The Relationship Dilemma: Organizational Culture And The Adoption Of New Technology By Banks In India

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Views are personal.
Not necessarily those of CAFRAL, RBI, or the IMF

Early version. Please do not circulate.

Credit Scores in Retail Lending

- Introduced in India in 2007

- Use of credit scores is a clear marker of technology adoption

- 2 types of banks with very different adoption patterns
  - Public sector banks (PSBs)
  - New private banks (NPBs)

- Perhaps more remarkably, two types of _borrowers_ with different adoption patterns
  - Current clients
  - New customers

In a picture and 3 Slides

Picture

Bureau Usage
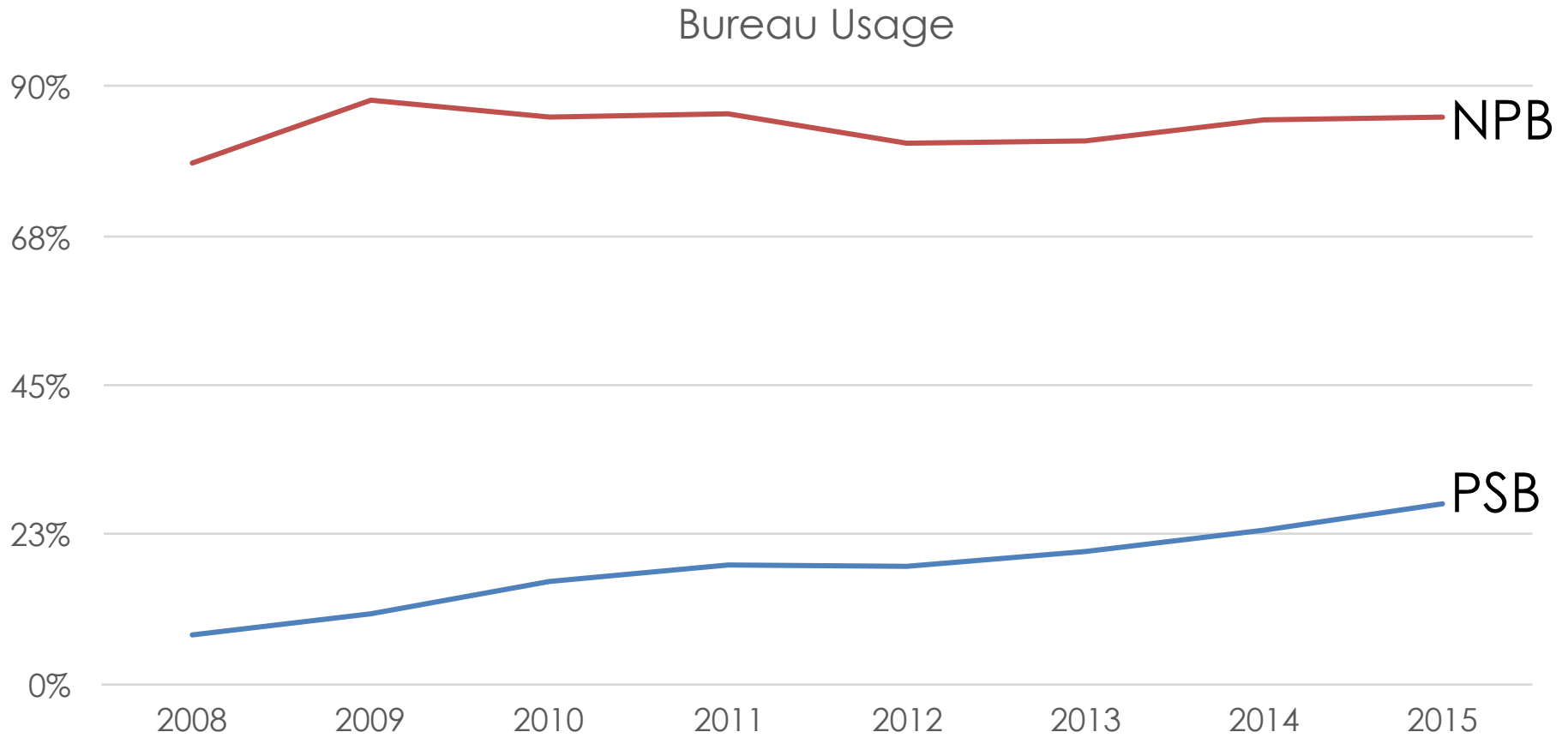
Findings

- Slow adoption of technology by PSBs
  - Only for borrowers with prior lending relationships
  - Reluctance to inquire fading over time

- Inquiries are useful.
  - Associated with lower ex post delinquencies

- 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 lower.

Interpretation

- Is slow adoption due to technology aversion? No.
  - No, new relationships show full adoption at inception
  - Nor is it size, capitalization, etc.

- Is adoption slow because PSBs find external information useless? No
  - Inquiries are effectively free, why not always inquire?
  - U-shaped pattern: inquire <u>less</u> when inside information is ambiguous
  - Counterfactuals suggest that information is left on table

- Why the slow adoption, inward orientation, for current customers?
  - Not ownership. OPBs of similar vintage as PSBs but private = PSBs
  - Perhaps culture shaped by commonality in formative experiences

- Competition and learning induce an outward orientation, organizational openness towards the market.

Broader Relevance

- A study of the adoption of technology
  - Technical progress drives growth
  - Generation of innovation episodic
  - Adoption drives progress

- Our study fills in a gap
  - Clear marker of adoption.
  - Micro data: some decisions with adoption, others without.
  - Clear measure of outcomes — delinquency.
  - Estimate consequences of non-adoption

- (Non)-adoption of modern management practices in emerging markets
  - Driver of low productivity in firms in emerging markets
  - Demonstrate an instance, in services industry

- Study of process — rather than product — innovation for organizations

Outline

- Related work

- Data

- Empirical results

- Discussion of findings

- Conclusions

Technology Adoption

- Innovation drives technological progress and growth
  - Generation of new innovation versus adoption
  - <u>Adoption</u> is key driver of technological progress
  - Useful to understand adoption and its drivers
  - Well developed literature on these issues: Solow 1956; Chari and Hopenhayn 1991; Romer 1990; Aghion and Howitt 1992.

- We fill in key gaps in technology adoption literature
  - We look at <u>organizational</u> adoption
  - Granular data on adoption
    - Outcomes of each decision to adopt or not
    - Similar-stage decisions in life cycle
  - Organizational traits explaining non-adoption
 - <u>Process</u> adoption analog of innovator's dilemma

Other Work

- State-owned banks (La Porta et al 2002)
  - Weak to negative association with growth
  - Typically explained by political channel (Sapienza, 2004; Khwaja and Mian, 2005)
  - We offer a channel that does not rely on political intervention

- Management practices (Bloom et al 2007)
  - Firms in emerging markets have low productivity
  - Non-adoption of modern practices explains the gap
  - We agree, illustrate the point, and begin to ask why: stickiness of culture and legacy processes

Other Work

- Organizational culture hard to measure but seems to be key driver of value in surveys (Harvey et al, 2017)

- Credit bureau literature (Jimenez et al., 2012, 2014)
  - Work addresses macro issues, e.g., transmission
  - We use bureaus to better understand lending practices, at micro level.
  - We spotlight loans made without inquiry, a new supply channel.

