The Impact of Bank Credit on Labor Reallocation and Aggregate Industry Productivity

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Question Addressed

- How do financial markets improve the allocation of resources and, as a consequence, aggregate productivity?
  - Growing body of evidence suggests that improvements in financial markets can significantly contribute to economic growth
  - Common interpretation: financial markets move resources towards the best economic opportunities → higher aggregate productivity
  - But limited *direct* evidence on how finance affects aggregate productivity

→ If all firms have better access to finance, why is there a shift towards more productive firms?

→ What is the importance of labor reallocation in driving these gains?

This Paper

We study how banks affect aggregate productivity by shaping the allocation of credit across existing firms – consider the role of labor reallocation

- Basic Idea: Banks are important in determining which firms are financed (monitoring and screening) → changes in banking markets can have first-order effects on the composition of credit supply

- Banks shift their loan portfolio towards firms with higher productivity within an industry → allocation of resources between existing firms becomes more aligned with their productivity → higher *aggregate* industry productivity

- Composition effect – same aggregate resources lead to higher industry output when the industry's capital and labor shifts towards more productive existing firms – intensive-margin allocation of resources and industry productivity

Empirical Setting

U.S. state banking deregulation: significant reforms that changed local banking markets by removing restrictions on the ability of outside banks to operate a local branch (focused reform)

- Previous research arguing that deregulation associated with significant improvements in bank credit allocation
  - Higher local growth, no changes in aggregate loan volume, and reductions in nonperforming loans (Jayaratne and Strahan (1996, 1998)) – but no direct evidence on previous changes in credit composition

- One reason to expect shift in credit composition towards more productive firms: improved selection mechanism for local banks
  - Consistent with evidence from bank balance sheets

- Also, increased competitive pressure on local banks might lead to stronger incentives for performance

Effects on Credit Composition and Resource Allocation?

- But impact of deregulation on credit composition among small firms is unclear:
  - New (larger) banks might not have comparative advantage in small-business lending and reduce deposit availability for previous local banks
  - Reductions in bank market power can harm relationship formation (Petersen and Rajan (1995)) and simply lead banks to lend less to all small business – as opposed to change in the credit composition
  - Similarly, increased bank entry might simply lead to a drop in interest rate – increase the availability of credit for all firms

- Even if credit composition shifts towards more productive firms, effect needs to be strong to matter for industry productivity

Overview of Results

- **First Contribution:** provide evidence that local banking deregulation is associated with a significant shift in the composition of bank credit supply towards more productive firms (within industry)
  - Census real and financial data covering all range of manufacturing firms
  - Control for credit demand effects and limited average effects
  - Effect mostly driven by youngest firms (new banking relationships)

- **Second Contribution:** evidence that these changes in credit allocation lead to a significant reallocation of resources (labor and capital) towards more productive firms and important industry productivity gains
  - Increases in the relative growth of more productive firms
  - Reduced gaps between the marginal products of more versus less productive firms (less misallocation within industry)
  - Simple approach to quantify the implied industry productivity gains

Role of Labor Reallocation

- **Third Contribution:** evidence on the importance of labor reallocation in driving the previous productivity gains
  - Reductions in marginal product gaps for labor are significant (drops in labor misallocation) and comparable to effects for capital
  - But labor is more important in production → greater role in driving productivity gains

- What explains reductions in labor misallocation?
  - Natural explanation: firms are financially constrained in their ability to hire or retain more workers – need for net working capital due to difference in timing between payments to workers and receipts from sales (Jermann and Quadrini (2012)).
  - Capital has financing advantage – firms can lease capital or pledge it as collateral - quality of financial intermediation might matter for financing labor

Data Sources and Sample

- Overall Sample: universe of single-establishment U.S. manufacturing firms between 1977 and 1993 – 76% of all manufacturing establishments
  - Need firms with operations focused in a state and industry

- Census LBD – annual plant-level employment information for universe of U.S. private establishments – initial list of firms

