Geographic Diversification and Banks' Funding Costs

Ross Levine
University of California, Berkeley and NBER

Chen Lin
Faculty of Business and Economics, the University of Hong Kong

Wensi Xie
CUHK Business School, Chinese University of Hong Kong

May 25th, 2017

Research Question

- How does diversification impact banks' funding costs?
  - Did the geographic diversification of bank assets across the US states in the 1980s & 1990s increase or decrease banks' cost of debts?
  - We examine the cost of debt, where debt accounts for about 90-95% of bank liabilities.

Motivation

- Banks matter for economic stability and prosperity.
- Yet, little is know about what shapes banks' funding costs.
  - Funding costs can shape bank stability and reflect bank risk, including solvency and liquidity risks.
  - Funding costs can influence asset allocations and the pricing of loans.

Theoretical Predictions

1. Agency view: Geographic diversification increases funding costs
   - It will intensify agency problems and increase the cost of debt
   - (e.g., Jensen, Jensen/Meckling, Jensen/Murphy, Scharfstein and Stein, etc.)
2. Diversification view: Geographic diversification reduces funding costs
   - It will reduce solvency and liquidity risk
   - (e.g., Gatev, Schuermann, and Strahan, 2009; Cornett, McNutt, Strahan, and Tehranian, 2011; Houston, James, and Marcus, 1997; Houston and James, 1998; Cortés and Strahan, 2014; Peek and Rosengren, 1997)

Existing Empirical Studies

- How does diversification impact banks' funding costs?
- We do not know the answer from existing studies
  - Previous research suggests that geographic diversification
    - Intensifies agency problems and reduces market valuations: *Evidence on agency cost (market valuations)* (Brickley, Linck, and Smith, 2003; Berger et al., 2005; Goetz, Laeven, and Levine, 2013)
    - Lowers stock return volatility: *Evidence on the risk diversification benefits* (Deng and Elyasiani, 2008; Goetz, Laeven, and Levine, 2016)
  - But, what about the cost of raising debt financing?
- Surprising, given that banks fund themselves primarily with debt.

Contribution

- This is the first empirical assessment of the impact of geographic diversification on banks' cost of debt.

Outline

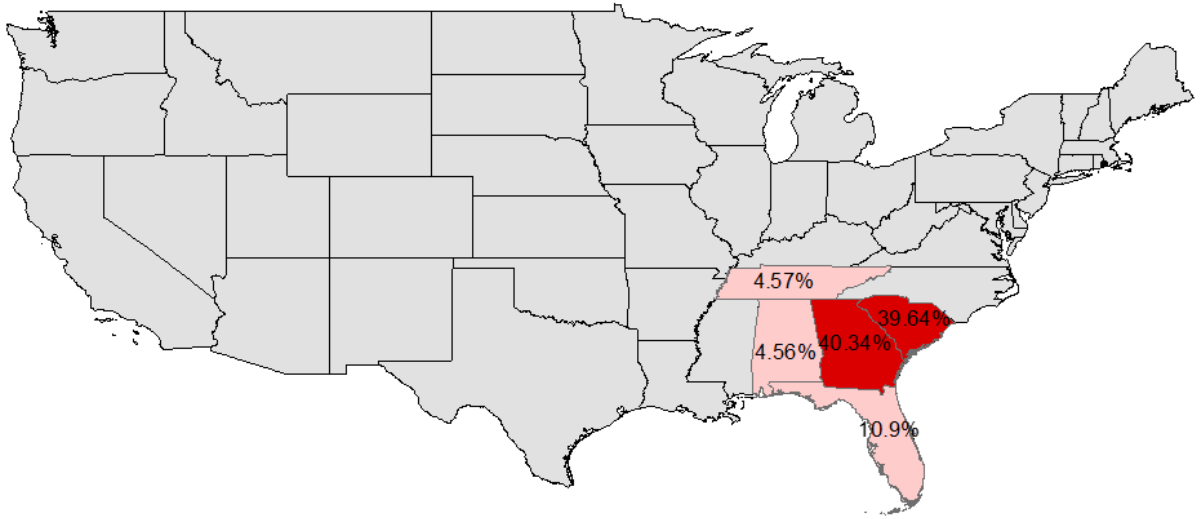
- **Methodology**
- Empirical Findings
- Conclusions

