Does IT help?
Information Technology in Banking and Entrepreneurship

Toni Ahnert Sebastian Doerr Nicola Pierri Yannick Timmer

Bank of Canada, BIS, IMF, Fed Board

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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)

However, evidence on the impact on this revolution on borrowers is scarce and indirect (e.g. Rajan and Petersen 2002)

Why the focus on Startups/Entrepreneurship?

Startups are "opaque" (have not produced much hard info)

- financing sensitive to banks ability collection and use of information
- maybe IT diminishes incentives to collect soft info hurting startups?
- maybe IT maximizes the use of scarce info helping opaque borrowers?

Also, startups are very important for job creation and productivity growth (Haltiwanger, Jarmin and Miranda, 2013; Klenow and Li, 2020)

This paper

- Study banks' reliance on IT and entrepreneurship
- Construct US county-level exposure to bank IT adoption through historical geographical footprint
- Propose a simple model of bank lending and screening

Main Results

- Model and empirical analysis: exposure to IT-intensive banks $\Uparrow \Rightarrow$ Entrepreneurship $\Uparrow$
  - collateral lending channel
    - borrowing against housing wealth
    - use house prices to provide evidence for this channel
  - IV approach (plausibly exogenous variation in local bank footprint) confirms main results

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: firms (old or young)
- firms need 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**: NO *info acquisition* screening
- high IT banks relatively better on collateral screening (e.g. better at assess collateral value and communicate with HQ–evidence on this later)

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

- **Prediction 1**: Share of high IT banks $\Uparrow \Rightarrow$ Share of lending to young firms $\Uparrow$ (higher share of entrepreneurs)
- **Prediction 2**: Collateral values $\Uparrow \Rightarrow$ Share of lending to young firms $\Uparrow$
- **Prediction 3**: Collateral values $\Uparrow$ & Share of high IT banks $\Uparrow \Rightarrow$ Share of lending to young firms $\Uparrow \Uparrow$
- **Prediction 4**: Share of high IT banks $\Uparrow \Rightarrow =$ "quality" of startups
- We test each of these hypotheses

We also provide evidence supporting model's assumptions (e.g. high IT banks comparative advantage in collateral screening)

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 2020):

- 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:

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

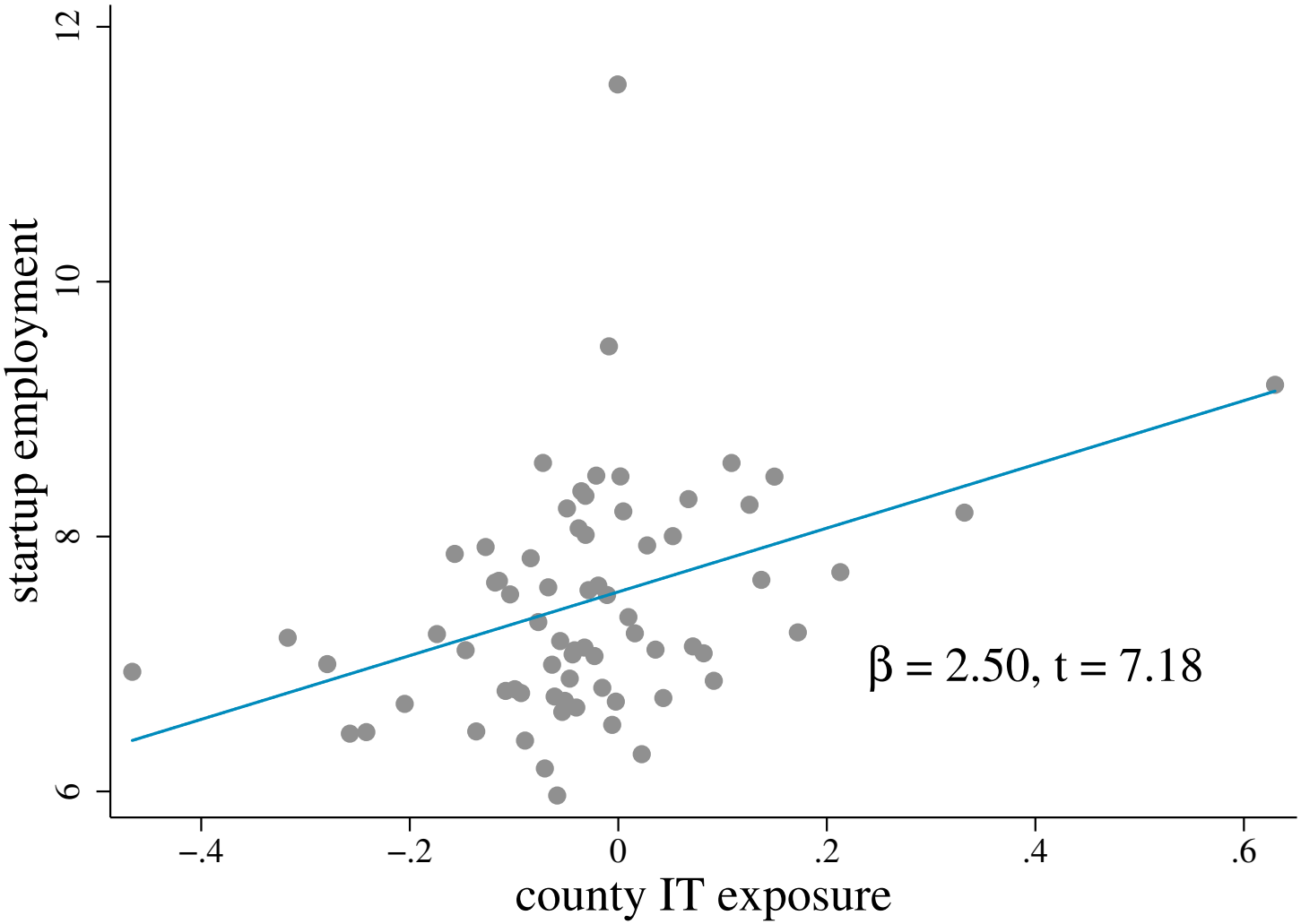
- $JobCreation^{Y}_{county,s}$ is defined as the job creation by young firms in a county (c) in sector (s), scaled by total employment in the county-sector cell
  - The share is averaged across the years 2000 to 2006
- IT_{county} is the county exposure to IT banks
- S.e. are clustered at the county 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

