Tier 6: 80
Non-urban facing banks inquire prior relationships less.
Older banks inquire less

Share past relationships inquired and bank age

- Blue for PSB
- Red for NPB
- Green for OPBs

Bank age (in years) vs. Share past relationships inquired
More rural facing NPBs inquire less even in urban areas

Bureau usage: Bank wide vs location NPB, Prior relationship borrowers

SH-NON-URB-LNS LOW

SH-NON-URB-LNS HIGH

<table>
<thead>
<tr>
<th>TIERS 3-6</th>
<th>TIERS 1-2</th>
<th>TIERS 3-6</th>
<th>TIERS 1-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>2014</td>
<td>2013</td>
<td>2014</td>
</tr>
</tbody>
</table>
More urban facing PSBs inquire more even in rural areas

Bureau usage: Bank wide vs location
PSB, Prior relationship borrowers

SH-NON-URB-LNS LOW

SH-NON-URB-LNS HIGH

TIERS 3-6
TIERS 1-2
TIERS 3-6
TIERS 1-2

2013  2014
Possible implication

• The more non-urban facing a bank, the more it allows discretion as a policy to its loan officers.
• This policy may have been more pronounced in the pre-ICT years, so it particularly impacts PSB/OPBs because
  – Hysteresis in structure
  – Hysteresis in policy
• Loan officers use this discretion more for prior relation borrowers.
  – Discuss reasons shortly
• PSBOPB indicator and SH-NON-URB-LNS are proxies for the policy of allowing discretion.
### Table 8 Dependent variable: Inquiry = 1

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>PSBOPB</td>
<td>-0.0860***</td>
<td>-0.0952***</td>
<td></td>
<td></td>
<td>-0.0653***</td>
<td>-0.0975***</td>
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<tr>
<td></td>
<td>(0.005)</td>
<td>(0.006)</td>
<td></td>
<td></td>
<td>(0.008)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>PRIOREL</td>
<td>-0.0047***</td>
<td>0.0659***</td>
<td>-0.2824***</td>
<td>0.1459***</td>
<td>0.0362**</td>
<td>-0.1821***</td>
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<tr>
<td></td>
<td>(0.002)</td>
<td>(0.004)</td>
<td>(0.014)</td>
<td>(0.015)</td>
<td>(0.017)</td>
<td>(0.019)</td>
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<tr>
<td>PRIOREL*PSBOPB</td>
<td>-0.3175***</td>
<td>-0.3537***</td>
<td></td>
<td></td>
<td>-0.2727***</td>
<td>0.0263</td>
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<tr>
<td></td>
<td>(0.003)</td>
<td>(0.006)</td>
<td></td>
<td></td>
<td>(0.011)</td>
<td>(0.022)</td>
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<tr>
<td>SH-NON-URB-LNS</td>
<td></td>
<td></td>
<td>-0.4012***</td>
<td>-0.4767***</td>
<td>-0.4117***</td>
<td>-0.4543***</td>
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<td>(0.012)</td>
<td>(0.015)</td>
<td>(0.022)</td>
<td>(0.024)</td>
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<tr>
<td>PRIOREL* SH-NON-URB-LNS</td>
<td></td>
<td></td>
<td>0.2106***</td>
<td>-0.7414***</td>
<td>-0.0907**</td>
<td>0.5058***</td>
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<td></td>
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<td>(0.025)</td>
<td>(0.030)</td>
<td>(0.046)</td>
<td>(0.052)</td>
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<tr>
<td>SH-NON-URB-LNS* PSBOPB</td>
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<td>0.0671***</td>
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<td>(0.020)</td>
</tr>
<tr>
<td>SH-NON-URB-LNS* PSBOPB * PRIOREL</td>
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<td></td>
<td></td>
<td></td>
<td>-0.7449***</td>
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</table>
Why do loan officers favor prior clients?

• Corruption
  – But why not squeeze new clients
  – Maybe need to be certain that client will not squeal to bosses
  – Perhaps a short prior relationship will indicate the nature of the client?

• Social relationship
  – Longer prior relationships should be associated with more exercise of favorable discretion

• Better information (or hubris)
  – Policy of allowing discretion should lead to better decisions (or worse ones)
## Corruption and/or social relationships

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard Error</th>
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<td>PSBOPB</td>
<td>-0.1477***</td>
<td>(0.006)</td>
</tr>
<tr>
<td>LONGREL</td>
<td>-0.0089*</td>
<td>(0.005)</td>
</tr>
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<td>LONGREL*PSBOPB</td>
<td>-0.3421***</td>
<td>(0.007)</td>
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<td>SHORTREL</td>
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<tr>
<td>SHORTREL*PSBOPB</td>
<td>-0.1168***</td>
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</table>
Does the exercise of discretion lead to better decisions?

