

The Digital Banking Revolution: Effects on Competition and Stability

Naz Koont

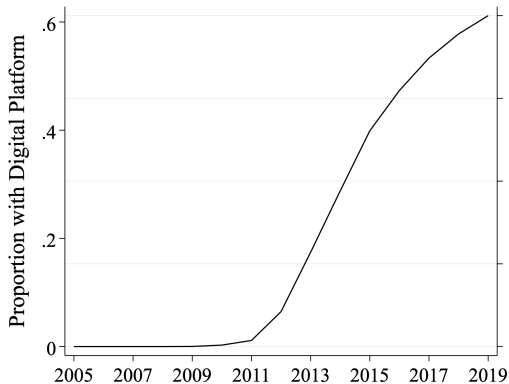
Stanford GSB

Digital Banking Revolution

- Rise of websites and mobile apps are transforming business models across many industries

Digital Banking Revolution

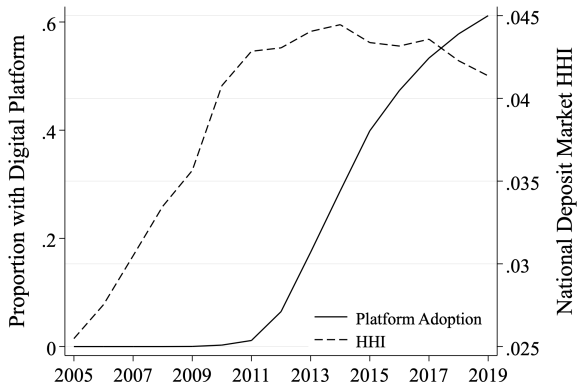
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- Leading way to access banking services (Source: FDIC)
- Widespread adoption by banks



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May alter bank competition



1. How has the availability of digital banking platforms altered bank competition?
 - ↓: Do larger banks develop higher quality platforms and capture more of the market
 - ↑: Or do smaller banks use this technology to compete more effectively with the extensive branch networks of large banks?

Research Questions

1. How has the availability of digital banking platforms altered bank competition?
 - ↓: Do larger banks develop higher quality platforms and capture more of the market
 - ↑: Or do smaller banks use this technology to compete more effectively with the extensive branch networks of large banks?

2. Do effects on competition vary across market segments, and where may risks build up in the banking sector as a result?
 - Digitalization may facilitate provision of services to certain types of depositors or borrowers
 - Compositional changes in bank balance sheets have implications for financial stability

Q1. The availability of digital platforms increases bank competition:

Concentration ↓ , volume-weighted markups ↓ , customers capture more of total surplus

- Counties become branchlessly more integrated
- Mid-sized banks grow: high quality digital platforms without extensive branch networks

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Q2. Digital platforms alter the composition of banks' balance sheets

- Liabilities: Uninsured deposits re-sort towards larger digital banks ↑ **funding risk**
- Assets: Decrease share of lending to low income borrowers in part due to reduced monitoring/screening ability ↑ **associated credit risks**
- Customer surplus ↑↑ for uninsured depositors and high income borrowers: digitalization disproportionately benefits wealthier segments of the economy

Contribution to literature

1. Competition and Integration

- Bank market power and integration of banking markets (Morgan, Rime, Strahan 2004; Drechsler, Savov, Schnabl 2017; Egan, Hortacsu, Matvos 2017; Wang, Whited, Wu, Xiao 2020; Vives & Ye 2022)
- IT revolution in services and star firms (Autor et al 2020; Hsieh & Rossi-Hansberg 2023)
- Digital platforms branchlessly increase local and national competition

2. Financial Stability

- Monitoring or screening (Petersen & Rajan 1994, 2002; Stein 2002; Berger et al. 2005; Liberti & Petersen 2019)
- Funding composition (Jiang, Matvos, Piskorski, Seru 2023; Koont, Santos, Zingales 2023)
- Digital platforms alter funding composition and monitoring or screening ability