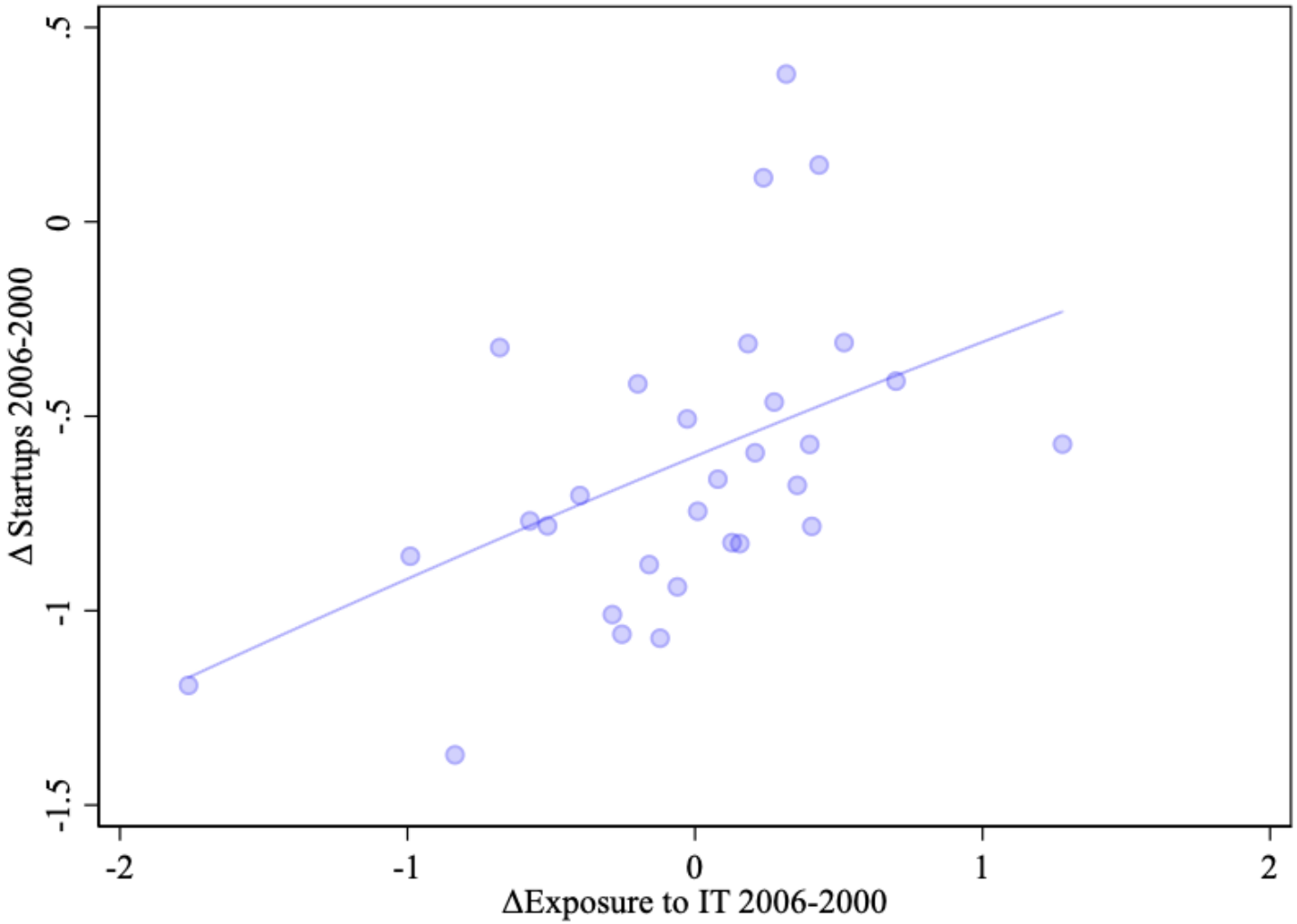
VARIABLES	(1) share 0-1	(2) share 0-1	(3) share 0-1	(4) share 0-1	(5) share 0-1
IT exposure	0.455***	0.397***	0.370***	0.373***	
	(0.118)	(0.098)	(0.098)	(0.098)	
IT exposure × ext. fin. dep				0.698***	0.677***
				(0.179)	(0.176)
Observations	25,742	25,742	25,742	25,742	25,742
R-squared	0.003	0.047	0.252	0.252	0.354
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 (average $\approx$ 9%)
- Impact stronger in industries with higher external finance dependence à la Rajan & Zingales