- Census LRD (Census years) – information on plant sales, capital, hours, inputs – used to estimate plant productivity

- Census QFR (Census years) – firm balance sheet information – bank debt, nonbank debt, total assets

Summary Statistics

Real Variables	Mean	StdDev	Nobs
Employment	22.28	46.23	2,287,000
Sales ($1987 1K)	1,446	4,047	2,287,000
Employment Growth	0.0089	0.4621	2,287,000
Employment Share	0.0272	0.0834	2,287,000

Financial Variables	Mean	StdDev	Nobs
Bank Debt Share	0.5912	0.3918	17,000
Bank Debt Ratio	0.1675	0.2186	20,000
Non-bank Debt Ratio	0.1214	0.2852	20,000

State Banking Deregulation

- Involved the removal of restrictions on banks' ability to operate branches in: (i) different regions within their state (intrastate deregulation), (ii) other states (interstate deregulation)
  - Construct state-level deregulation index capturing both restrictions

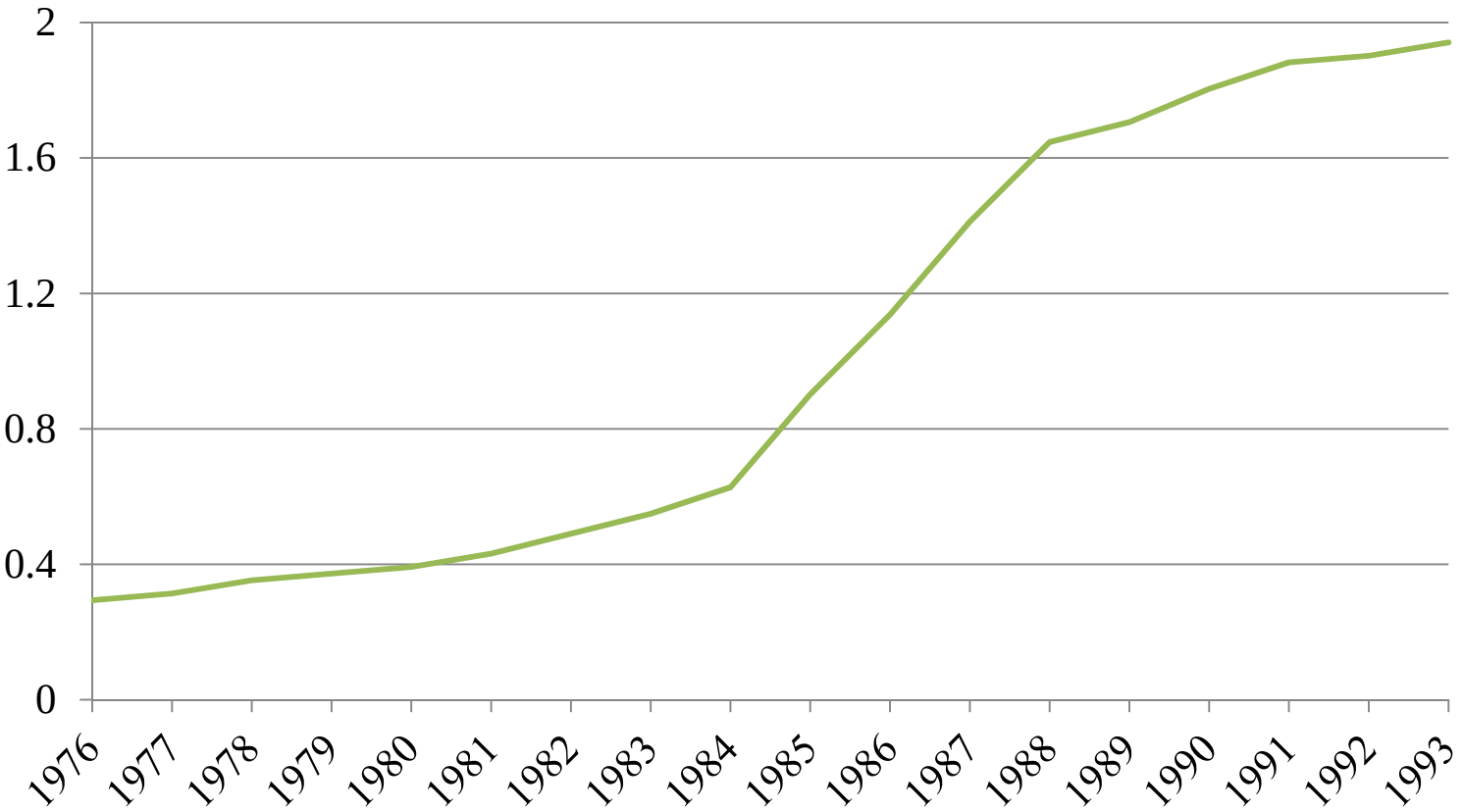
- These deregulations are *staggered* at the state level (between the 1970s and 1993) and small firms rely heavily on loans from local banks for financing over this period