BHC Data

- Primary Sample: U.S. Public listed bank holding companies (BHCs), headquartered in 50 states & DC (excluding Alaska & Hawaii), 1986 – 2007
  - Federal Reserve provides consolidated balance and income statements starting in June 1986 (Y-9C reports)
- 35,741 BHC-quarter obs. on 915 public BHCs
- Actual diversification measure: *1 – Herfindahl Index of assets across states*
  - From the *Call reports*, we match each banking institutions to its BHC

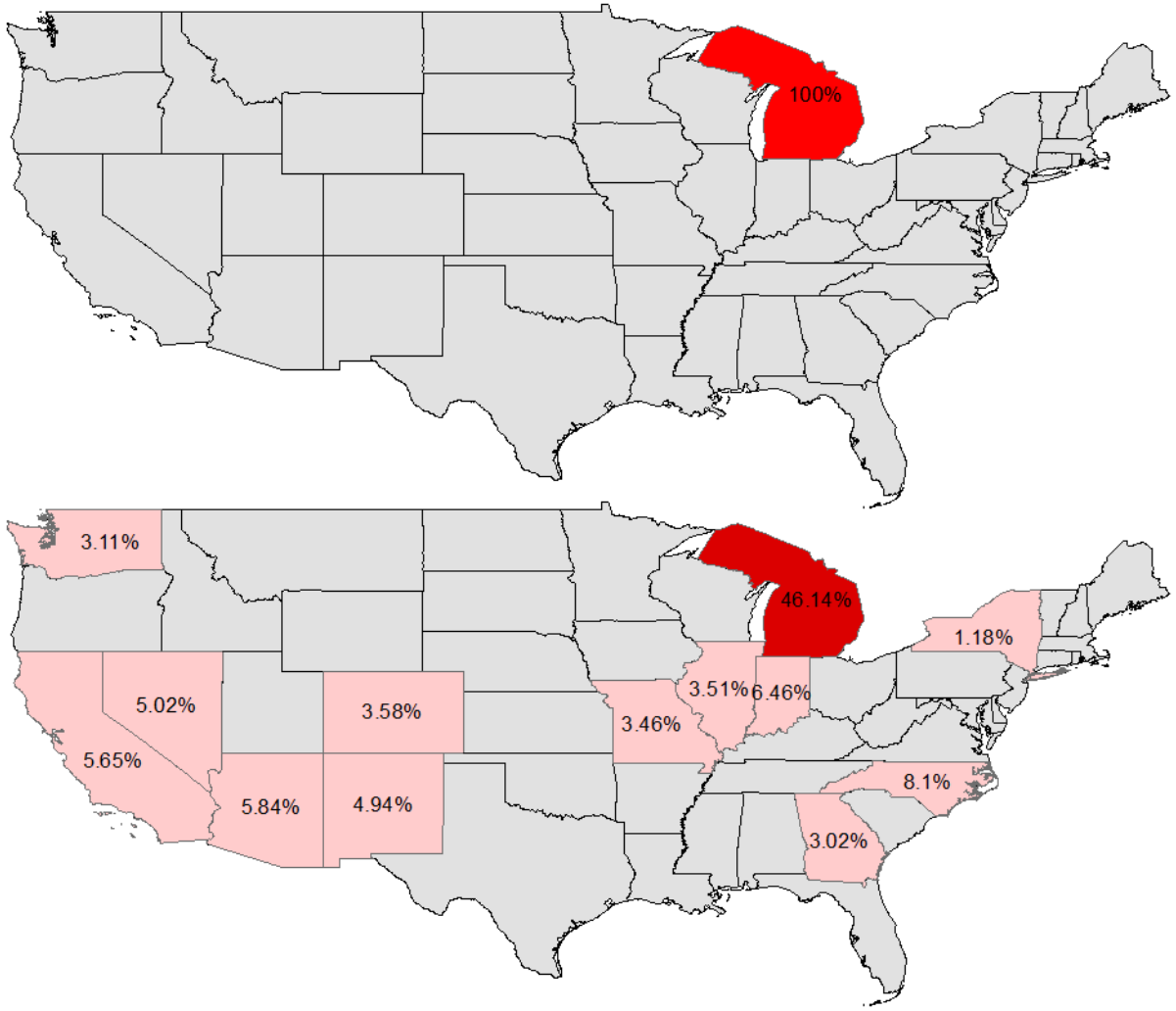
Patterns of Geographic Diversification

Example1: Synovus Financial Corp. 1986-2007



Patterns of Geographic Diversification

Example 2: Capital Bankcorp Ltd. 1990-2007



Regression Specification

$$Cost\ of\ funds_{bst} = \beta GeoD_{bt} + X'_{bs,t-1}\theta + \delta_b + \delta_{st} + \varepsilon_{bst}$$

- Cost of funds$_{b,s,t}$: Natural logarithm of the total cost of funds (debts) / domestic deposits, by BHC *b,* in state *j,* in period *t.*
- Cost of funds = total interest expenses / total interest-bearing liabilities. Similar definition applies to domestic deposits
- GeoD$_{b,t}$: geographic dispersion of bank subsidiaries assets across states, by BHC *b* in period *t.*
- $X_{b,s,t-1}$ = Time-varying BHC traits, namely size, capital-asset ratio, and profitability
- δ_b and δ_{st} = BHC and state-time fixed effects

Identification

- Goal:
  - Exogenous time-varying shocks to the geographic diversity of each BHC in U.S.
  - Need an instrument.
- Strategy:
  1. Exploit interstate bank deregulation to generate time-varying shock to geographic diversity at the state-level.
  2. Exploit the gravity model to differentiate among BHCs in the same state.
  - Integrate to create a BHC-time instrument of geographic diversity.
- Warning:
  - I will now spend 15 minutes explaining the implementation of this strategy.