Prediction 1 - Binscatter



Same pattern if focus on changes over time



- Confirmed by regression model

Instrumental Variable Approach

Threat to identification: some unobservable county's characteristic may attract both entrepreneurs and high-IT adoption banks

- Gravity model and staggered interstate banking deregulation $\Rightarrow$ exogenous variation in bank's local presence
  1. Predict banks' geographic distribution of deposits across counties with a gravity model: *i*) distance between banks' headquarters and branch counties, *ii*) relative market size (Goetz et al 2013, 2016)
  2. Adjust predicted deposits with state-level index of deregulation (Rice and Strahan 2010)

Instrument for county IT: "synthetic" IT exposure computed by using predicted bank local footprint (rather than actual presence)

IV Result

VARIABLES	(1) share 0-1	(2) IT exposure	(3) share 0-1	(4) share 0-1
IT exposure	0.319***			0.526***
	(0.109)			(0.143)
IT exposure - gravity RS approach		0.640***	0.337***	
		(0.0667)	(0.0889)	
Observations	19,293	19,293	19,293	19,293
R-squared	0.246	0.536	0.247	0.051
County Controls	✓	✓	✓	✓
NAICS FE	✓	✓	✓	✓
County FE	-	-	-	-
Cluster	County	County	County	County
Estimator	OLS	OLS	OLS	IV
Instrument	-	-	-	Gravity/RS

- IV estimate not statistically different from OLS

  $\Rightarrow$ We continue with OLS

Collateral Values

County-industry-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

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

Collateral 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, Schoar, & 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?

$$transition_{county,s,t} = \frac{EmploymentAge2to3_{county,s,t+2} - EmploymentStartup_{county,s,t}}{EmploymentStartup_{county,s,t}}$$

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

	(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

Conclusion

- Entrepreneurship has declined during the years of the IT revolution in finance (and other industries)
- This paper study connection between adoption of IT in banking and entrepreneurship
- A parsimonious model shows that IT in banking can spur entrepreneurship by making it easier to borrow against collateral–especially when collateral values increase
- Results are confirmed empirically using data on IT adoption of US banks

Results even more important nowadays as role of non-banks and FinTech in lending to SME increased since GFC (Gopal & Schnabl 2020)