- Timing of deregulation largely driven by national-level technological changes combined with state initial conditions (Krozsner and Strahan (1999))

Bank Credit Allocation - Evidence

- Analyze relative importance of bank versus nonbank debt within a firm-year over time to isolate shifts in bank credit supply
- Combine initial state-level differences in deregulation with timing of national wave in deregulation
  - Convergence between states initially deregulated and other states after national-level wave
- Examine changes in the within-industry-state relationship between firm productivity and bank debt
- Effects should bee strongest for youngest firms (if driven by bank selection) - new bank relationships being formed

National-Level Deregulation Wave
Average Value of Deregulation Index



Deregulation Index (Dereg) = Intra_Dereg + Inter_Dereg

Intra_Dereg = equals one if state has passed intrastate deregulation

Inter_Dereg = equals one if state has passed interstate deregulation

Bank Debt Share Analysis

$$BankDShare_{isjt} = \alpha_{sjt} + \gamma_0 \times TFP_{isjt} + \gamma_1 \times Pre_t \times TFP_{isjt} + \gamma_2 \times IDereg_s \times TFP_{isjt} + \boldsymbol{\beta \times Pre_t \times IDereg_s \times TFP_{isjt}} + \delta' X_{isjt} + \varepsilon_{isjt},$$

Bank Debt Share: ratio of bank debt to total debt

TFP: log of total factor productivity

$IDereg_s$: initial value of banking deregulation index

Pre_t: indicator that equals one prior to deregulation wave

α_{sjt}: denotes industry-state-year fixed effects; X_{isjt}: additional controls

- Controls for state fixed differences and time-series changes in the sensitivity of bank debt share to firm productivity
- Identification comes from the convergence in deregulation across states after the national-level wave – differential impact across states
- Estimate results separately for age groups

Bank Debt Share Results

	Young (age 1-10)	**Old (age 11+)**
Pre × Initially Deregulated × TFP	0.2049***	0.0369
	(0.0515)	(0.0460)
Industry-State-Year FE	Yes	Yes
R-Square	0.04	0.02
Nobs	4,000	10,000

	Young (age 1-5)	**Young (age 6-10)**
Pre × Initially Deregulated × TFP	0.2937***	0.1767***
	(0.0650)	(0.0674)
Industry-State-Year FE	Yes	Yes
R-Square	0.06	0.04
Nobs	2,000	2,000

Reported effect – relative change for firms in top versus bottom TFP quartiles (i.e., coefficient multiplied by within-industry-state TFP gap between bottom and top quartiles)