- Treat “Inquiry” regression as first stage, where PSBO PB or SHR-Non-Urb-Lns and their interactions are instruments for a bank-wide policy of discretion.

- Examine how instrumented inquiry affects delinquency in second stage.
  - More instrumented inquiry leads to lower delinquencies implies allowing discretion (which implies less inquiry) does not improve loan decisions.
  - Primarily because loan officer has little discretion on interest rates charged.
### Dependent variable =1 if loan delinquent

<table>
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<tr>
<th>VARIABLES</th>
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<th>Specification (2)</th>
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<tr>
<td></td>
<td>First stage</td>
<td>Second Stage</td>
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<tr>
<td>Inquired</td>
<td></td>
<td>-0.0143***</td>
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<tr>
<td></td>
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<td>PSBOPB * PRIOREL</td>
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<td>PRIOREL * SH-NON-URB-LNS</td>
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<td></td>
</tr>
<tr>
<td>SH-NON-URB-LNS</td>
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</tbody>
</table>
In sum
Explaining Slow Adoption

- Not state ownership
- Favored explanation is
  - Past regulation forcing more rural-oriented structures
  - With communications between head office and branch difficult and hard data sparse, allowing discretion was optimal then for rural branches.
- Bank wide policy driven by extent of rural facing.
- Structures persisted
- Policies of discretion persisted
- Uns suited for today where hard information more available => Delinquencies significantly higher when discretion allowed
- But policies they are a changing
Simple (and heroic) bank level partial correlations supports the broad story

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction of FA from Prior Relationships inquired, Drop Outlier Bank</td>
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<td></td>
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<tr>
<td>PSB</td>
<td>-0.2585*</td>
<td>0.0024</td>
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<tr>
<td></td>
<td>(0.140)</td>
<td>(0.125)</td>
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<tr>
<td>OPB</td>
<td>-0.3253**</td>
<td>-0.1297</td>
</tr>
<tr>
<td></td>
<td>(0.159)</td>
<td>(0.136)</td>
</tr>
<tr>
<td>LOG BANK AGE</td>
<td>-0.0891</td>
<td>-0.1105**</td>
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<tr>
<td></td>
<td>(0.060)</td>
<td>(0.049)</td>
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<td>BIG BANK</td>
<td>0.0772</td>
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<td></td>
<td>(0.095)</td>
<td>(0.094)</td>
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<td>HIGH ROA BANK</td>
<td>0.1372</td>
<td>0.1913**</td>
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<td></td>
<td>(0.110)</td>
<td>(0.091)</td>
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<td>SH-NON-URB-LNS</td>
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<td>-0.5831**</td>
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<td>(0.227)</td>
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<td>CONSTANT</td>
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<td></td>
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<td>(0.200)</td>
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<tr>
<td># Observations</td>
<td>44</td>
<td>44</td>
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<tr>
<td>Adjusted R²</td>
<td>0.399</td>
<td>0.487</td>
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</tbody>
</table>
Related work

- **Management practices** (Bloom et. al. 2007; Cole et al, 2016)
  - Non-adoption causes lower productivity in emerging market firms
  - We offer evidence across organizations with different structures and experiences
  - Suggestions why adoption is slow

- **Innovation** (Solow, 1956, Aghion and Howitt, 1992, Romer, 1990)
  - Adoption not IP generation is the major source of growth.
  - We offer evidence on the determinants of adoption and its outcomes.

- **State-owned enterprises**
  - La Porta et al 2002; Sapienza, 2004; Khwaja and Mian, 2005
  - Non-political channel for inefficiency – based on the nature of work assigned state owned firms
  - OPBs are “innocent’ participants

- **Organizational culture** Grennan 2017; Grennan et. al. (2017).

- **Credit bureaus** Jimenez et. al. 2012, 2014; Baskaya et. al. 2017
Conclusion

• We study data from a major credit bureau in India – 1% sample drawn from 472 million loan records.

• Adoption of credit scoring by banks

• Slower uptake of scoring technology by PSBs – Only when borrower has prior relationship

• Inquiries associated with lower delinquencies

• Potential explanation in past practices of the two types of organizations

• Takeaway: Organizational experiences affect current behavior including technology adoption.
Thank you!

Questions?