Gravity-Deregulation Model

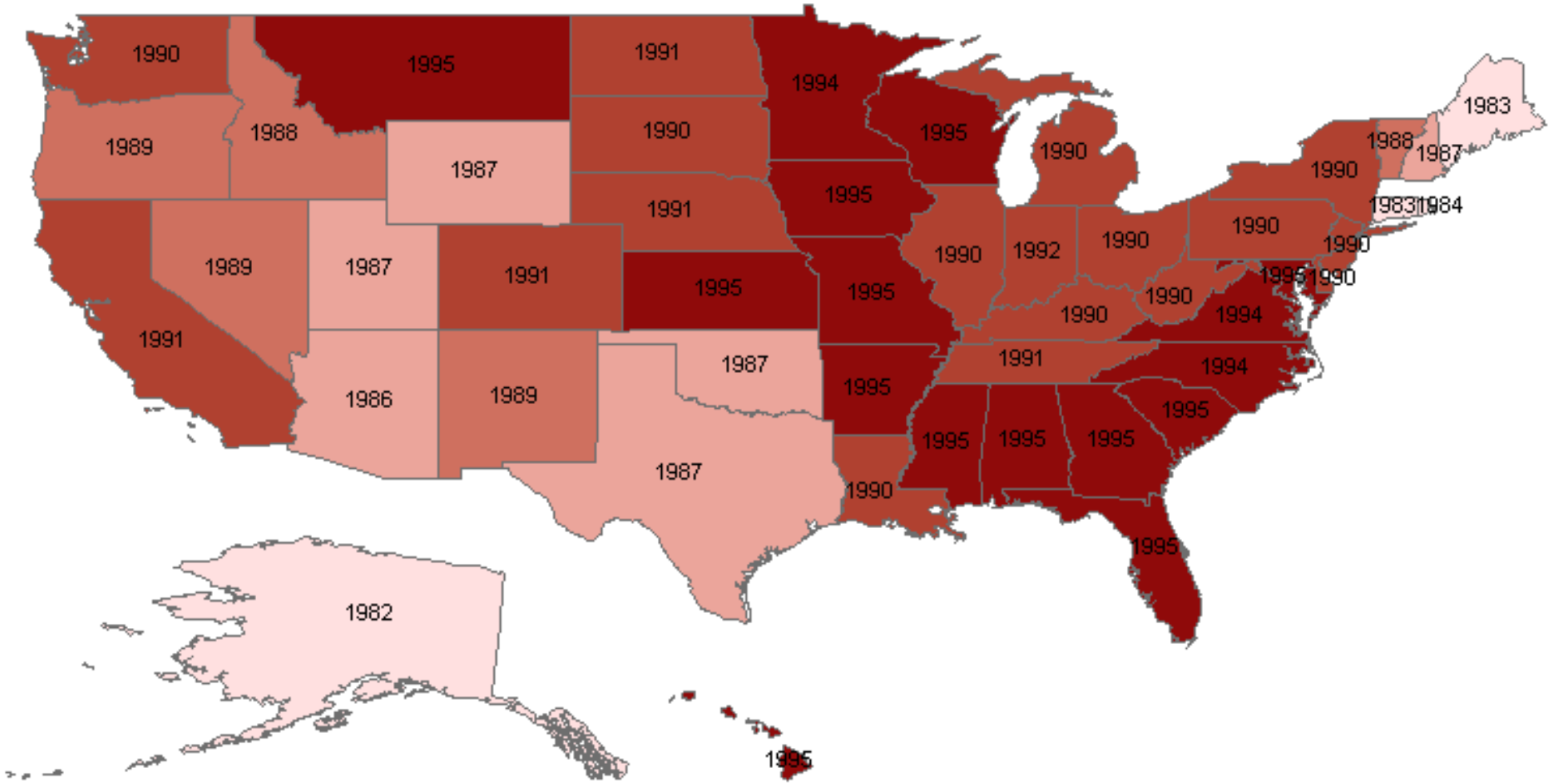
Interstate Banking Deregulation

Interstate Banking Deregulation

- Exploit X-state, X-time variation in the *process* of interstate bank deregulation to identify exogenous changes in BHC diversity.
- Prior to 1978
  - BHCs restricted from establishing subsidiaries/branches across states.
  - National technological innovations and court decisions triggered deregulation (Kroszner and Strahan, 1999)
- 1978-1994
  - Deregulation allowed BHCs to purchase & establish subsidiaries
  - States:
    - Started in different years.
    - State-specific process of bilateral and multilateral reciprocal arrangements.
- Since 1995: Deregulation ended with the Riegel-Neal Act in 1994