Mean of Bank Debt Share – 0.59 – <u>effects are economically large</u>

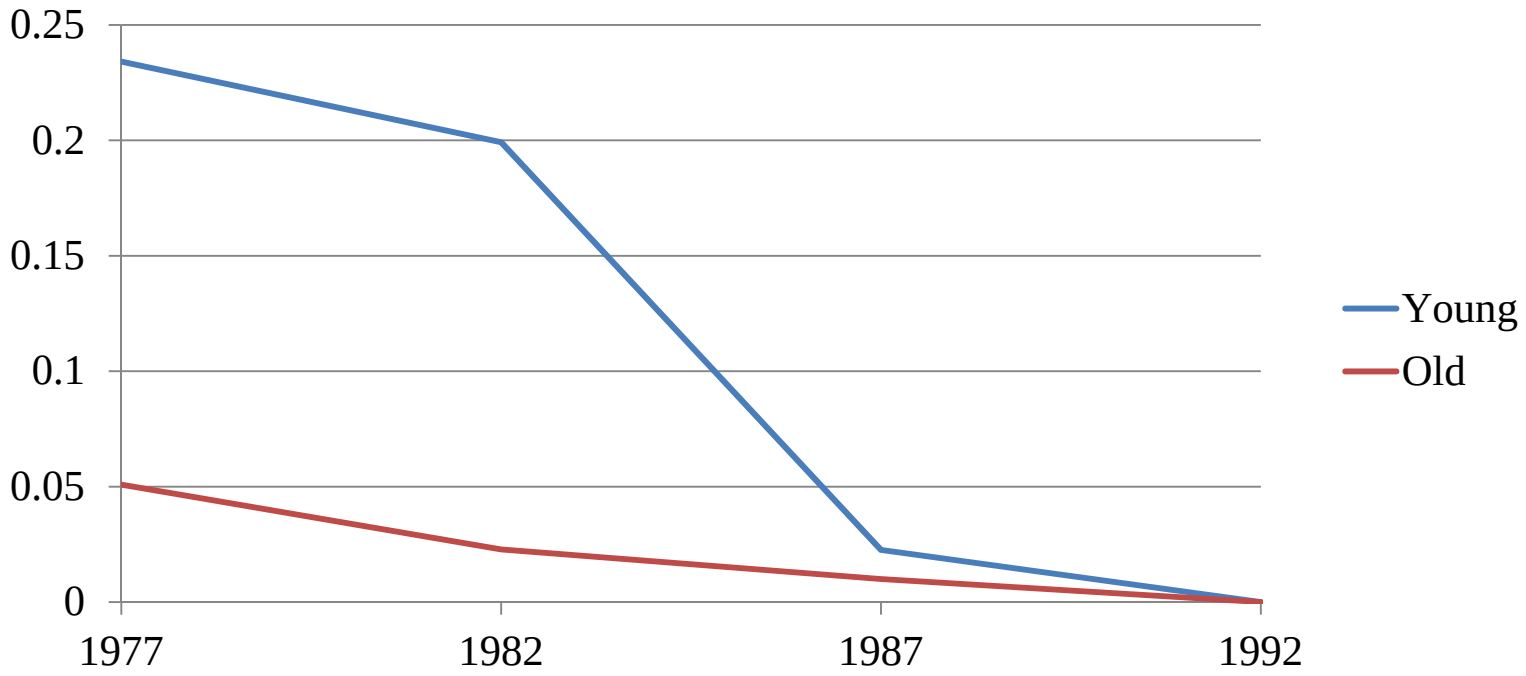
Bank Debt Share Results

	Young (age 1-10)	**Young (age 1-5)**
Pre × Initially Deregulated × TFP × Young	0.1814***	0.2609***
	(0.0648)	(0.0997)
Industry-State-Year-Age Group FE	Yes	Yes
R-Square	0.02	0.02
Nobs	14,000	12,000

Previous results - change in link between debt share and TFP after convergence in deregulation – estimated for different age groups

This result – differential change in link for youngest firms – similar magnitudes to previous effects for youngest firms

Bank Debt Share Results – Timing of Effects



Differences in the link between bank debt share and TFP over time – initially deregulated states versus other - relative to the same link in 1992 (end of sample)