Definitions
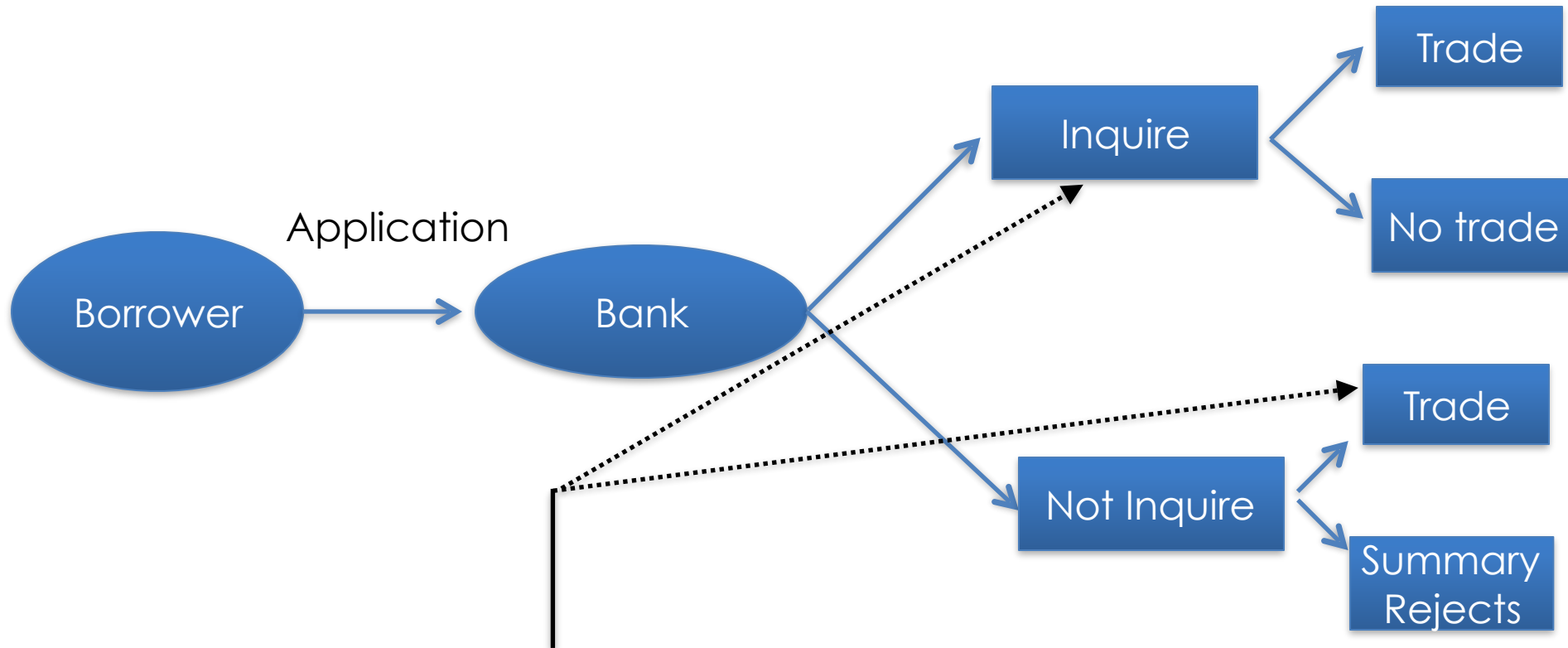
Filtered applications ≡ # [inquiries] + # un-inquired loans

Bureau Usage ≡ # inquiries/#filtered applications

Master Data Files

- Transunion CIBIL

- Inquiry file: FID, bank, date, risk-management or lending

- Trade file: FID, 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 in 2013 and 2014

- 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 77% (#), 51% (amount)

- We have two sub-samples
  - Descriptive sample: 2006-2015.
  - Sample with scores: 2013 and 2014

India
Banks, Credit Bureaus, and Consumer Credit

India's Banking System

- National market that has been tightly regulated. Entry is rare
  - The result is a small number of banks with national franchises

- 26 state-owned banks (PSBs)
  - These are formerly private, nationalized in 1969 and 1980
  - Median age = 87 years
  - PSBs have 71% market share

- 7 new private banks (NPBs)
  - These are modern entities licensed after 1991 liberalization
  - Median age = 21 years
  - NPBs have 22% market share

- Old Private Banks (OPBs)
  - OPBs are like NPBs [privately owned]
  - OPBs are like PSBs [median age = 89 years], similar formative experiences but not nationalized
  - OPBs are potentially interesting hold out sample.

- Foreign banks have 1-2% shares, mostly branches in large metropolitan areas. We exclude them

Credit Bureaus

- Credit bureaus are new to India, enabled in 2007
  - They face many ground level challenges: KYC, exclusion

- Bureaus are governed by CICRA, 2005
  - Banks must submit data on loans and repayments
  - Banks are not required to use bureaus in lending

- Current industry
  - 4 bureaus, subs of U.S. and European entities
  - Compile lending and repayment data
  - Inquiry costs are nominal, US$ 0.15-0.30 per inquiry
  - Bureaus return a score returned if they find a match.

India's Consumer Credit Market

- India is a $2 trillion+ economy
  - A booming consumer credit market

- RBI data on consumer loans
  - 2006: 65 million loans for INR 5.27 trillion
  - 2015: 106 million loans for INR 11.4 trillion

- Financial exclusion has been high
  - PMJDY program in 2014 opened 300 million new bank accounts

- In our 1% bureau sample
  - 2006: 178,032 loans, INR 38.87 billion
  - 2015: 579,000 loans, INR 177 billion
  - CAGR = 15.2% #, 20% INR
  - More borrowers, better bureau coverage

Data

Inquiries and loans: All loan types

Year	# Filtered Application	# Inquiries	# Loans No Inq	# Loans Inq	Amount Total (INR bn)	Amount No Inq (INR bn)	Amount Inq (INR bn)	Bureau Usage	% Loans Inq	% Amt Inq
2006	190,264	17,382	172,882	5,150	38.9	35.9	3.0	9.1%	2.9%	7.6%
2007	262,929	89,557	173,372	21,403	43.1	33.2	9.8	34.1%	11.0%	22.8%
2008	351,470	210,844	140,626	44,127	49.2	30.8	18.4	60.0%	23.9%	37.3%
2009	292,356	168,980	123,376	32,673	43.8	29.0	14.8	57.8%	20.9%	33.7%
2010	273,642	122,321	151,321	33,250	61.5	36.4	25.2	44.7%	18.0%	40.9%
2011	345,195	157,033	188,162	51,403	94.7	55.4	39.3	45.5%	21.5%	41.5%
2012	457,643	203,545	254,098	80,227	105.1	51.0	54.1	44.5%	24.0%	51.5%
2013	593,863	271,330	322,533	101,746	133.3	59.4	73.8	45.7%	24.0%	55.4%
2014	712,092	351,892	360,200	131,576	148.7	60.8	87.9	49.4%	26.8%	59.1%
2015	850,010	448,434	401,576	177,439	177.7	63.1	114.6	52.8%	30.6%	64.5%
Total	4,329,464	2,041,318	2,288,146	678,994	896.0	455.2	440.8	47.2%	22.9%	49.2%

