

Bank Lending in the Knowledge Economy

Giovanni Dell’Ariccia^{1,5} Dalida Kadyrzhanova²

Camelia Minoiu³ Lev Ratnovski⁴

¹International Monetary Fund ²Georgia State University ³Federal Reserve Board
⁴European Central Bank ⁵CEPR

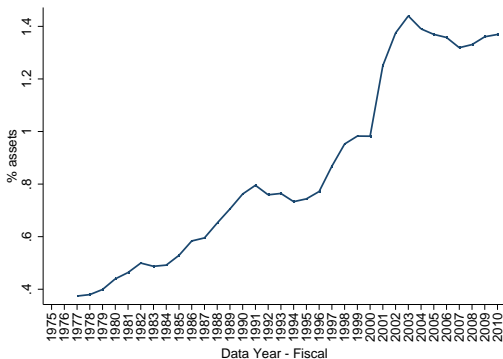
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Increasing importance of *IK* in the last 50 years

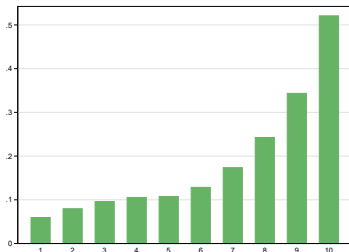
▶ Examples

- Aggregate investment in intangibles grew 5x relative to tangible investment (Corrado and Hulten (2010))
- Firm-level intangible capital (*IK*) more than tripled (Falato, Kadyrzhanova, and Sim (2015))



Knowledge Economy and Corporate Finance

- IK has low collateral value and does not support debt financing (Hart and Moore (1994), Rampini and Viswanathan (2010))
- Firms with more IK:
 - ▶ Rely **more** on internal financing (cash, retained earnings)
 - ▶ Rely **less** on debt (bank loans, corporate bonds)



Cash (% assets)



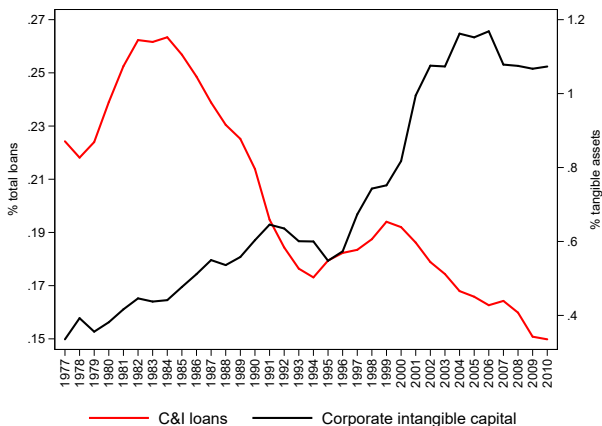
Liability structure (% assets)

As IK has grown in importance, firms increasingly save more and borrow less (Falato, Kadyrzhanova, and Sim (2015))

This Paper

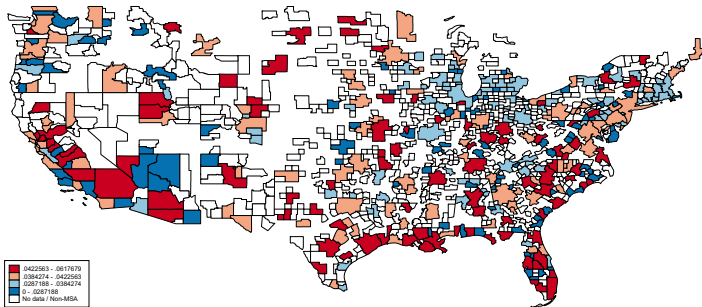
How has the rise in IK affected the banking sector?

- Banks face greater frictions in lending to firms → Over time, less commercial (C&I) lending
- Exploit **geographic variation** (across MSAs) in corporate IK



Average IK Growth across U.S. MSAs, 1984-2008

- Fast-growing MSAs (IK growth > 5%): Memphis (TN), Tampa (FL), New Orleans (LA), Sacramento (CA), Bakersfield (CA)
- Slow-growing MSAs (IK growth < 0.5%): Carson City (NV), Ithaca (NY), Sandusky (OH), Flagstaff (AZ), Merced (CA)



Notes: Sample restricted to MSAs with more than 30 years of continuous data on IK. Sources: Compustat, U.S. Census.