Convergence in link for young firms matches the timing of convergence in local banking deregulation (deregulation convergence mostly takes place in 83-88)

Bank Debt Share - Additional Results

- Limited changes in average of bank debt share – previous effects without TFP interaction - statistically insignificant – magnitude about 10 times smaller than the one from previous effects

- **Falsification Test #1**: exogenous shocks to state-level growth (Bartik instrument) do not lead to similar patterns

- **Falsification Test #2**: conditional on deregulation, state-level growth is not correlated with similar patterns

- Results are similar when estimated using only cross-sectional differences in state deregulation (at same point in time) and age interaction does not capture size

Bank Debt Level Results

	Young (age 1-5)	
	Bank Debt Ratio	Non-Bank Debt Ratio
Pre × Initially Deregulated × TFP	0.1407***	-0.0532
	(0.0462)	(0.1131)

Mean of Bank Debt Ratio and Non-Bank Debt Ratio (Young) – 0.20 and 0.18, respectively

	Old (age 11+)	
	Bank Debt Ratio	Non-Bank Debt Ratio
Pre × Initially Deregulated × TFP	0.0088	-0.0211
	(0.0177)	(0.0215)

Mean of Bank Debt Ratio and Non-Bank Debt Ratio (Old) – 0.15 and 0.10, respectively

Resource Reallocation Effects

- Examine if previous shifts in credit allocation are associated with changes in the relative growth of more productive firms within a local industry (conditional on age)

- Analyze differential effect among youngest firms – where there is a differential change in the composition of bank credit supply

- Annual data on employment growth available - estimate how the relative growth of more productive firms changes around deregulation in a state – control for firm fixed differences in their growth rate
  - Labor decisions might be affected directly or indirectly (through changes in capital) by the availability of bank credit

- Also consider changes in firm investment (available in census years)

Labor Reallocation and Banking Deregulation

$$EmpGrowth_{isjt} = \alpha_{sjt} + \mu_i + \gamma_s \times TFP_{isjt} + \theta_t \times TFP_{isjt} + \boldsymbol{\beta \times Dereg_{st} \times TFP_{isjt}} + \delta' X_{isjt} + \varepsilon_{isjt},$$

TFP: log of total factor productivity (last census); *Dereg*: banking deregulation index; θ_t: year fixed effects; γ_s: state fixed effects; μ_i: firm fixed effects

Controls for state fixed differences and time-series changes in the link between employment growth and TFP - identification comes from the timing of reform across states

Separately estimate this specification for different age groups – focus on the difference between the value of β for young versus old firms

Labor Reallocation Results

	Employment Growth	
Dereg × TFP × Young1	0.0149***	0.0213***
	(0.0019)	(0.0023)
Dereg × TFP × Young2		0.0151***
		(0.0026)
Dereg × TFP	0.0026	-0.0042**
	0.0024	(0.0022)
R-Square	0.07	0.07
Nobs	2,287,000	2,287,000

As before, coefficients are multiplied by TFP gap between top and bottom quartiles of local industries (industry-state)

Young1 (Young2) – firms with age between 1 and 5 (6 and 10) in the last census

Labor Reallocation Results - Dynamics

	Employment Growth	
Dereg(-1 to -3) × TFP × Young1	0.0009	
	(0.0021)	
Dereg(-1 to -6) × TFP × Young1		-0.0021
		(0.0022)
Dereg × TFP × Young1	0.0138***	0.0117***
	(0.0023)	(0.0022)
R-Square	0.07	0.07
Nobs	2,287,000	2,287,000

Dereg(-1 to -6) = Inter_Dereg(-1 to -6) + Intra_Dereg(-1 to -6)
Inter_Dereg and Intra_Dereg – indicators that equal one in the six years prior to deregulation
Dereg(-1 to -3) defined in analogous way using three years prior to deregulation

Capital Reallocation and Banking Deregulation

$$PPEGrowth_{isjt} = \alpha_{sjt} + \gamma_s \times TFP_{isjt} + \theta_t \times TFP_{isjt} + \boldsymbol{\beta \times Dereg_{st} \times TFP_{isjt}} + \delta' X_{isjt} + \varepsilon_{isjt},$$

Same specification as before, but now without firm fixed effects - data is available only in Census years (every five years) – want to include youngest firms

Separately estimate this specification for different age groups – focus on the difference between the value of β for young versus old firms

Capital Reallocation Results

	Net PPE Growth	
Shock × TFP × Young1	0.0041***	0.0040***
	(0.0012)	(0.0015)
Shock × TFP × Young2		0.0019
		(0.0014)
R-Square	0.02	0.02
Nobs	398,000	398,000

As before, coefficients are multiplied by TFP gap between top and bottom quartiles of local industries (industry-state)

Young1 (Young2) – firms with age between 1 and 5 (6 and 10) in the last census

Identification Concerns

(1) Deregulation events might be correlated with changes in local economic conditions (note the absence of pre-trends) – results might not capture effect of deregulation

(2) Deregulation might cause changes in local economic conditions and drive the effects through alternative channels

- In order to explain the results, the effects in (1) and (2) need to lead to an increase in the relative growth of more productive firms which is only important within the youngest firms

  - Previous evidence suggests that young existing firms are not more sensitive to local economic shocks than older firms
  - Changes in entry and contestability of product markets should matter more for older firms

Falsification Tests

- Examine if changes in local economic conditions or specific changes in local demand, input markets, or labor markets can generate the patterns in the previous results – different alternative mechanisms

$$EmpGrowth_{isjt} = \alpha_{sjt} + \mu_i + \gamma_s \times TFP_{isjt} + \theta_t \times TFP_{isjt} + \boldsymbol{\beta \times Shock_{sjt} \times TFP_{isjt}} + \delta' X_{isjt} + \varepsilon_{isjt},$$

Shock = captures a shock to state overall economic conditions or to other local industries where there are strong spillovers in terms of local demand, input markets, or labor markets

As before, separately estimate this specification for different age groups – focus on the difference between the value of β for young versus old firms

Falsification Tests – Broad Local Conditions I

- Analyze exogenous shocks to local economic conditions – predict shocks using combination of initial industry composition with national-level changes in industry conditions (Bartik approach)

	Employment Growth	
Shock × TFP × Young1	-0.0039	-0.0048
	(0.0045)	(0.0049)
Shock × TFP × Young2		-0.0032**
		(0.0015)
R-Square	0.01	0.01
Nobs	2,287,000	2,287,000

Shock – predicted increase in local employment between current year and initial sample year

Reported effects – capture a one standard deviation change in *Shock* – effect on relative growth of top vs. bottom *TFP* quartiles (as before)

Falsification Tests – Broad Local Conditions II

- Analyze simple changes in local economic conditions conditional on bank deregulation (avoid capturing previous effects)

	Employment Growth	
Shock × TFP × Young1	0.0005	0.0009
	(0.0021)	(0.0022)
Shock × TFP × Young2		0.0013
		(0.0010)
R-Square	0.01	0.01
Nobs	2,287,000	2,287,000

Shock – realized increase in local employment between current year and initial sample year

Reported effects – capture a one standard deviation change in *Shock* – effect on relative growth of top vs. bottom *TFP* quartiles (as before)

Falsification Tests – Local Demand Effects

- Use previous approach to capture local exogenous shocks – but focus on growth shocks to local customers (input-output tables) – capture shifts in local demand for the industry

	Employment Growth	
Shock × TFP × Young1	-0.0039	-0.0022
	(0.0023)	(0.0016)
Shock × TFP × Young2		0.0009
		(0.0011)
R-Square		0.01
Nobs		2,287,000