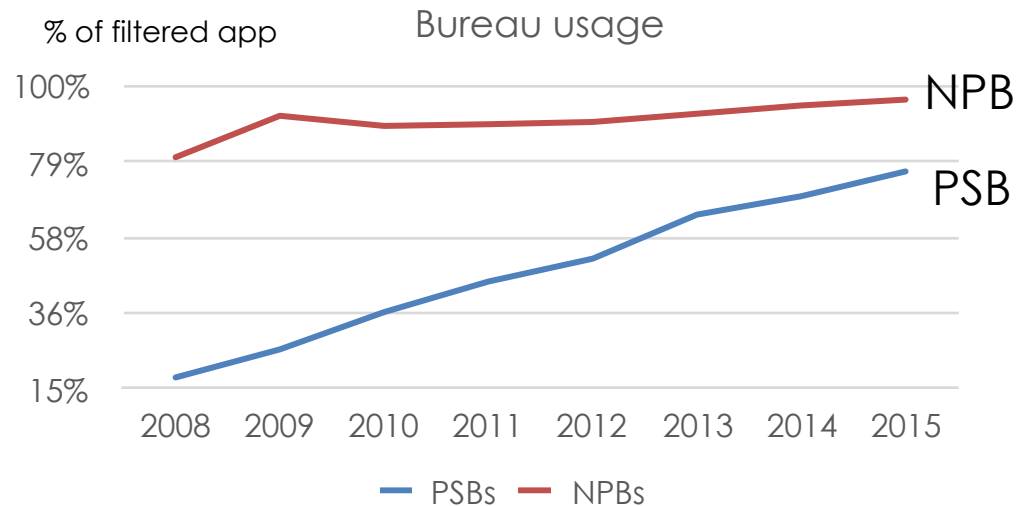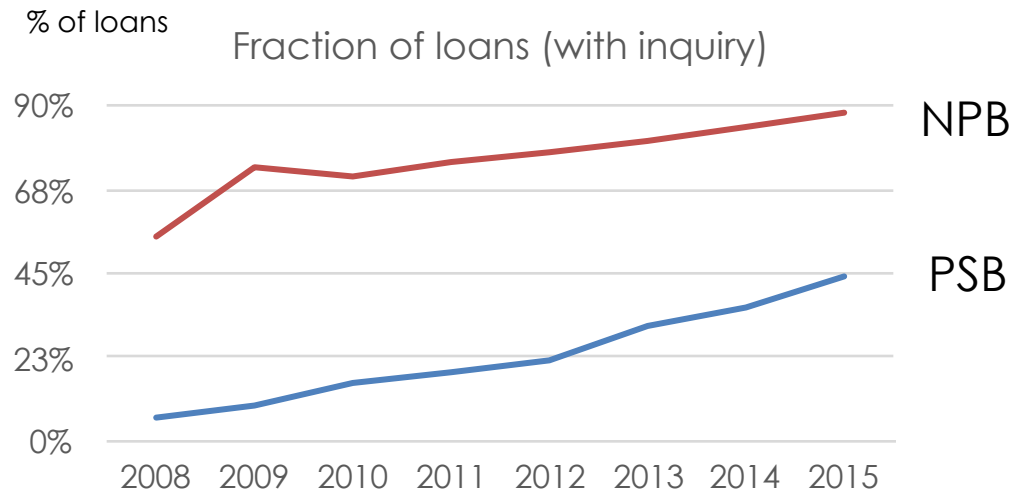# Bureau Usage
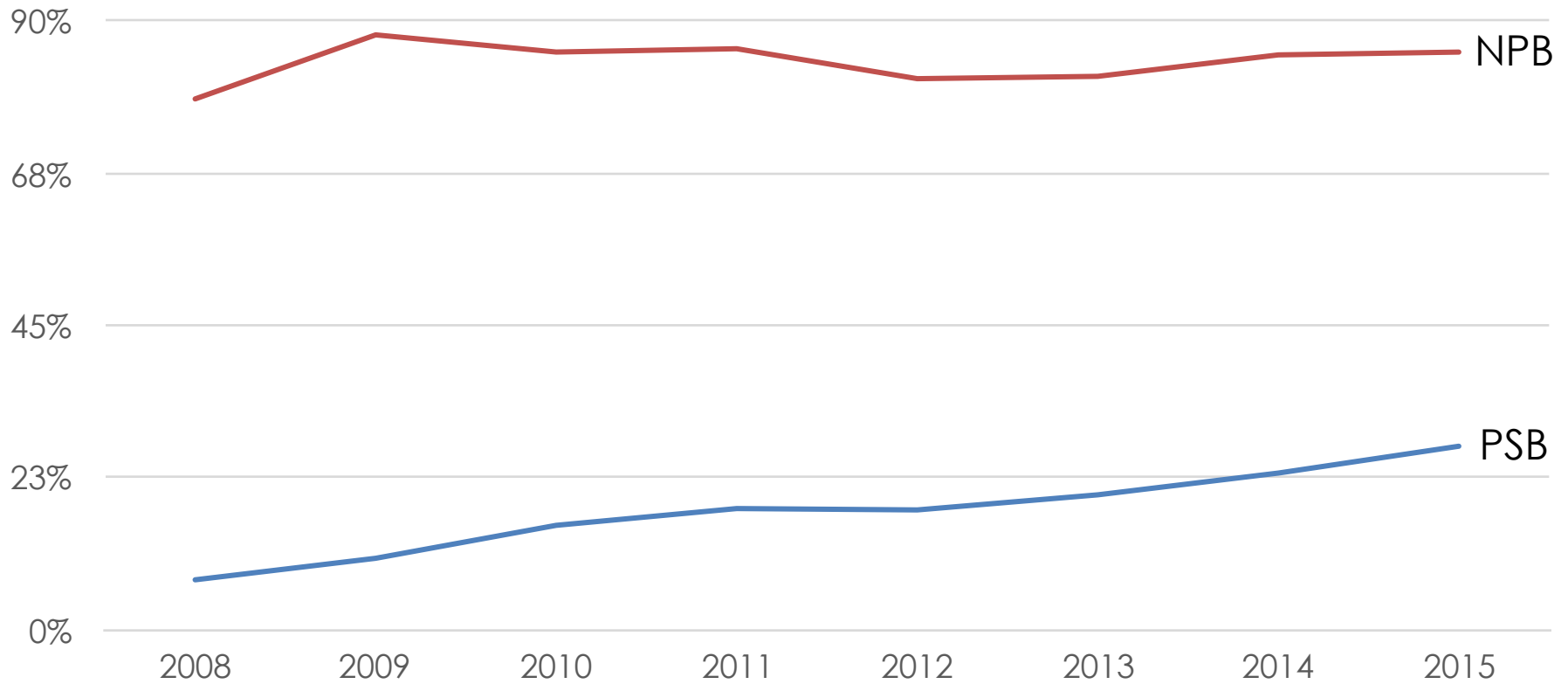
NPBs inquire more — but gap is decreasing

Explaining Usage Gap

I.   Product differences, due to state mandates

II. Prior relationships

III. Credit scores are unavailable for PSBs

IV. Credit scores are irrelevant for PSBs

Priority Sector Loans, Gold Loans

- Priority sector loans, not inquired
  - State mandates: Priority sector = 40%-50% of lending
  - PSBs may meet targets through loans to small farmers

- Gold loans, not inquired, mainly from PSBs
  - Overcollateralization, cultural reasons => low default
  - May be inquired less and drive low inquiries for PSBs

- 85% of gold and 99% of priority sector loans by PSBs
  - Only 2-3% inquired

- We exclude gold and priority sector loans. Doing so narrows the inquiry gap somewhat, especially in recent years

Excluding PSL and Gold

% of loans

Fraction of loans (with inquiry)

- NPB
- PSB

90%
68%
45%
23%
0%

2008 2009 2010 2011 2012 2013 2014 2015

% of filtered app

Bureau usage

- NPB
- PSB

100%
79%
58%
36%
15%

2008 2009 2010 2011 2012 2013 2014 2015

— PSBs — NPBs

- PSBs have legacy lending processes

- For past borrowers, bureau data may upend legacy process
  - If bureau data confirms internal data, great.
  - If bureau data may contradicts internal markers
    - More resources must be spent in reconciliation
    - If not, bank officer faces trouble
  - Better not to inquire for past borrowers?
    - Particularly when internal data is imprecise:

- For new borrowers
  - Bureau data helps generate paper trails, aids status quo

Past Relationships: All Banks

Year	Bureau Usage	
	Past Relationship	No Past Relationship
2006	1.2%	99.6%
2007	13.0%	99.1%
2008	40.8%	99.2%
2009	42.6%	99.5%
2010	31.6%	99.3%
2011	37.2%	99.2%
2012	42.6%	99.2%
2013	54.1%	99.2%
2014	60.6%	99.2%
2015	69.5%	99.2%
Total	41.4%	99.2%

Past Relationships: PSBs and NPBs

| Year | Bureau Usage | | | |
| | New Relationships | | Past Relationships | |
	PSB	NPB	PSB	NPB
2006	99.9%	99.6%	0.1%	2.1%
2007	99.6%	99.0%	1.1%	18.8%
2008	98.5%	99.2%	2.3%	58.6%
2009	98.4%	99.8%	3.9%	79.9%
2010	98.7%	99.6%	7.2%	73.5%
2011	98.5%	99.7%	12.5%	73.9%
2012	98.4%	99.6%	17.9%	74.9%
2013	98.6%	99.6%	28.9%	80.4%
2014	98.6%	99.6%	36.5%	86.3%
2015	98.5%	99.7%	48.3%	90.3%
Total	98.6%	99.6%	20.0%	61.3%

Bottomline so far ...