Main Results

- The rise of corporate IK leads to a decline in C&I lending
 - ▶ Secular rise in IK explains at least 25-40% of the aggregate decline in C&I loan share since mid-1980s
- Other bank balance sheet adjustments in response to IK
 - ▶ Banks reduce size? **NO**
 - ▶ Banks **reallocate** to other assets
 - ★ Especially to real estate loans
- Implications:
 - ▶ Bank capital matters more for firms with tangible capital
 - ▶ Banks transmit shocks across real sectors: bank lending channel (Chakraborty, Goldstein, and MacKinlay (2016))

Roadmap

- Data and empirical specification
- Baseline results
- Empirical challenges
- Conclusions and implications

Empirical Specification

Examine banks' asset allocations in response to changes in IK of firms in the MSA where the bank operates:

$$Y_{ijt} = \alpha_t + \beta_1 IK_{jt} + \beta_2 X_{jt} + \beta_3 Z_{it} + \epsilon_{ijt}$$

- Y_{ijt} : bank C&I loans, total assets, non-C&I assets
- IK_{jt} : corporate IK in the MSA of bank's headquarters
- X_{jt} : MSA-level controls (house prices, per capita income, population, firm sales)
- Z_{it} : bank-level controls (size and capital)
- Standard errors clustered by bank
- Estimated in growth rates

Data

Bank data, US Call Reports

- 1 Panel of yearly bank balance sheet data for commercial banks
- 2 1984-2008

MSA-level intangible capital

- 1 Industry-level IK growth weighted by MSA's sectoral employment shares (BLS):

$$IK_{jt} = \sum_{k \in K_j} \left[s_{jkt-3} IK_{kt}^{BEA} \right]$$

where j indexes areas (MSAs) and k indexes industries.

- ▶ Close proxy for a bank's local client base: Firms are more likely to borrow from a local bank
- 2 Industry-level intangible capital growth (BEA)
 - ▶ Capitalized R&D, using perpetual inventory method
 - ▶ Industries at NAICS 3-digit level

Baseline Results–Commercial loans

- Slower C&I loan growth in banks exposed to higher local IK growth

C&I loans	
(1)	
IK growth	-0.2073*** (0.068)
MSA-level controls	Yes
Bank controls	Yes
Observations	70,477
R-squared	0.082
Year FE	Yes

Baseline Results–Commercial loans

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- One SD increase in local IK growth reduces C&I loan growth by 1% (about 14% of sample mean)

Baseline Results–Reallocation

- Exposed banks continue to grow; expand non-C&I lending

	C&I loans	Bank assets	Non C&I assets
	(1)	(2)	(3)
IK growth	-0.2073*** (0.068)	0.0437 (0.030)	0.0467*** (0.012)
MSA-level controls	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes
Observations	70,477	77,450	75,443
R-squared	0.082	0.078	0.812
Year FE	Yes	Yes	Yes

Baseline Results–Reallocation

- Exposed banks continue to grow; expand non-C&I lending
- Especially residential real estate lending

	C&I loans (1)	Bank assets (2)	Non C&I assets (3)	RE loans (4)	Residential RE loans (5)	Commercial RE loans (6)
IK growth	-0.2073*** (0.068)	0.0437 (0.030)	0.0467*** (0.012)	0.1079** (0.044)	0.1624*** (0.056)	0.0771 (0.070)
MSA-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	70,477	77,450	75,443	72,743	69,472	69,258
R-squared	0.082	0.078	0.812	0.202	0.107	0.101
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Identification Concern: Ruling Out the “Demand Channel”

Concern: IK growth \rightarrow \uparrow knowledge workers \rightarrow \uparrow demand for RE loans

- **Absorb local loan demand using MSA \times year fixed effects (similar to Khwaja and Mian, 2008)**
 - ▶ Exploit that many banks from different locations lend *to the same MSA*
 - ▶ Loan-level mortgage data from HMDA (Home Mortgage Disclosure Act)
 - ▶ In a given MSA-year, do banks exposed to higher IK growth expand mortgage lending more?