Shock – predicted increase in employment of local customers between current year and initial sample year

Reported effects – capture a one standard deviation change in *Shock* – effect on relative growth of top vs. bottom *TFP* quartiles (as before)

Falsification Tests – Input Market Effects

- Focus on growth shocks to local suppliers (input-output tables) – capture shifts in local input markets for the industry

	Employment Growth	
Shock × TFP × Young1	0.0002	0.0004
	(0.0002)	(0.0003)
Shock × TFP × Young2		0.0008
		(0.0006)
R-Square	0.01	0.01
Nobs	2,287,000	2,287,000

Shock – predicted increase in employment of local suppliers between current year and initial sample year

Reported effects – capture a one standard deviation change in *Shock* – effect on relative growth of top vs. bottom *TFP* quartiles (as before)

Falsification Tests – Labor Market Effects

- Focus on growth shocks to local industries which share similar workers – capture shifts in local labor markets for the industry

	Employment Growth	
Shock × TFP × Young1	0.0000	0.0004
	(0.0017)	(0.0022)
Shock × TFP × Young2		0.0007
		(0.0014)
R-Square	0.01	0.01
Nobs	2,287,000	2,287,000

Shock – predicted increase in employment of local industries with worker overlap between current year and initial sample year

Reported effects – capture a one standard deviation change in *Shock* – effect on relative growth of top vs. bottom *TFP* quartiles (as before)

How Does Deregulation Affect Reallocation?

- Overall, evidence supports idea that the previous shifts in the allocation of bank credit lead to a stronger link between firm growth and *TFP*
  - The increase in this link after deregulation is only present within the youngest firms, matching the same exact age pattern in the credit allocation effects
  - The magnitudes of the real and credit effects are consistent with each other
  - A range of falsification tests suggests that changes in local economic conditions, including possible effects through local demand, local input markets, and local labor markets are unlikely to drive the results

Implications for Industry Productivity?

- As the allocation of resources within an industry moves towards more productive firms, aggregate industry productivity should increase (e.g., Olley and Pakes (1996), Hsieh and Klenow (2009))

- Intuitively, these effects should be reflected in the marginal product gaps between more and less productive firms

- Financing frictions → prevent increases in the relative growth of more productive firms → marginal product gaps → industry productivity losses due to misallocation

- As banks shift credit supply towards more productive firms → increase in their relative growth → marginal product gaps should reduce

Implications for Industry Productivity?

- We first analyze this intuitive prediction with simple measures for gaps in the marginal product of firms within a same industry-state-year-age.

- We then consider what our findings imply for the industry productivity losses associated with resource misallocation – need explicit framework
  - Simple approach building on framework typically used in resource misallocation literature (e.g., Hsieh and Klenow (2009))

- Analyze the role of labor misallocation in this process (in addition to capital misallocation)
  - Should expect reductions in MPL gaps only if finance affects industry productivity by shaping the allocation of labor – e.g. frictions in financing labor
  - If labor simply moves in response to capital ("standard view") – should see labor reallocation but not convergence in MPLs

Labor and Capital Misallocation Effects

$$MPL_{isjt} = \alpha_{sjta(i)} + \beta_0 \times Pre_t \times IDereg_s \times TFP_{isjt} + \boldsymbol{\beta_1 \times Pre_t \times IDereg_s \times TFP_{isjt} \times Young_{isjt}} + \delta' X_{isjt} + \varepsilon_{isjt},$$

MPL = log(Y/L); in capital results use MPK = log(Y/K)

$\alpha_{sjta(i)}$: denotes industry-state-year-age fixed effects;

X_{isjt}: additional controls, including interactions with *TFP*

- *MPL* and *MPK* will capture gaps in marginal products if firms have similar factor elasticities within a same industry-state-age-year (e.g., Cobb-Douglas production function with parameters that can depend on industry-state-age-year)

- Data available only during Census years – same specification used in financial results