I.   Differences in adoption even after excluding gold+PSL

II.   Inquiry gap driven by old clients.

Why does bureau usage differ sharply between PSBs and NPBs for old clients?
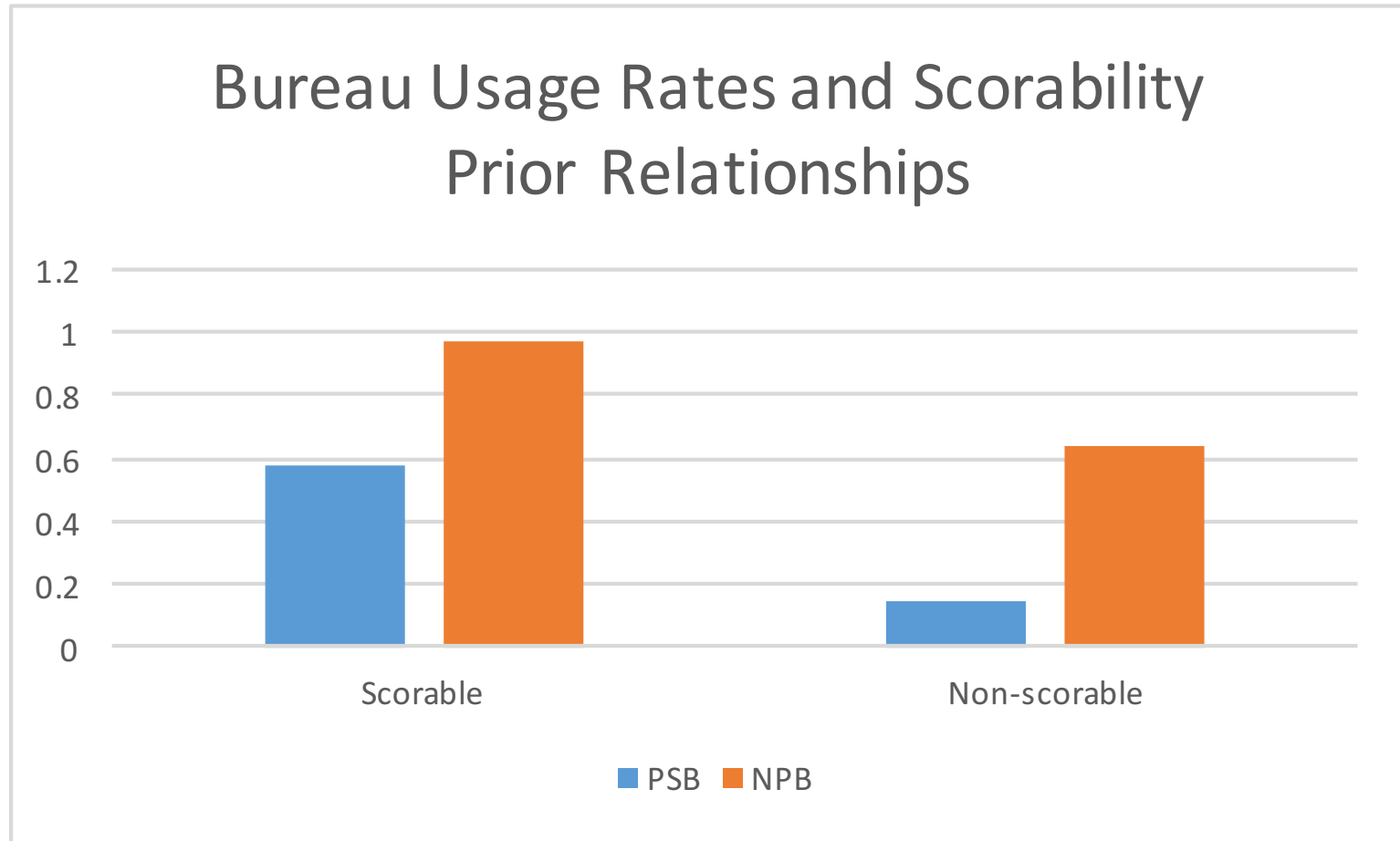
III. Bureau information is not available

Scorable Population

PSB Scorable	~0.3915
NPB Scorable	~0.4133

Y-axis values: 0.38, 0.385, 0.39, 0.395, 0.4, 0.405, 0.41, 0.415, 0.42
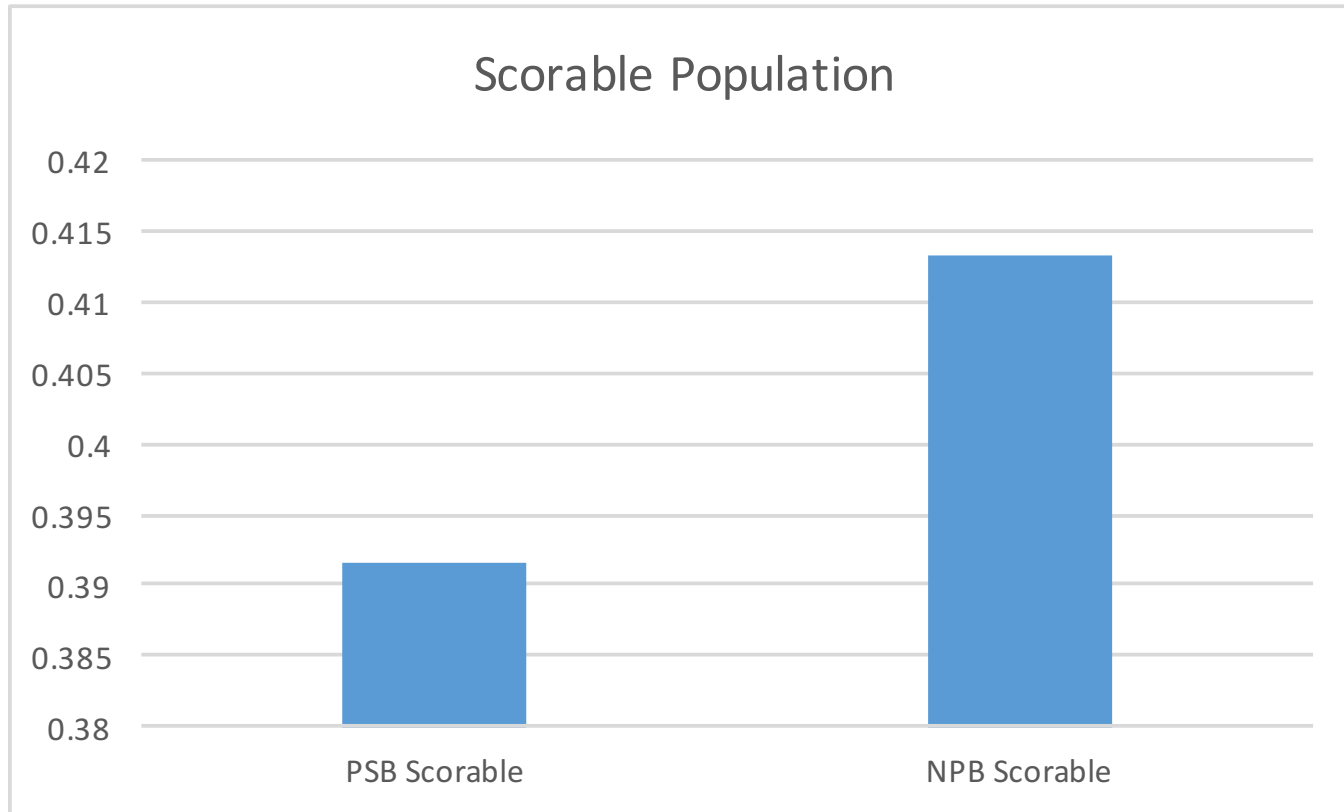
Very minor ~2% difference