3. Technology in Banking

- IT investments (Berger & DeYoung 2006; Vives 2019; He, Jiang, Xu, Yin 2021; Modi, Pierri, Timmer, Peria 2022; Jiang, Yu, Zhang 2022; Haendler 2022)
- Fintech and credit access (Di Maggio & Yao 2021; Erel & Liebersohn 2020)
- Quantify aggregate effects of digital platforms on bank competition and stability

1. Data & Identification Strategy
2. Structural Model & Estimation
 - Model ingredients motivated by stylized facts
 - Disentangle economic mechanisms
3. Counterfactual Exercise
 - Compare our digital world to a counterfactual without digital platforms

Data on digital platforms for the universe of banks

- Baseline measure of digital platforms:** Indicator variable tracking whether the bank has a mobile application at the start of a given year. *data.ai*
 - Release dates on Apple and Google + features, reviews, ratings

App	Company	App Price	App Initial Release Date
 Wells Fargo Mobile Jump to	 Wells Fargo	Free	May 17, 2009
 Wells Fargo Mobile Jump to	 Wells Fargo	Free	May 25, 2010

Blackhawk Bank & Trust Mobile

Ratings and Reviews

4.8 out of 5

712 Ratings



Blackhawk Bank & Trust (BhB&T) mobile banking makes banking from anywhere simple and convenient. From viewing your account activity to finding any of our branch locations in the Illinois and Iowa Quad Cities and surrounding areas, your accounts can be conveniently accessed 24/7.

Easy to Use:

- Enroll from the app
- Deposit checks
- Make transfers
- Send money
- Pay bills

Monitor your money:

- Instant Balance
- Transaction history
- Control your debit card
- View credit score
- Customize real time alerts for your accounts

Manage your accounts:

- Open a new account
- Make loan payments
- Contact us
- Find our locations

Secure:

- Username and password login
- Fingerprint and Facial recognition enabled
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Member FDIC & Equal Housing Lender

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- Annual website maps: website complexity and features

archive.org

Features of digital platforms

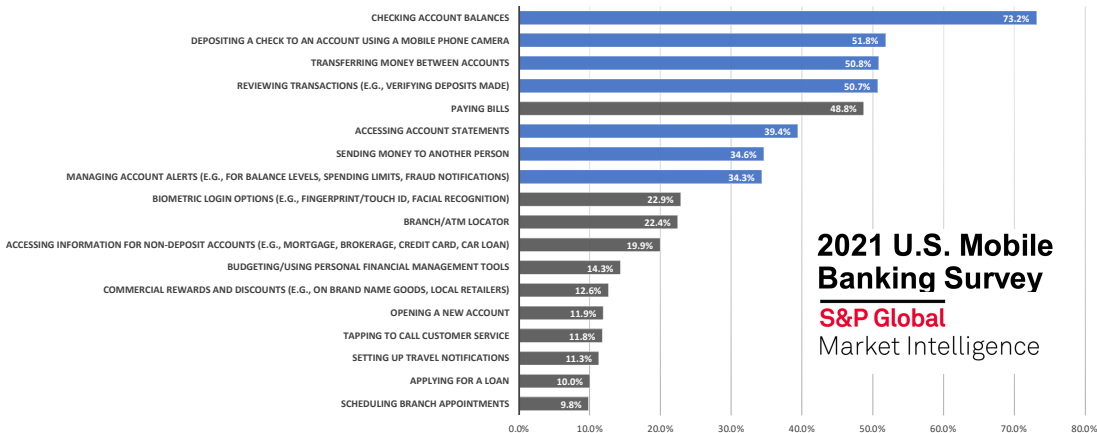
Which features currently available on your bank's mobile banking app do you consider most valuable?



**2021 U.S. Mobile
Banking Survey**
S&P Global
Market Intelligence

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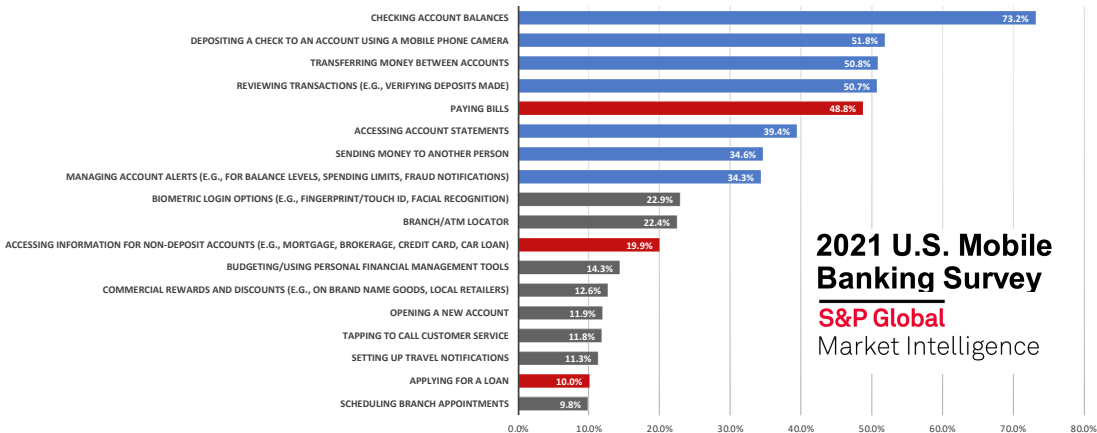


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Interpretation

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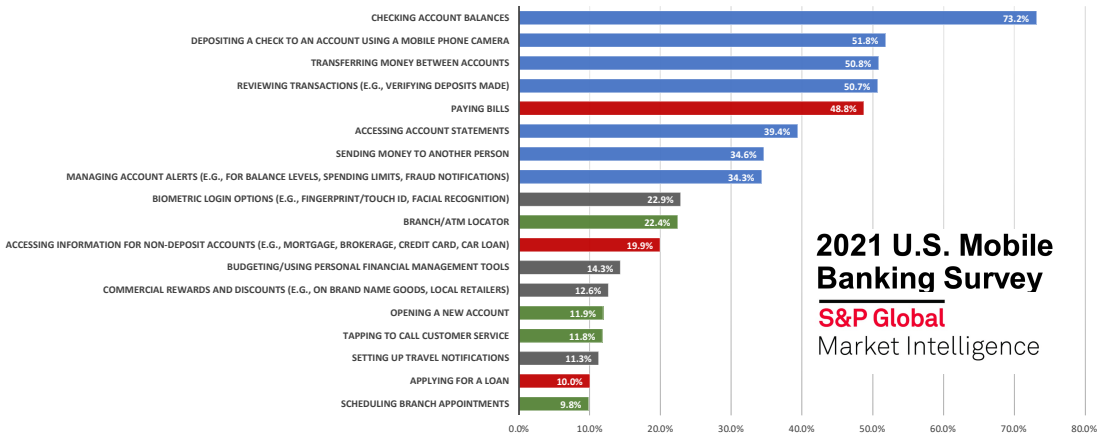


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Interpretation

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$$Y_{b,t} = \beta \widehat{\text{Digital}}_{b,t} + \gamma X_{b,t} + \varepsilon_{b,t}$$

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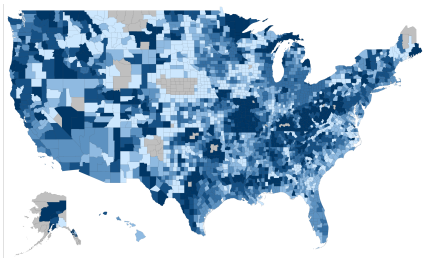
Smartphones & app stores are a key technological advance that facilitate digital banking

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Smartphones & app stores are a key technological advance that facilitate digital banking