Empirical Specification

Examine whether mortgage lending to the same MSA-year varies across banks exposed to different IK shocks:

$$Y_{ijt} = \alpha_{jt} + \beta_1 IK_{it-1} + \beta_2 X_{it-1} + \beta_3 Z_{it-1} + \beta_4 L_{ijt} + \epsilon_{ijt},$$

- Y_{ijt} : change in mortgage loan volume and acceptance rate by bank i in MSA j in year t
- α_{jt} : borrower MSA \times year fixed effect (captures local RE demand shocks)
- IK_{it-1} : corporate IK in bank i 's headquarters MSA
- Numerous controls:
 - ▶ X_{it-1} : MSA-level house prices, per capita income, population, and firm sales the headquarters MSA of bank i
 - ▶ Z_{it-1} : bank size and capital
 - ▶ L_{ijt} : characteristics of bank i ' mortgage applicant pool in MSA j (income, demographics, risk profile)

Reallocation to RE: Loan-level Evidence

- Banks exposed to higher IK growth in their headquarters MSA expand mortgage lending in other areas

	$\Delta \log(\text{lending volume})$			$\Delta \text{ acceptance rate}$		
	All obs.	All obs.	Outside HQ MSA	All obs.	All obs.	Outside HQ MSA
	(1)	(2)	(3)	(4)	(5)	(6)
IK growth	7.0477** (3.5778)	6.8266** (3.2104)	8.4258** (3.6148)	0.4645*** (0.1353)	0.5102*** (0.1768)	0.6477*** (0.2202)
Bank HQ-MSA controls		Yes	Yes		Yes	Yes
Bank controls		Yes	Yes		Yes	Yes
Bank mortgage applicant pool controls		Yes	Yes		Yes	Yes
BorrowerMSA \times Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	53,245	53,245	31,147	53,874	53,874	31,763
R-squared	0.1679	0.2036	0.2584	0.1175	0.1476	0.1954

- One SD increase in IK growth leads to mortgage volume increase of 36% and acceptance rate increase of 2.7%

Effects on Bank Profitability

- Bank profitability should go up if “demand channel” at work
- Dependent variable: Growth rate of bank RE loan interest margins

	RE loans (1)	RE loan profitability (2)
IK growth	0.1079** (0.044)	-0.0527* (0.027)
MSA controls	Yes	Yes
Bank controls	Yes	Yes
Observations	72,743	48,399
R-squared	0.202	0.244
Year FE	Yes	Yes

Robustness (1): Matching Banks and IK Shocks

- Baseline measure captures corporate IK in bank's headquarters MSA
- Concern: Match is *imprecise*, especially in the post inter- and intra-state bank branching deregulation period
- Construct bank-level IK measure that reflects *the spatial distribution of the bank's activities*
 - ▶ Use both (a) location of deposits (FDIC) and (b) mortgage lending (HMDA)

$$IK_{it} = \sum_{j \in J} [l_{ijt} IK_{jt}]$$

Baseline Results with Bank-level IK Measures

	C&I loans (1)	Bank assets (2)	Non C&I assets (3)
IK: Mortgages, volume			
IK growth	-0.2897*** (0.098)	0.0461 (0.044)	0.0444*** (0.017)
Observations	37,367	40,030	39,317
R-squared	0.084	0.069	0.845
IK: Mortgages, number			
IK growth	-0.2128*** (0.070)	0.0464 (0.032)	0.0394*** (0.012)
Observations	37,367	40,030	39,317
R-squared	0.084	0.069	0.845
IK: Deposits			
IK growth	-0.2578*** (0.070)	-0.0390 (0.032)	0.0494*** (0.011)
Observations	63,401	69,218	67,715
R-squared	0.081	0.075	0.830
Macro, bank controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Reallocation to RE with Bank-level IK Measures

	$\Delta \log(\text{lending volume})$ (1)	$\Delta \text{ acceptance rate}$ (2)
IK: Mortgages, volume		
IK growth	2.4746*** (0.8089)	0.2249** (0.0885)
Observations	68,817	69,553
R-squared	0.1799	0.1304
IK: Mortgages, number		
IK growth	2.3344*** (0.7974)	0.1901** (0.0940)
Observations	68,817	69,553
R-squared	0.1798	0.1300
IK: Deposits		
IK growth	2.3509^ (1.6728)	0.2338^ (0.1715)
Observations	68,109	68,823
R-squared	0.1821	0.1304
Macro, bank controls	Yes	Yes
BorrowerMSA \times Year FE	Yes	Yes