Labor and Capital Misallocation

	MPL		MPK
	Young (age 1 to 10)	**Young (age 1 to 5)**	**Young (age 1 to 10)**
Pre × Initially Deregulated × TFP × Young	-0.0254***	-0.0280***	-0.0208**
	(0.0074)	(0.0094)	(0.0101)
R-Square	0.01	0.01	0.01
Nobs	542,000	413,000	549,000

As before, coefficients are multiplied by TFP gap between top and bottom quartiles of local industries (industry-state)

Effects capture percentage drop in marginal product between top and bottom quartiles

Drops in gaps are significant for both labor and capital – similar effects with alternative specifications – initial MPL gap is 12%

Implications for Industry Productivity?

- Analyze implications for industry productivity losses in the context of monopolistic competition framework from misallocation literature (e.g., Hsieh and Klenow (2009))

- A firm *i* in industry *j* and time *t* produces output Q_{ijt} where:

$$Q_{ijt} = A_{ijt}\left(K_{ijt}\right)^{\alpha_j}\left(L_{ijt}\right)^{\beta_j}\left(M_{ijt}\right)^{\gamma_j}$$

A_{ijt}: time-variant and firm-specific productivity component

K_{ijt}: firm's capital stock

L_{ijt}: labor

M_{ijt}: materials

Implications for Industry Productivity?

- Firms face monopolistic competition in product markets – firms in the industry supply their output to a representative firm which produces a single industry output given by:

$$Q_{jt} = \left(N_{jt}\right)^{\frac{\rho-1}{\rho}} \left(\sum_i {Q_{ijt}}^{\rho}\right)^{1/\rho}$$

- This representative firm faces a competitive market for its output –with a fixed price that might change over time

- This leads to a constant elasticity of demand for output of industry firms – firm-specific prices P_{ijt}

Implications for Industry Productivity?

- We can write industry output as:

$$Q_{jt} = TFP_{jt}\left(K_{jt}\right)^{\alpha_j}\left(L_{jt}\right)^{\beta_j}\left(M_{jt}\right)^{\gamma_j}$$

A_{ijt}: time-variant industry total factor productivity

K_{jt}, L_{jt}, M_{jt}:industry's capital stock, labor, and materials

- Industry TFP will depend on the distribution of firm TFP and the allocation of resources across existing firms – can consider losses due to the intensive-margin misallocation of resources

- Under an assumption that firm productivity is lognormally distributed, these misallocation losses are proportional to $\mathrm{Var}\left(MPR_{ijt}\right)$, where $MPR_{ijt} = \alpha_j \log\left(\frac{Y_{ijt}}{K_{ijt}}\right) + \beta_j \log\left(\frac{Y_{ijt}}{L_{ijt}}\right)$ and $Y_{ijt} = P_{ijt}Q_{ijt}$ (assumed no misallocation in materials)

Implications for Industry Productivity?

- Can decompose these losses by predicting within-industry differences in MPR_{ijt} with TFP_{ijt}→ $MPR_{ijt} = \delta TFP_{ijt} + \varepsilon_{ijt}$

- Marginal product gaps between firms with different productivity is associated with a misallocation loss equal to $\delta^2 Var(TFP_{ijt})$

- Can use δ^2 to analyze how industry productivity losses change conditional on a TFP distribution

→ Results imply drops in industry misallocation between 30%-40%

→ Contribution of labor misallocation for these gains is important because labor has higher factor share

Concluding Remarks

- Provide evidence that local banking deregulation is associated with a significant shift in the composition of bank credit supply towards more productive firms

- Analysis suggests that these changes in credit allocation lead to a significant reallocation of resources (labor and capital) towards more productive firms and important industry productivity gains

- Contrasts with common view that labor is a sideshow for understanding implications of financial markets for aggregate productivity and growth – important to consider role of labor as source of economic gains

- Direct evidence that financial markets can have important implications for aggregate productivity through changes in the intensive-margin allocation of resources