Bureau Usage Rates and Scorability
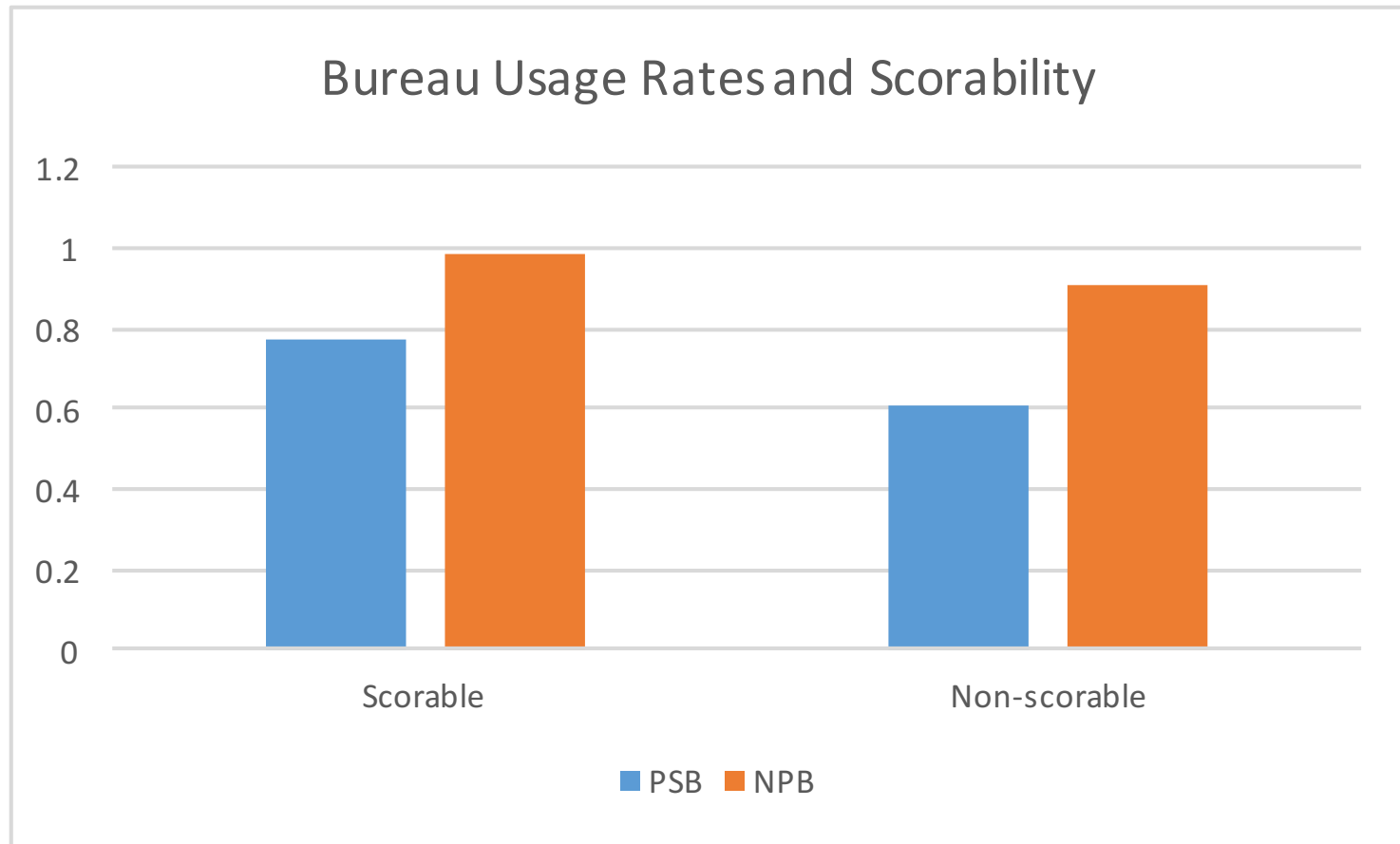
PSB bureau usage gaps in both populations

Bureau Usage Rates and Scorability Prior Relationships

Bureau usage gap high if there is prior relationship

Bureau Usage Rates and Scorability
No Prior Relationships

Bureau usage gap low for new customers
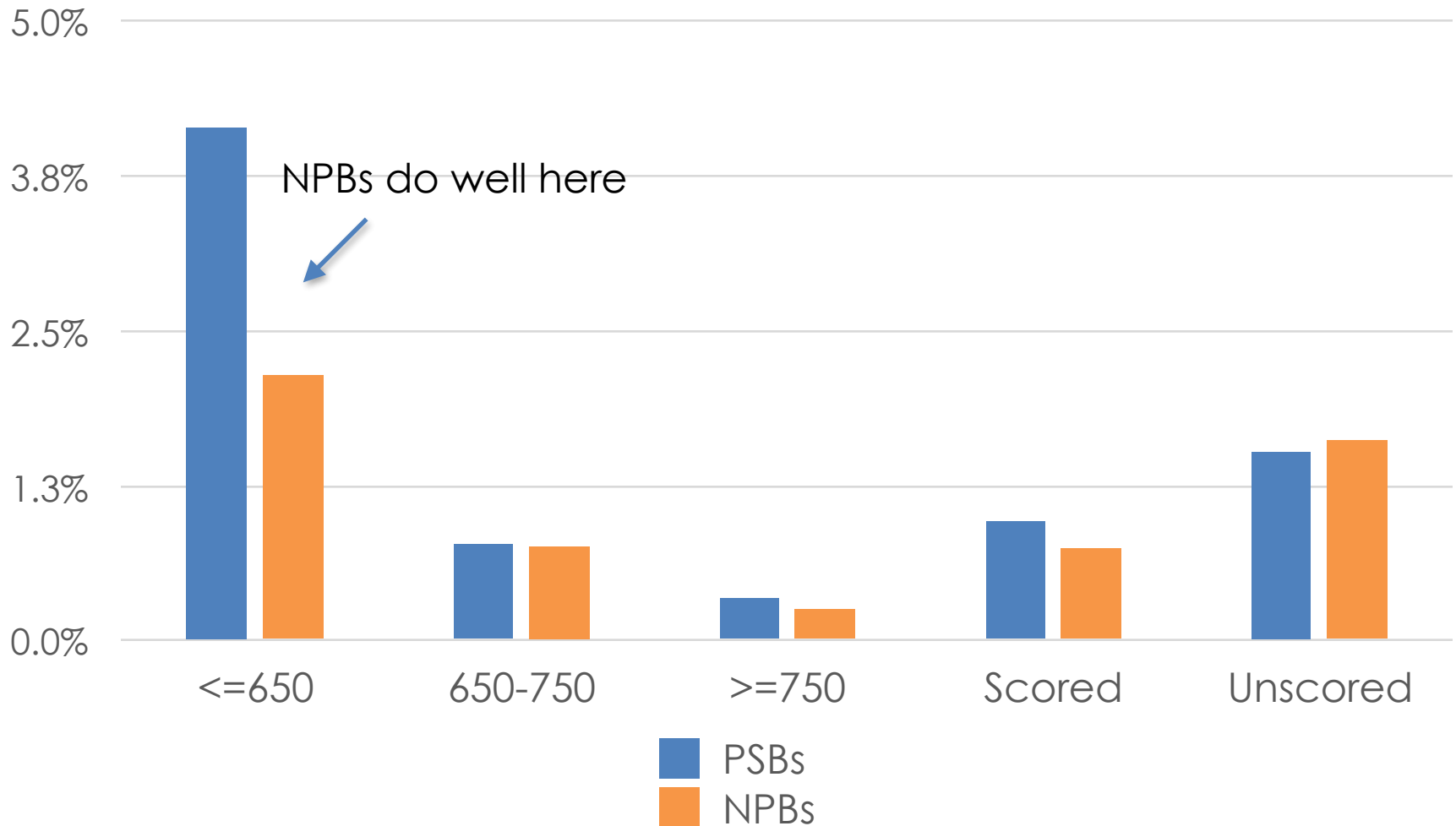Usage essentially complete for both PSBs and NPBs
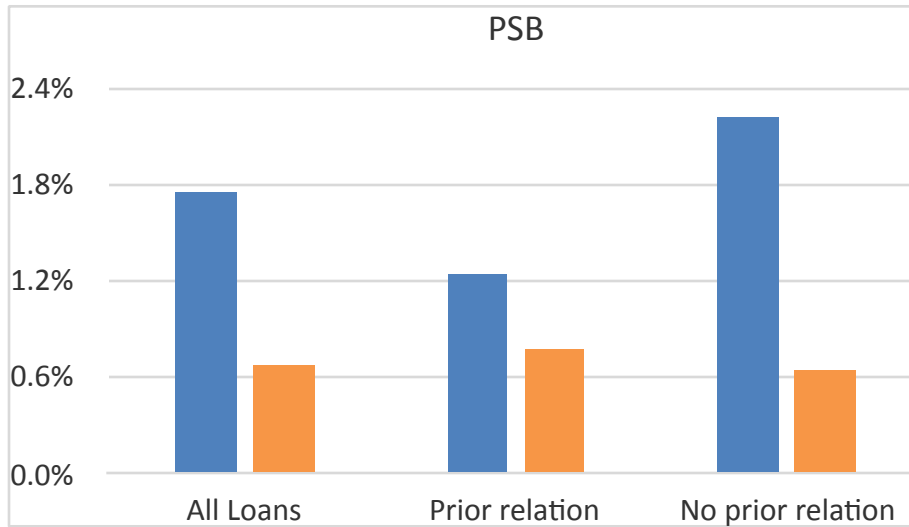
Are Scores Useful?

360-day delinquency rates
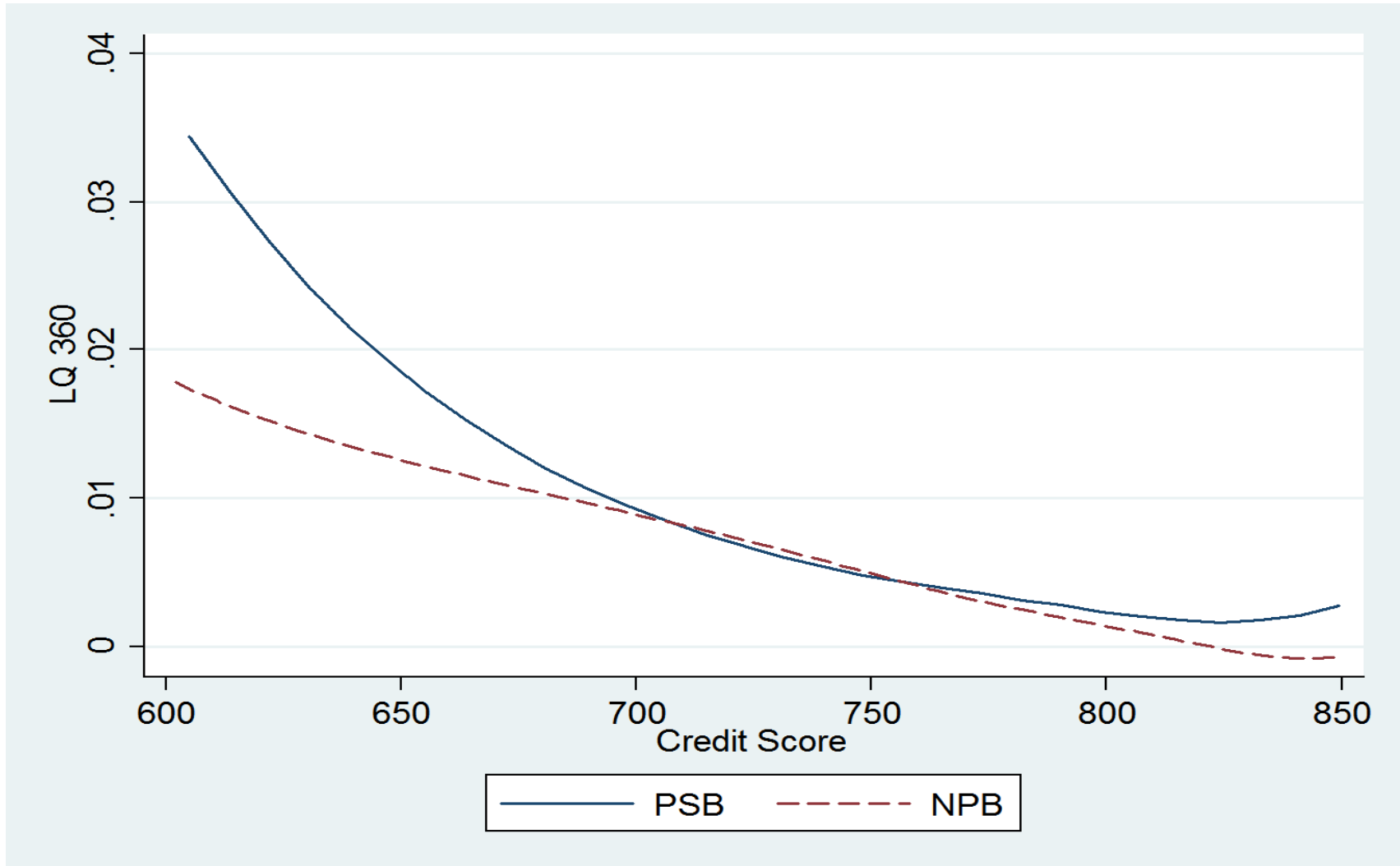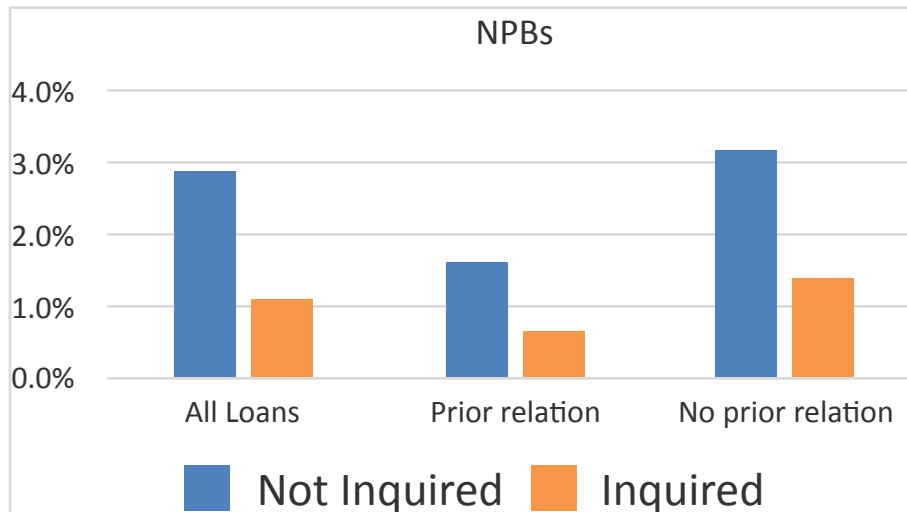
Are scores useful for PSB loans?
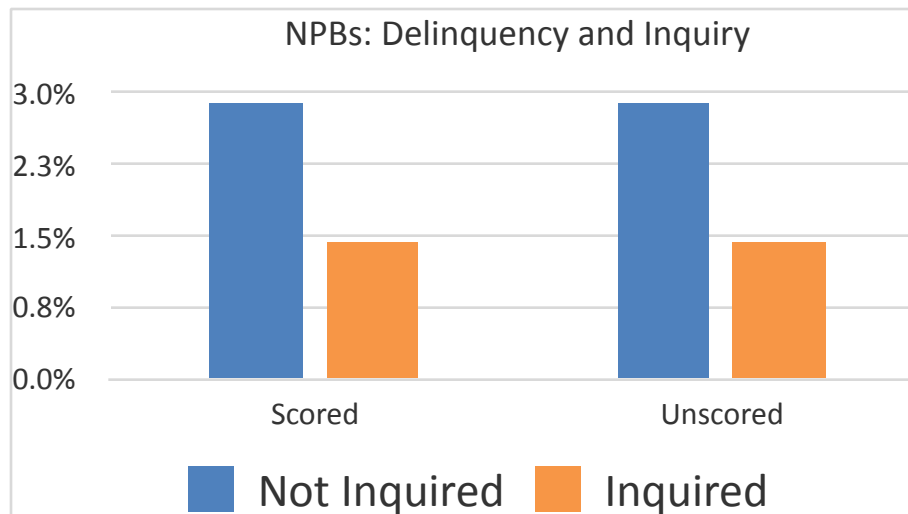

Delinquency by Credit Score: PSBs vs NPBs

NPBs do well here

Are inquiries useful?

PSB
Inquiry: less delinquency

NPB
Inquiry: less delinquency

PSBs: Delinquency and Inquiry

NPBs: Delinquency and Inquiry
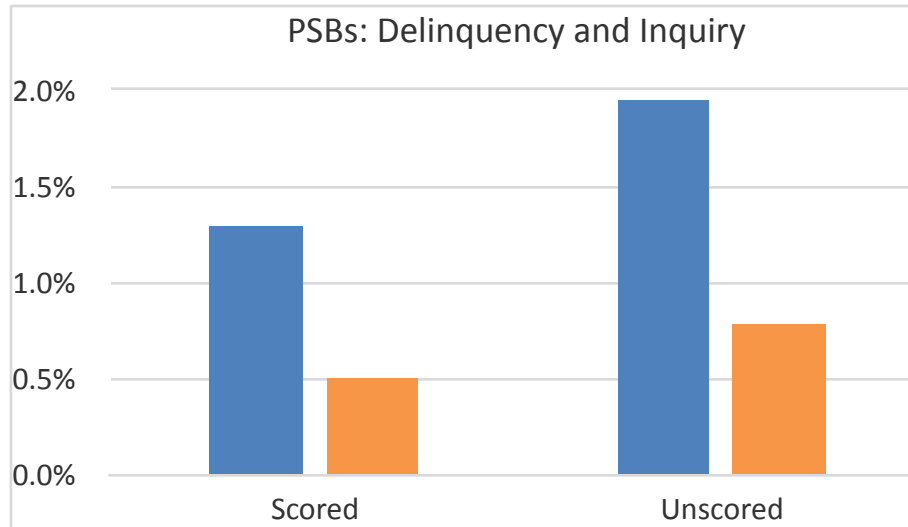
Inquiry reflects culture

Not Inquired Inquired

Delinquency Rate: Unscored and No Prior Relation

Legend:
- No Inq (blue)
- Inq (orange)

Categories: All, PSB, NPB

- Do credit scores predict ex post delinquency? Yes

- Do credit scores predict delinquency for PSBs? Yes

- Are inquiries associated with lower DRs? Yes
  - Even for unsecured population

- Not inquiring skews population towards low quality.

- Different kind of loans by PSBs
  - Yes, but we exclude gold and PSL

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

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

- Is bureau information irrelevant for PSBs? No…
  - Inquiry predicts ex-post delinquency

Information left on the table quantitative estimates

PSBs inquire less

	(1)	(2)
PSB (=1)	-0.2536***	-0.1593***
	(0.002)	(0.002)
Past Relationship	-0.0807***	0.0663***
	(0.002)	(0.001)
Past Relationship*PSB		-0.2965***
		(0.004)
Male (=1)	0.0260***	0.0222***
	(0.002)	(0.002)
LN(Age)	-0.0026	0.0113***
	(0.003)	(0.003)
Time FE	Y	Y
#	348,158	348,158
R^2	0.121	0.169

Delinquency Specification IV

	First Stage	Second Stage
TWE 180		-0.0115***
		(0.003)
PSB (=1)	-0.2229***	
	(0.002)	
Past Relationship (=1)	-0.1412***	-0.0060***
	(0.002)	(0.001)
Low Score	0.1773***	0.0224***
	(0.002)	-0.003
Medium Score	0.1398***	-0.0027***
	(0.002)	-0.001
High Score	0.1778***	-0.0057***
	(0.002)	-0.001
Male (=1)	0.0101***	0.0019**
	(0.002)	-0.001
LN(Age)	-0.0259***	-0.0074***
	(0.003)	(0.001)
LN(1+Amt)		-0.0037***
		(0.000)
Acct Type FE	N	Y
Qtr-Year FE	Y	Y
Observations	331,961	107,284

- PSBs do not adopt enough: Many loans, no inquiry.

- What if they inquired more?
  - We obtain scores for un-inquired loans
  - Point in time, what PSBs would have seen

- Must specify counterfactual policy functions
  - How this information would be used in lending.
  - What delinquencies we would see.

Counterfactuals

- PSBs inquire all loans: too aggressive?

- PSBs inquiring more: perhaps behave like NPB

$$Q_{NI \to I}(PSB) = p_c(NPB, X_c, S_c) \times L_C \times \delta_{c,NI}, \qquad (1)$$

- PSBs scale but maintain current inquiry policy functions, e.g., must accommodate unobserved state mandates

- Modeling delinquency under high inquiry. Either use actual, leave it as it is for PSBs, or use NPB delinquency rates, depending on assumptions about banks' recovery methods.

$$LQ360_{NI \to I}(PSB) = p_c(NPB, X_c, S_c) \times L_C \times \delta_{c,NI} \times LQ360_c(PSB,.) \qquad (2)$$

$$LQ360_{NI \to I}(PSB) = p_c(NPB, X_c, S_c) \times L_C \times \delta_{c,NI} \times LQ360_c(NPB,.) \qquad (3)$$

Counterfactuals

| Prior Relation	(1)	(2)	(3)	(4)	(5)= (2)/(1)	(6)= (3)/1
	P(I) * P(T|I) * Amt	(1) * PSB LQ360	(1) * NPB P(LQ360)	LQ %	CF LQ% PSB LQ360	CF LQ% NPB LQ360
Panel A. NPB Model						
No	281,603	1,970	1,603	1.33%	0.70%	0.57%
Yes	719,841	6,997	4,135	1.29%	0.97%	0.57%
All	1,001,444	8,967	5,739	1.29%	0.90%	0.57%
Panel B. PSB Model						
No	153,104	1,160	1,505	1.33%	0.76%	0.98%
Yes	382,826	4,104	3,298	1.29%	1.07%	0.86%
All	535,931	5,264	4,803	1.29%	0.98%	0.90%

Discussion

Explaining Slow PSB Adoption

- Size, profits, capitalization, etc.? No
  - PSB dummy is significant after these controls

- What determines stickiness of legacy process?
  - Ownership?
  - Vintage?

Old Private Banks

- 14 OPBs
  - Formed at same time as PSBs, median 89 years,
  - Smaller than PSBs
  - Privately owned like NPBs, not nationalized in 1969 and 1980.

- Do OPBs behave like PSBs? or NPBs?
  - If NPB, perhaps ownership drives adoption
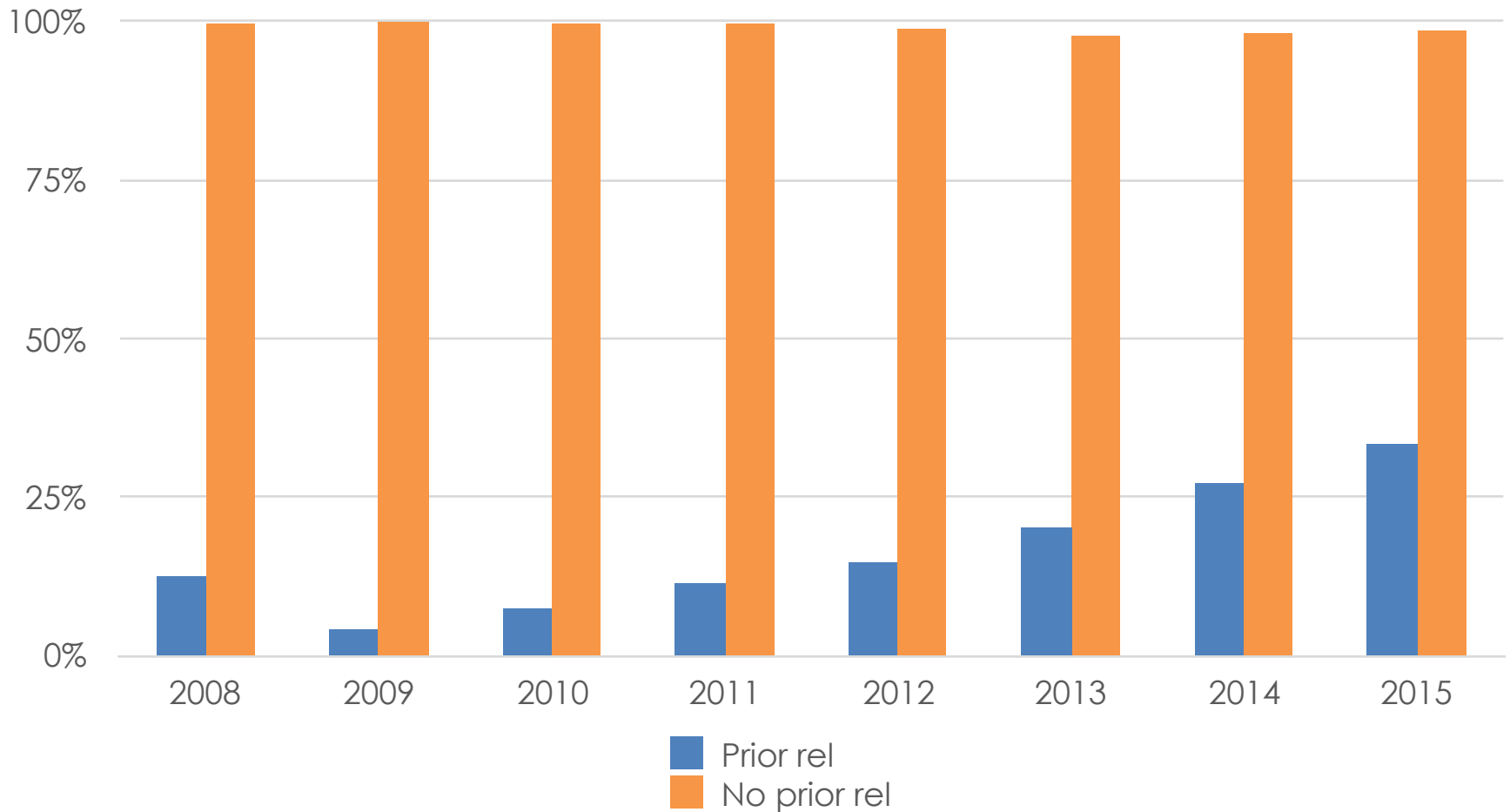 - If PSB, ownership and size do not drive adoption

OPBs
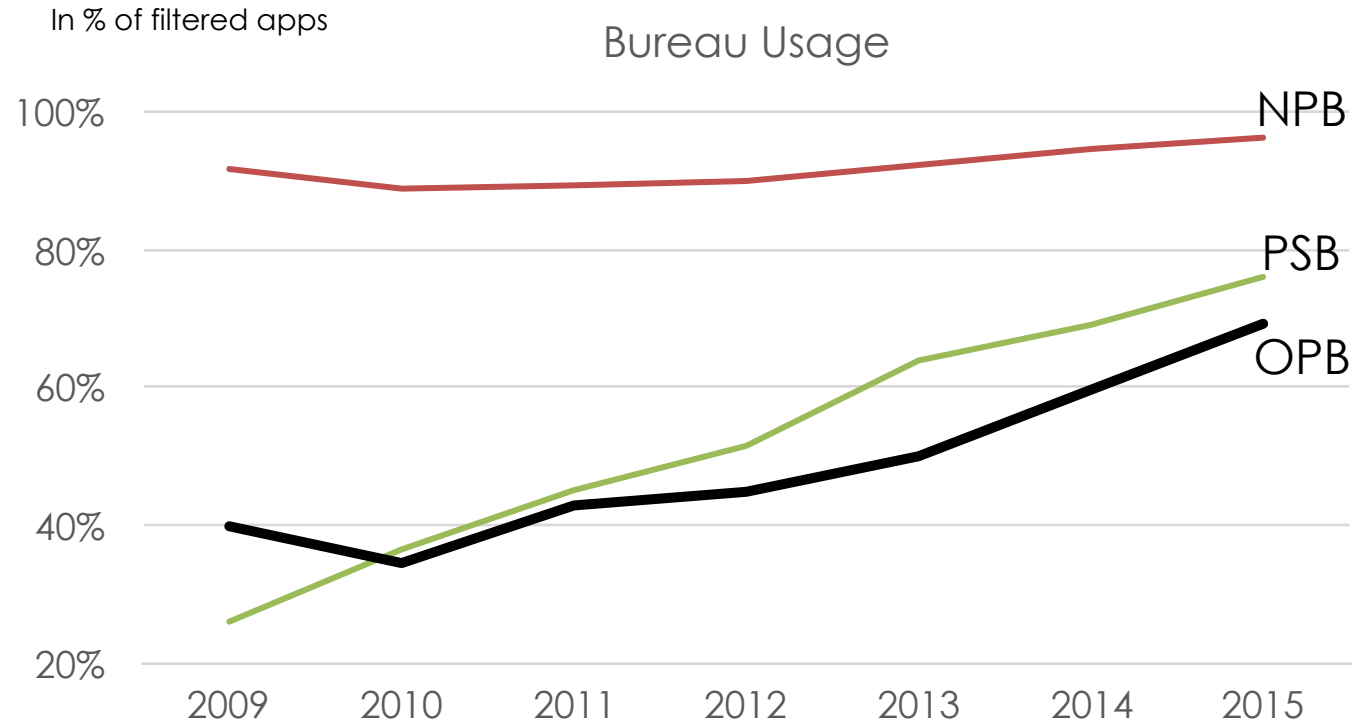
To the first order, OPBs are like PSBs
Formative experiences, not ownership, drives adoption patterns (culture?)

OPBs and Past Relationships

Bureau Usage: Old vs New

Once again, OPBs resemble PSBs not NPBs

Conclusion

- Credit bureaus exogenously introduced in India

- We study the adoption of credit scoring by banks

- 1% sample drawn from 472 million loan records.

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

- A variety of explanations on differences in products types, availability of scores or their usefulness do not explain the differences.

- Not inquiring leaves information on the table.
  - Regressions and IV specification
  - Counterfactuals using data available to PSBs but not used

- Conjecture: cultural differences are the deep determinants of organizational adoption of new technology.

- What drives culture?
  - Not observable attributes like size or capital.
  - Not ownership [OPBs]
  - Perhaps the formative experiences in life cycle shape lethargic, inward oriented culture

Conclusion

- Add to multiple strands of research
  - Technology adoption
  - Technology adoption by organizations
  - Innovator's dilemma
  - Process innovations and their adoption
  - The adoption of new management practices in emerging markets

Thank you!

Questions?

Strong negative correlation between age and Bureau usage