1. The "smartphone revolution" started with the iPhone, exclusive to AT&T for 5 years



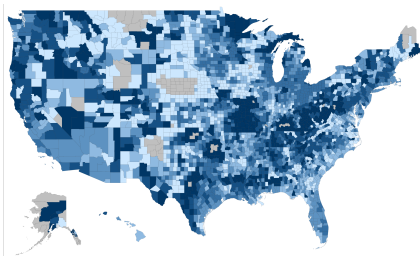
AT&T vs Verizon Coverage

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2. Banks serve different regions of the US



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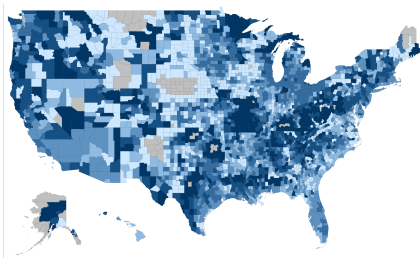
Most Popular Bank by State

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Most Popular Bank by State

Isolate quasi-random variation in banks' ability to serve existing customers digitally:

Banks with higher AT&T coverage across their markets are more likely to adopt digital platforms relative to banks with higher Verizon coverage, despite being ex-ante comparable

$$Z_{b,t} = \sum_c \text{Shares}_{b,c} \times \text{Shocks}_{c,t}$$

- **Shares:** Proportion of bank b 's deposit customers that reside in county c in 2009:

$$\text{Shares}_{b,c} = \frac{\text{Deposit Share}_{b,c} \times \text{Population}_c}{\sum_c \text{Deposit Share}_{b,c} \times \text{Population}_c}$$

- **Shocks:** Technology availability

$$\text{Shocks}_{c,t} = \text{AT\&T}_c \times 1\{\text{Post 2007}\}_t$$

- Create analogous variable for Verizon + AT&T coverage to control for **observable + unobservable** drivers of cellular coverage that may correlate with bank characteristics

1. Data & Identification Strategy
2. Structural Model & Estimation
 - Model ingredients motivated by stylized facts
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3. Counterfactual Exercise
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Model Ingredients & Stylized Facts

Digital platforms represent an alternative to branch visits, so may affect:

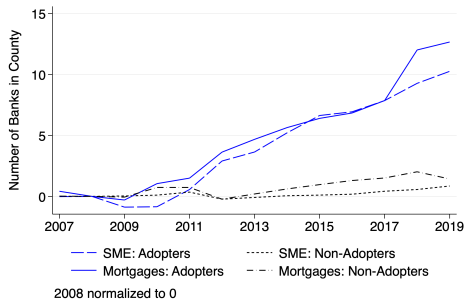
1. Geographic scope and branch networks

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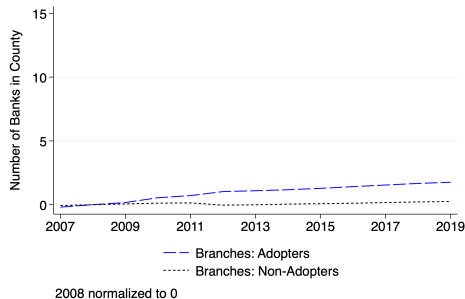
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SME and Mortgage Lending



Branch Presence



Restrict to mortgages that are not sold off; in figures classify adopters depending on if bank adopted by 2014.

1. Geographic scope and branch networks

$$Y_{b,t} = \beta_t + \beta_1 \widehat{\text{Digital}}_{b,t} + \gamma X_{b,t} + \varepsilon_{b,t}$$

	(1)	(2)	(3)
	Num Markets Mortgages	Num Markets Branches	Within-Market Branches
Digital	0.86** (0.37)	-0.01 (0.02)	-0.06* (0.03)
Controls	Yes	Yes	Yes
FE	Year	Year	County-Year
Observations	21,644	50,357	212,798
F	27.28	179.20	325.71

Digital banks branchlessly enter counties; reduce number of branches they maintain per county but do not fully close all branches in a given county

Banks, customers in deposit & loan markets

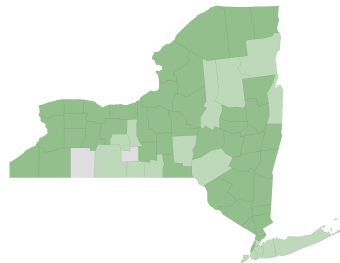
Model Overview

Banks, customers in deposit & loan markets

$t = 0$: Banks choose costly investments to maximize profits

1. Digital platform adoption decision
2. Branches in each of their local counties
3. Loan market entry decisions

Adoption, branching, entry is endogenous & interdependent



Key Bank NY

Digital platforms represent an alternative to branch visits, so may affect:

1. Geographic scope and branch networks
2. Demands and costs of providing services, depending on banks' ex-ante business models

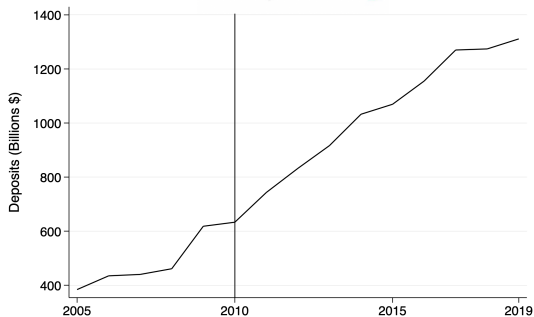
Digital platforms represent an alternative to branch visits, so may affect:

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2. Demands and costs of providing services, depending on banks' ex-ante business models
 - Which banks grow faster after adopting digital platforms?

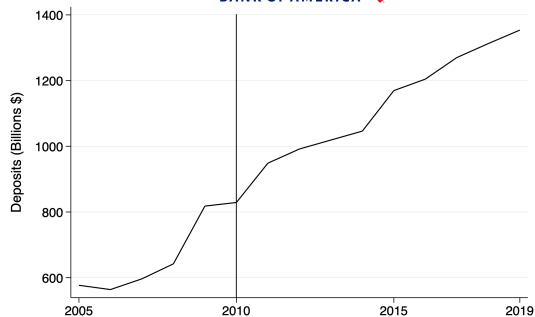
2. Bank Growth Following Digital Platform Adoption

For largest banks, not much change in deposit growth around digital platform adoption ...

JPMorganChase 

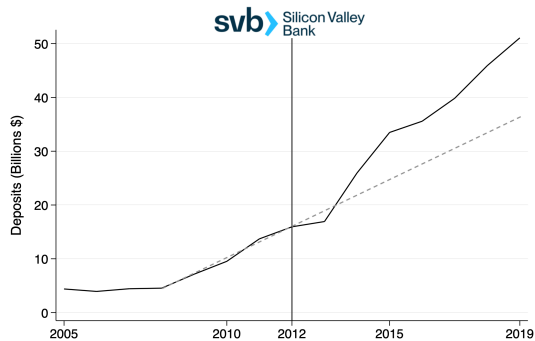
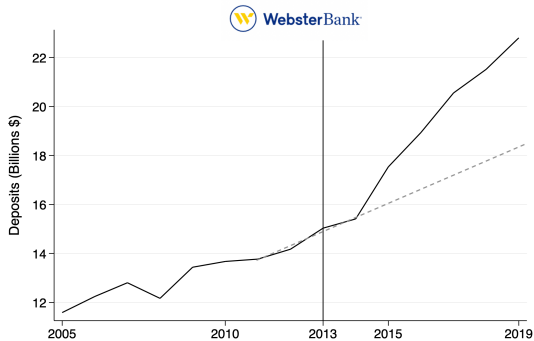


BANK OF AMERICA 



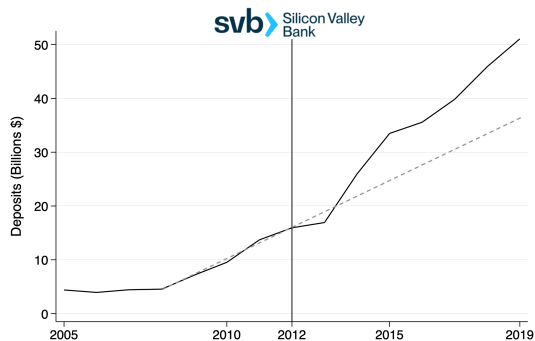
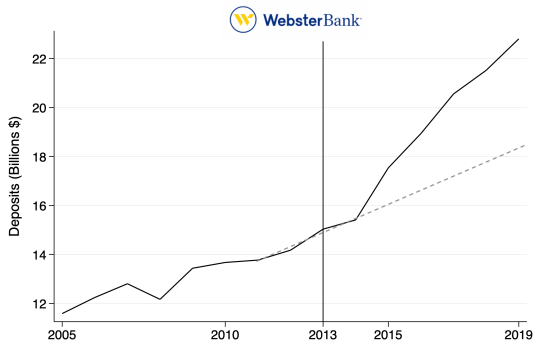
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... dramatic change in deposit growth for mid-sized banks after digital platform adoption!



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2. Bank Growth Following Digital Platform Adoption

	Assets			Deposits		
	(1)	(2)	(3)	(4)	(5)	(6)
Digital, \$100B+	-0.001 (0.007)	-0.002 (0.007)	-0.010 (0.007)	0.007 (0.008)	0.006 (0.008)	-0.001 (0.008)
Digital, \$10B – \$100B	0.038*** (0.010)	0.036*** (0.010)	0.034*** (0.010)	0.042*** (0.011)	0.040*** (0.011)	0.038*** (0.010)
Digital, \$10B–	-0.012 (0.015)	-0.015 (0.015)	-0.009 (0.013)	-0.012 (0.017)	-0.015 (0.017)	-0.009 (0.014)
Nonbank Fintech Exposure		-0.068*** (0.016)	-0.070*** (0.015)		-0.071*** (0.017)	-0.072*** (0.017)
Year FE & Baseline Controls	Yes	Yes	Yes	Yes	Yes	Yes
Local Economy Controls	No	No	Yes	No	No	Yes
Observations	49463	49463	43894	49373	49373	43813
F	48.35	48.81	49.22	47.87	48.25	48.90

Find that mid-sized banks grow fastest: \implies Net effect of opposing forces

Digital platform quality vs. substitutability/erosion with existing branch network

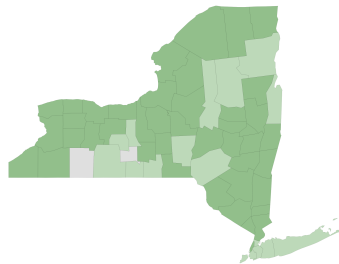
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Banks, customers in deposit & loan markets

$t = 0$: Banks choose costly investments to maximize profits

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Adoption, branching, entry is endogenous & interdependent



Key Bank NY

$t = 1$: Differentiated banks compete by setting rates in deposit and loan markets,
Customers maximize utility by choosing where to bank, including outside option

- Banks' marginal costs and customers' utility depends on branches, digital platforms
- Allow effects to vary across bank business models

Decompose effects on demands and costs

Digital platforms represent an alternative to branch visits, so may affect:

1. Geographic scope and branch networks
2. Demands and costs of providing services, depending on banks' ex-ante business models
3. Balance sheet composition, through differential effects across market segments

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3. Balance sheet composition, through differential effects across market segments
 - a. **Liabilities:** Increase ratio of uninsured deposits
 - b. **Assets:** Reduce ratio of lending to low income borrowers

Model Overview

Banks, customers in **insured and uninsured** deposit
& **high and low income** loan markets

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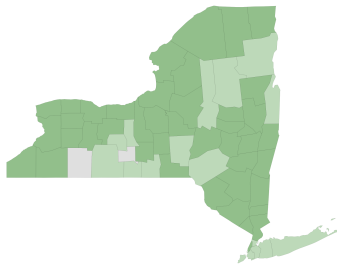
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Model Estimation: Overview

Demand via discrete choice: relates bank market shares to rate and non-rate attributes

- (1) Deposit demand elasticity for digital platforms highest for mid-sized banks
- (2) Disproportionate demand response by uninsured depositors and high income borrowers

Model Estimation: Overview

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Rich supply specification: Fixed costs + variable costs + loan losses

- Banks' revealed preference reveals bounds for fixed costs
- Banks' rate-setting FOC imply that equilibrium prices reveal marginal costs
- Modeling loan losses allows monitoring or screening to depend on branches & digitalization

Model Estimation: Overview

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- Banks' revealed preference reveals bounds for fixed costs
 - Banks' rate-setting FOC imply that equilibrium prices reveal marginal costs
 - Modeling loan losses allows monitoring or screening to depend on branches & digitalization
- (1) Entail significant fixed costs but reduce variable service costs
 - (2) **Reduce** expected loan losses for high-income lending
 - (3) **Increase** expected loan losses for low-income lending

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What are the aggregate effects of digital platforms on competition, welfare, and stability?

In the absence of digital platform technology ...

1. Banks may have closed fewer branches
2. Banks may not have branchlessly entered as many markets
3. Non-banks in mortgage market also would not have digital platforms

Counterfactual equilibrium

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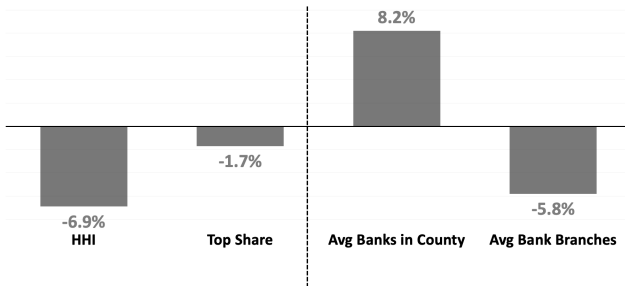
Consider counterfactual equilibrium with digital platforms O_b turned off

1. Banks may have closed fewer branches
Allow branch network adjustment N_b
2. Banks may not have branchlessly entered as many markets
Allow market exit C_b
3. Non-banks in mortgage market also would not have digital platforms
Adjust characteristics of mortgage outside option

Equilibrium computation follows Lee & Pakes (2009) and Wollmann (2018)

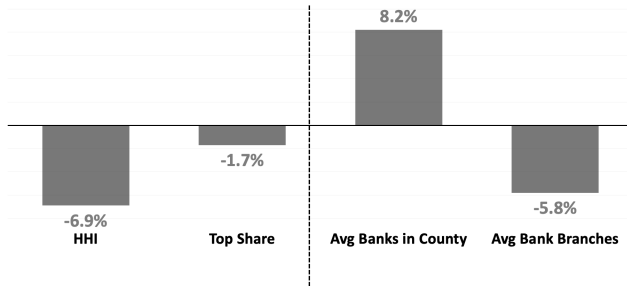
Aggregate Effects of Digital Platforms on Bank Competition

1. Market concentration decreases, and markets become branchlessly more integrated
2. "Top Share" of deposits provided by banks with above \$100B in assets falls
3. Volume-weighted markups fall



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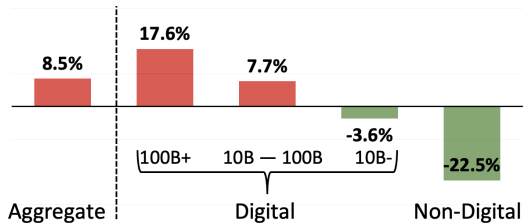
4. Customers are able to capture more of total surplus created in digital economy
 - Average expected consumer surplus \uparrow vs. aggregate bank profits unchanged
 - Accrues mostly to wealthier segments of economy
 - Aggregate unchanged profit masks heterogeneity: small banks' avg profit \downarrow

Financial Stability Implications of Digital Platforms

1. Flattened bank size distribution \implies increased size, geographic scope of mid-sized digital banks
(e.g. SVB \$71B Assets in 2019)

Financial Stability Implications of Digital Platforms

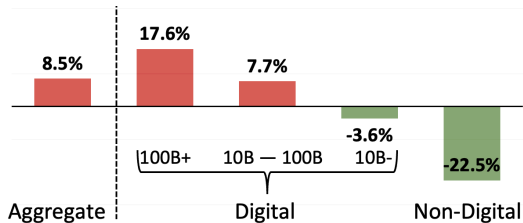
1. Flattened bank size distribution \implies increased size, geographic scope of mid-sized digital banks (e.g. SVB \$71B Assets in 2019)
2. Aggregate and compositional shift towards flightier deposits in the digital equilibrium



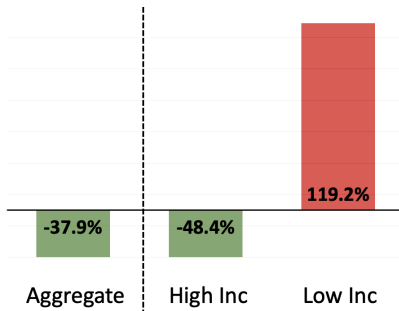
(a) Uninsured Deposit Ratio

Financial Stability Implications of Digital Platforms

1. Flattened bank size distribution \implies increased size, geographic scope of mid-sized digital banks (e.g. SVB \$71B Assets in 2019)
2. Aggregate and compositional shift towards flightier deposits in the digital equilibrium
3. Build up of credit risks within segments that are less well served by digital technologies



(a) Uninsured Deposit Ratio



(b) Credit Risk Per Dollar Originated

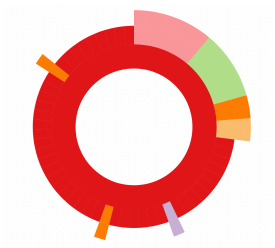
1. Digital banking platforms increase competition in the banking sector
 - Counties become branchlessly more integrated & mid-sized banks grow larger
 - Customer surplus ↑ disproportionately benefits wealthier segments of the economy
2. Digital platforms alter composition of banks' balance sheets
 - Re-sorting of flighty uninsured deposits towards large digital banks
 - Build up of credit risk in markets less well served digitally

Appendix

Additional Data: Website Complexity



Wells Fargo



Bank of the Valley

Back

Correlation: App Release and Website Complexity

A banks' website becomes more complex, as measured by the log number of distinct urls, on the year that the bank develops a mobile application:

	Website Size	
	(1)	(2)
Year App Released	0.21*** (0.02)	0.05*** (0.02)
Bank FE	Yes	Yes
Year FE	No	Yes
Observations	56368	56368
Adjusted R^2	0.410	0.527

How to interpret binary measure of adoption given varying features?

Binary measure captures effect of average features during time sample, 2010 to 2019

- + Capture average overall effect of this technological innovation so far
- + Heterogeneity analysis by bank size sheds light on how digital service quality matters
- Precludes disentangling exactly which features lead to observed outcomes
 - Customers value checking account balances **or** remote check deposit
 - Customers aware of more banks due to digital features but still visit branch to apply for loan **versus** customers actually apply to loans online

Future work: decompose exactly which features drive observed effects to tease out details

Back

Banks' shareholder communications

In a random sample of the annual reports of public US banks in 2022,

1. Banks talk about digital platforms often

- 85% of banks mention digital service platforms
- Average bank mentions digital service platforms 10x, ("digital", "mobile", "online")
 - Investments in digital infrastructure
 - Performance of platforms
 - Resulting operational efficiencies
 - Heightened competitive pressures due to digital technologies

2. Reveals how banks invest in and develop these digital platforms

- 60% of banks mention obtaining digital service technologies from third party providers: FIS, Fiserv, Jack Henry, + many vendors focusing on digital platforms
- Fiserv's 10-K: *services are typically provided under a fixed or declining (tier-based) price per unit based on volume of service*
 - Fixed costs: investments in digital infrastructure
 - Variable costs: per-unit service fees