Robustness (2): More Granular, Loan-level Analysis

- Baseline analysis matches banks and firms on MSA
- Assumption: Local firms are more likely to borrow from the bank
- Could we instead match banks with firms directly?
- Use data on large corporate loans (Dealscan) to examine directly the effect of firm-level IK on lending standards (volumes, prices)
 - ▶ **Control for C&I loan demand** using numerous firm-level controls and time-varying fixed effects for small clusters of firms
 - ▶ Explore heterogeneity by firm size (large firms as opposed to small local firms)
 - ▶ Exploit a firm-level measure of IK

Results of Loan-level Analysis

- Firms with greater IK receive smaller and more expensive bank loans

	(1)	Log(loan volume)		(4)	Loan spread	
	(1)	(2)	(3)	(4)	(5)	(6)
Firm-level IK	-0.1808*** (0.026)	-0.1496*** (0.020)	-0.1460*** (0.033)	14.1367*** (2.353)	7.7116*** (1.945)	6.5852*** (1.888)
Observations	11,370	11,370	8,629	10,617	10,617	8,020
R-squared	0.335	0.343	0.661	0.513	0.564	0.824
Bank controls		Yes	Yes		Yes	Yes
Firm controls		Yes	Yes		Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank MSA × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm industry FE	Yes	Yes		Yes	Yes	
Firm rating category FE	Yes	Yes		Yes	Yes	
Industry × Rating category × Year FE			Yes			Yes

Conclusions and Implications

- The rise of intangible capital creates frictions in bank lending to firms
- In response to higher intangible capital in firms, banks:
 - ▶ Reduce commercial lending
 - ▶ Increase real estate lending
 - ▶ Do not shrink
- Suggests bank capital more important for firms with greater tangible investments, less so for new-economy firms
- **What is the role of banks in an economy where corporate assets cannot be pledged?**
 - ▶ “*Commercial Bank Is Misnomer. Real Estate Bank Is More Apt*” (American Banker, Aug 8 2016)

Regression Specification: A Derivation

- Start with the firms collateral constraint:

$$B_t = \frac{1}{R}(TK_t) = \frac{1}{R}\theta_t K_t$$

- Growth rates are approximately differences in logs, so

$$\log(B_t) - \log(B_{t-1}) = \log(\theta_t) - \log(\theta_{t-1}) + \log(K_t) - \log(K_{t-1})$$

- θ_t is fraction IK in total firm assets
- K_t is total capital (firms investment opportunities) captured by firm sales growth in the regressions

NAICS-3 Industry Ranking by Intangible Capital, 1984-2008

▶ Back

High IK

- Motion picture and sound recording industries
- Publishing industries (including software)
- Miscellaneous professional, scientific, and technical services
- Performing arts, spectator sports, museums, and related activities
- Chemical products

Low IK

- Oil and gas extraction
- Accommodation
- Real estate
- Forestry, fishing, and related activities
- Railroad transportation

Top industries by IK growth

- Chemical products
- Publishing industries (including software)
- Motion picture and sound recording industries
- Computer and electronic products
- Miscellaneous manufacturing
- Information and data processing services
- Administrative and support services
- Management of companies and enterprises
- Insurance carriers and related activities
- Printing and related support activities

Empirical Concern: Reverse Causality

Concern: Weak banks \rightarrow less C&I \rightarrow more IK investment

- **MSA IK measure unrelated to local conditions**

- ▶ Historic (3-year lagged) MSA industry composition + U.S.-aggregate industry IK
- ▶ Robust to using deeper (5- and 10-year) lags of employment shares
- ▶ Robust to using pre-sample employment shares from 1975

Baseline Results—Deeper Lags for Employment Shares

	C&I loans (1)	Bank assets (2)	Non C&I assets (3)
IK: Employment shares at (t-5)			
IK growth	-0.2128*** (0.070)	0.0464 (0.032)	0.0394*** (0.012)
Observations	70,477	77,450	75,443
R-squared	0.082	0.078	0.812
IK: Employment shares at (t-10)			
IK growth	-0.2578*** (0.070)	-0.0390 (0.032)	0.0494*** (0.011)
Observations	70,477	77,450	75,443
R-squared	0.082	0.078	0.812
IK: Employment shares in 1975			
IK growth	-0.2082*** (0.063)	-0.0414 (0.032)	0.0341*** (0.010)
Observations	70,477	77,450	75,443
R-squared	0.082	0.078	0.812
Macro controls	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes