Does IT help?
Information Technology in Banking and Entrepreneurship

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IT revolution in Banking

Banks have massively invested in Information Technology (IT) since the late 90s

- *"We see ourselves as a technology company with a banking license"*
  Michael Corbat (Citibank CEO)
- *"We are a technology company"*
  Marianne Lake (JPMorgan Chase CFO)
- *"We want to be a tech company with a banking license"*
  Ralph Hamers (ING CEO)


JPMorgan Chase & Co + Add to myFT

JPMorgan plots 'astonishing' $12bn tech spend to beat fintechs

Big increase in investment will hurt profitability, raising fears for rival bank earnings in 2022

Literature (e.g. Rajan and Petersen 2002) discusses impact of IT on credit and borrowers, but direct evidence still incomplete

Why the focus on Startups/Entrepreneurship?

Startups are "opaque" (have not produced much hard info), so financing sensitive to banks' ability to collect and use information

- maybe IT diminishes incentives to collect soft info, hurting startups?
- maybe IT facilitates the use of soft info, helping opaque borrowers?

Also, startups:

- often rely on external finance / bank credit (Robb and Robinson 2014)
- are paramount for job creation and productivity growth (Haltiwanger, Jarmin and Miranda, 2013; Klenow and Li, 2020)

This paper

Study how banks' IT adoption affects entrepreneurship

- Develop a simple model of bank lending and screening to derive predictions
- Construct US county-level exposure to bank IT adoption through historical geographical footprint

Main Results (model and empirical analysis)

- Higher exposure to IT-intensive banks $\Rightarrow$ Entrepreneurship $\Uparrow$
  - Results driven by collateral lending channel: IT increases sensitivity of entrepreneurship to changes in housing wealth
  - Bank-level IV approach (landgrant colleges and banks' HQ): SME lending of IT intensive banks more responsive to house price growth

A simple model of IT in banking and entrepreneurship

A sketch of the model

Key elements

- banks (high or low IT) randomly match with potential borrowers: old or young firn
- firms need external funds to invest in a project
- project quality known only to the firm (asymmetric information)

$\Rightarrow$ need for screening: through info acquisition or collateral

Heterogeneity

- young firms are **opaque**: costly screening through *info acquisition*
- high-IT banks relatively better at screening via collateral
  - easier to transmit info on collateral within the bank (Petersen and Rajan, 2002)
  - IT improved real-estate related operations (Jud et al., 2002; Kummerow and Lun, 2005; Sawyer et al., 2005)

Equilibrium

- young firms with enough collateral receive funds from high-IT banks
- all banks lend to old firms by acquiring information about them
- young firms of high quality with insufficient collateral are not funded

Testable implications

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- **Prediction 4**: Share of high IT banks $\Uparrow \Rightarrow$ same "quality" of startups
- (Prediction 5: high-IT banks increases the share of lending to young firms by less in recourse states than in non-recourse)
- (Prediction 6: role of distance is less important for high-IT banks)
- We test each of these hypotheses (today only 1–4)

Taking the model to the data

Data on young firms

Quarterly Workforce Indicators (QWI)

- Detailed data on end-of-quarter employment at the county-two-digit industry-year level
- Breakdown by firm age brackets
- Define young firms or entrepreneurs as firms aged zero to one following Adelino, Ma & Robinson (2017) and aggregate the data to the county level
- In our baseline specification we scale the job creation of young firms by total employment in the same county-industry cell

IT Data

Survey data from Aberdeen (previously Harte Hanks)

- PCs/Employee in the US in 1999, 2003, 2004, 2006, 2016
- For 2016 we have the IT budget
- Used in many seminal papers on IT-adoption (non-financial)
  - e.g. Beaudry et al., 2010 JPE; Bloom et al., 2012 AER; Bresnahan et al., 2002 QJE
- Highly correlated with IT budget and adoption of new technologies (Cloud Computing) for later years, 65%

Measuring IT adoption

At the **bank level**, aggregate from branch-level regression (Pierri & Timmer JME 2022):

- Purge $\widetilde{IT}_b$ from local demand factors, branch size, time trends

$$PCs/Emp_{i,t} = \widetilde{IT}_b + \theta_c + \theta_{type} + \theta_t + \gamma \cdot Emp + \epsilon_{i,t}$$

At the **county level**:

- Merge the $\widetilde{IT}_b$ with with FDIC summary of deposits
- Geographic footprint of banks across counties (as of 1999)

$$IT_{county} = \sum_{b=1}^{N} \widetilde{IT}_b * \frac{No.Branches_{b,county}}{No.Branches_{county}}$$

  - $No.Branches_{b,county}$ is the number of branches of bank b in the county
  - $No.Branches_{county}$ is the total number of branches across all banks in the county
  - IT_{county} is standardized with mean zero and standard deviation of one

Prediction 1

Prediction 1: Share of high IT banks $\Uparrow \Rightarrow$ Share of lending to young firms $\Uparrow$ (higher share of entrepreneurs)

We estimate the following county-sector level regression:

$$JobCreation^{Y}_{county,s} = \alpha + \beta_1 IT_{county} + \epsilon_{county,s} \quad (1)$$

- $JobCreation^{Y}_{county,s}$ is defined as the job creation by young firms in a county (c) in sector (s), scaled by total employment in the county-sector cell
  - The share is averaged across the years 2000 to 2006
- IT_{county} is the county exposure to IT banks
- S.E. are clustered at the county level, counties weighted by population
- Controls include: local industrial structure, local IT adoption by non-financial firms, education, income, density, total population, share of black population, population age, average unemployment rate

Prediction 1: Results

VARIABLES	(1) share 0-1	(2) share 0-1	(3) share 0-1	(4) share 0-1	(5) share 0-1
IT exposure	0.462***	0.405***	0.378***	0.380***	
	(0.118)	(0.100)	(0.099)	(0.100)	
IT exposure × ext. fin. dep				0.714***	0.692***
				(0.185)	(0.181)
Observations	25,779	25,779	25,779	25,779	25,779
R-squared	0.003	0.046	0.248	0.248	0.350
County Controls	-	✓	✓	✓	-
NAICS FE	-	-	✓	✓	✓
County FE	-	-	-	-	✓
Cluster	County	County	County	County	County

- One st. dv. $\Uparrow$ bank IT $\Rightarrow \Uparrow \approx$ 0.4 pp job creation of young firms
- Comparison: decline of entrepreneurship since 1990 $\approx$ 3 pp
- Impact stronger in industries with higher external finance dependence à la Rajan & Zingales

Collateral Values

County-year panel to test **predictions 2 & 3**

Prediction 2: Collateral values $\Uparrow \Rightarrow$ Lending to young firms $\Uparrow$

- Increase in house prices raises home equity values of potential entrepreneurs
- Exploit heterogeneous house price growth across counties, $\Delta HP_{c,t}$

$$JobCreation^{Y}_{c,s,t} = \beta_1 \Delta HP_{c,t} + \epsilon_{c,s,t}$$

Prediction 3: Collateral values $\Uparrow$ & Share of high IT banks $\Uparrow \Rightarrow$ Lending to young firms $\Uparrow \Uparrow$

- Effects of rising house prices stronger in more IT-exposed areas

$$JobCreation^{Y}_{c,s,t} = \beta_1 \Delta HP_{c,t} + \beta_2 \Delta IT_c + \beta_3 IT_c * \Delta HP_{c,t} + \epsilon_{c,s,t}$$

Results

VARIABLES	(1) share 0-1	(2) share 0-1	(3) share 0-1	(4) share 0-1	(5) share 0-1	(6) share 0-1	(7) share 0-1	(8) share 0-1
IT exposure	0.348***		0.341***					
	(0.111)		(0.110)					
Δ HPI		0.020**	0.024**	-0.024**	-0.041***	-0.034***		
		(0.010)	(0.010)	(0.011)	(0.014)	(0.011)		
IT exposure × Δ HPI				0.075***	0.064**	0.071**		
				(0.027)	(0.032)	(0.029)		
IT exposure × Δ HPI × Low SU							0.136***	
							(0.051)	
IT exposure × Δ HPI × Homeequity								0.175**
								(0.087)
Observations	195,220	214,327	194,535	192,402	168,836	168,836	192,097	192,097
R-squared	0.008	0.006	0.008	0.564	0.581	0.597	0.621	0.621
County × NAICS FE	-	-	-	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	-	-	-
Year FE × NAICS FE	-	-	-	-	-	✓	✓	✓
County × Year FE	-	-	-	-	-	-	✓	✓
Cluster	County	County	County	County	County	County	County	County

- $\beta_1 > 0 \Rightarrow$ Prediction 2 (as in Adelino, Shoar, & Severino 2015)
- $\beta_3 > 0 \Rightarrow$ Prediction 3
- β_3 larger in industries where home equity is more used to start companies or average startup capital is low

IT in banking and Transition Rates

Prediction 4: Share of high IT banks $\Uparrow \Rightarrow$ = "quality" of startups

- no direct info on startup survival or defaults
- but can look at "transition rates" = how much has the employment at startups created in a given year growth or shrank?

$$transition_{county,s,t} = \frac{Employment\ Age\ 2to3_{county,s,t+2} - Employment\ Startup_{county,s,t}}{Employment\ Startup_{county,s,t}}$$

	(1)	(2)	(3)
VARIABLES	employment transition rate age 0-1 to 2-3 (average)		
IT exposure	-0.000237	-0.000332	-0.000352
	(0.000449)	(0.000410)	(0.000401)
Observations	23,729	23,729	23,729
R-squared	0.000	0.005	0.068
County Controls	-	✓	✓
NAICS FE	-	-	✓
Cluster	County	County	County

We find no correlation between average transition rates and county-exposure to IT in banking: $\Rightarrow$ more startups and not of worse quality

Bank-level results

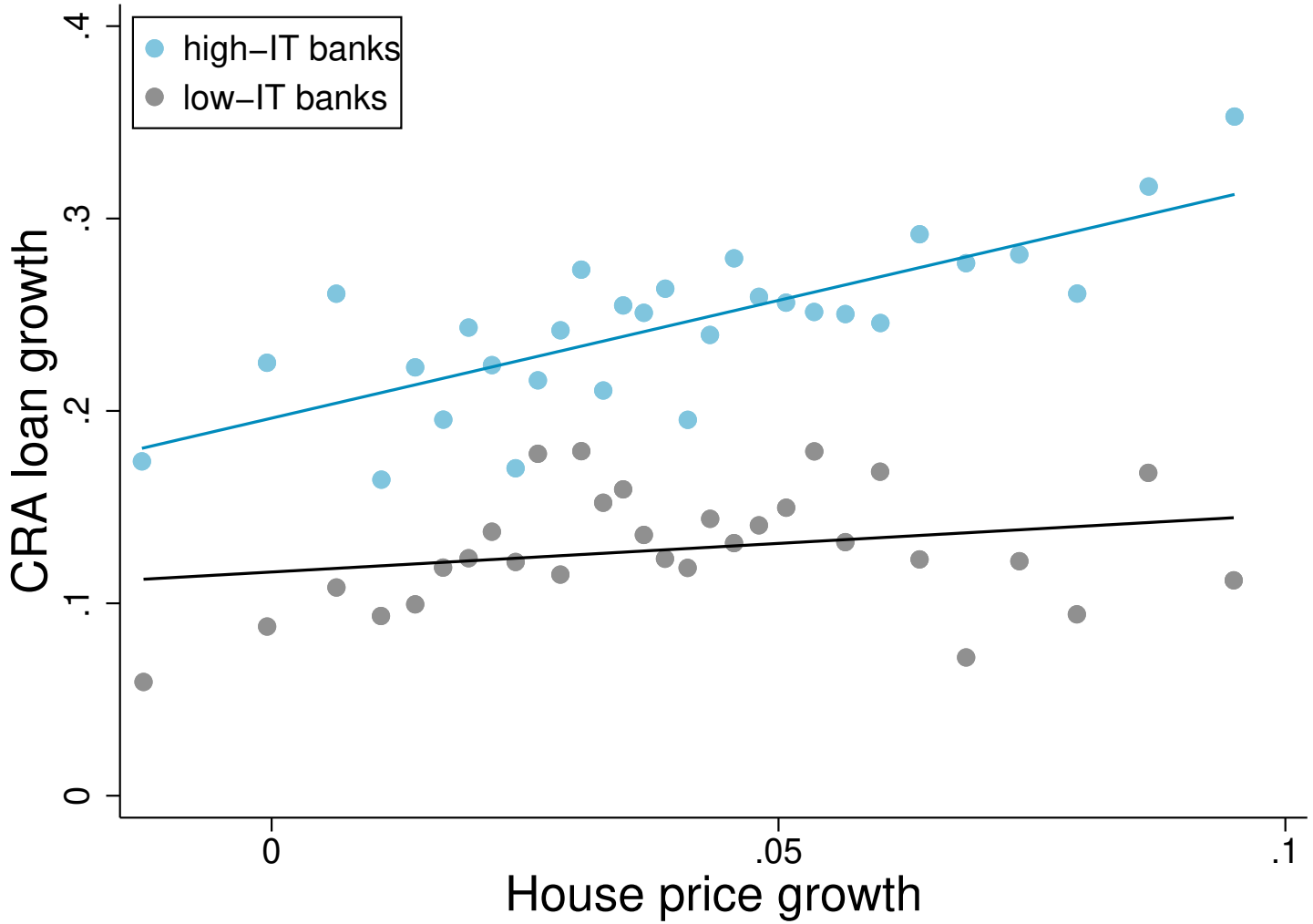
Construct bank-county-year panel:

- bank-county-year CRA data for loans $\leq$ 1 mn USD (or $\leq$ 100 k USD)
- study how $\Delta loans_{b,c,t}$ respond to house prices, borrower-lender distance, and local income shocks
- ... as a function of bank-level IT

Findings:

- high IT banks' small business lending respond more to house prices rises $\rightarrow$ Prediction 3
- low IT banks' respond less to local income shocks of counties farther away; high IT banks respond similarly to shocks in close and far counties $\rightarrow$ Prediction 6

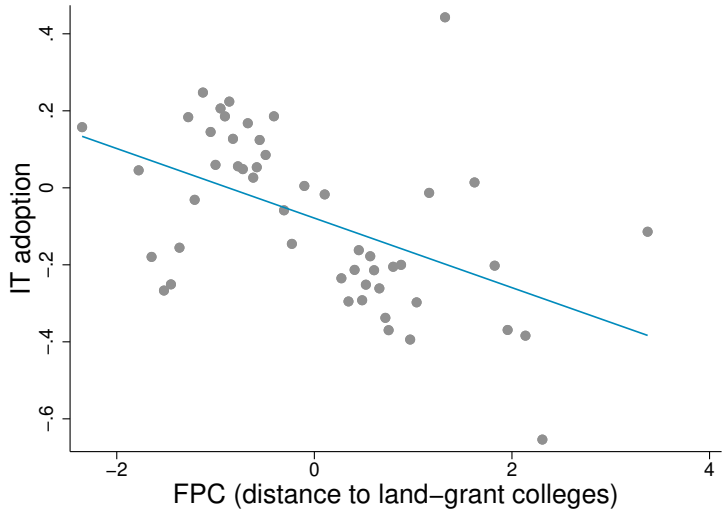
SME credit, Bank's IT, and House Prices



IV Approach

IT adoption could be correlated with unobservable bank-level confounding factors (e.g., management practise)

- we instrument bank-level IT with distance between BHC HQ and land-grant colleges (Pierri and Timmer 2022, He et al. 2021)
- colleges established in 19th century to provide technical education (and even today students mostly in technical subjects) $\Rightarrow$ shifter of technical knowledge
- $\Rightarrow$ BHC HQ farther away from LG lead to lower IT adoption
- IV estimates confirm bank-level result



Conclusion

- Entrepreneurship has declined during the years of the IT revolution in finance (and other industries)
- This paper studies the connection between adoption of IT in banking and entrepreneurship
- Prediction: IT in banking can spur entrepreneurship, through a strengthened collateral lending channel
- Results are confirmed empirically using data on IT adoption of US banks