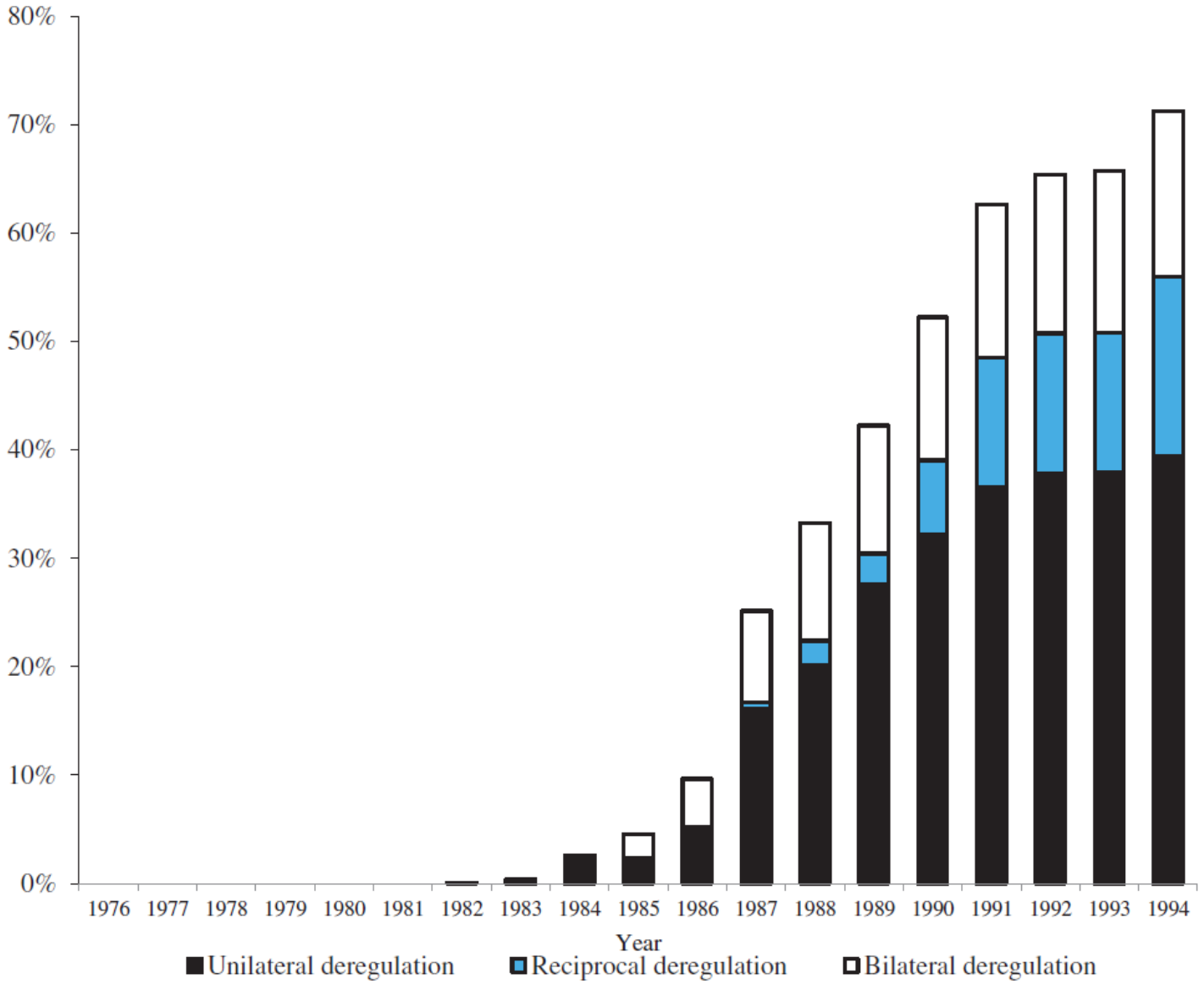
Interstate Banking Deregulation

- **Pattern of interstate banking deregulation: The case of Massachusetts**



Interstate Banking Deregulation

- **Dynamic process of interstate banking deregulation**
  1. Unilaterally open
  2. National reciprocal
  3. Bilateral & multilateral agreements



Gravity Model of Bank Investment

$$Share_{bijt} = \alpha Ln(Distance_{bij}) + \beta Ln\left(pop_{it}/pop_{jt}\right) + \delta_t + \delta_i + \delta_j + \delta_{ij} + \varepsilon_{bijt}$$

- $Share_{b,i,j,t}$: the share of assets a BHC *b* headquartered in state *i* holds through its subsidiaries in a foreign state *j* over the quarter *t.*
- $Ln(Distance_{b,i,j})$: natural logarithm of geographic distance between the BHC *b*'s headquarter and the capital city of state *j* (in miles).
- $Ln(pop_{i,t} / pop_{j,t})$: natural logarithm of ratio of the total population of the BHC *b*'s home state *i* to the total population of the foreign state *j* in quarter *t*.
- δ_t , δ_i , δ_j , and $\delta_{i,j}$ = Quarter, BHCs' home state, foreign state, and state-pair fixed effects

Gravity Model: "Zero-stage" Estimation Results

$$Share_{bijt} = \alpha Ln(Distance_{bij}) + \beta Ln\left(pop_{it}/pop_{jt}\right) + \delta_t + \delta_i + \delta_j + \delta_{ij} + \varepsilon_{bijt}$$

Variables	Asset share							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln(Distance)	-0.137***	-0.137***	-0.192***	-0.192***	-0.215***	-0.267***	-0.386***	-0.382***
	(0.00346)	(0.00351)	(0.00481)	(0.00485)	(0.00524)	(0.00861)	(0.0250)	(0.0251)
Ln(Population ratio)	-0.0343***	-0.0344***	-0.0237***	-0.0240***	-0.0222***	-0.0697*	-0.158***	
	(0.00257)	(0.00257)	(0.00239)	(0.00238)	(0.00262)	(0.0402)	(0.0297)	
Quarter fixed effects		Yes		Yes	Yes	Yes	Yes	
Home-state fixed effects					Yes	Yes		
Foreign-state fixed effects						Yes		
State-pair fixed effects							Yes	
State-pair-quarter fixed effects								Yes
Estimation model	Fractional logit	Fractional logit	OLS	OLS	OLS	OLS	OLS	OLS
Observations	1,381,467	1,381,467	1,381,467	1,381,467	1,381,467	1,381,467	1,381,467	1,381,467

Column 1 & 2: Average Marginal Effects from a fractional logit estimation (Papke & Wooldridge, 1996, 2008)

Implement Gravity-Deregulation Model: Two-step

- Step 1: Estimation and Projection
  - "Zero-stage" estimation:
    - Only includes state-pair-quarters obs. in which expansion is legally feasible because of interstate banking deregulation
  - Projected $\text{Share}_{b,i,j,t}$:
    - For state-pair-quarters in which diversity is allowed, use the estimated coefficient from the gravity model
    - For state-pair-quarters in which expansion is prohibited, impose a value of zero
- Step 2: Construct an instrument for actual geographic diversification
  - 1 - Herfindahl Index of assets across states (Predicted)
    - Using these projected $\text{Share}_{b,i,j,t}$ values
    - Time-varying, and BHC-specific, at the BHC *b*, in state *i*, and at time *t*

Outline

- Methodology
- **Empirical Findings**
- Conclusions

Summary Statistics

Variable	N	mean	sd	min	p25	p50	p75	max
					All			
Total cost of funds (level)	36611	0.011	0.004	0.003	0.008	0.011	0.014	0.022
Cost of domestic deposits (level)	36601	0.011	0.004	0.003	0.008	0.010	0.014	0.021
Cost of uninsured funds (level)	36286	0.013	0.005	0.004	0.010	0.012	0.015	0.031
1-Herfindahl index of assets across states	36611	0.044	0.128	0	0	0	0	0.852
1-Herfindahl index of branch deposits across states	33793	0.068	0.160	0	0	0	0	0.919
Capital-asset ratio(lag)	35741	0.085	0.023	0.040	0.070	0.083	0.097	0.182
Return on assets(lag)	35741	0.003	0.002	-0.006	0.002	0.003	0.003	0.007
Total assets(lag)	35741	5.665	18.238	0.122	0.342	0.731	2.371	140.085
Noninterest income	35405	0.652	0.120	0.364	0.574	0.645	0.723	0.970
Market concentration (MSA)	16960	0.424	0.262	0.030	0.224	0.356	0.557	1.000
US/State comovement	3511	0.816	0.439	-0.978	0.949	0.992	0.998	1.000
Accessible states comovement	3587	0.746	0.310	-0.900	0.599	0.910	0.963	1.000
Accessible states comovement-weighted	3587	0.536	0.240	-0.690	0.360	0.634	0.731	0.814
10-K length	26845	12.011	0.542	7.126	11.752	12.014	12.290	14.546
10-K Fog index	26845	19.684	1.782	13.252	18.935	19.584	20.214	57.980
10-K Smog index	26845	17.127	0.995	12.494	16.609	17.087	17.552	33.358

Diversity and Cost of Debts: OLS Regression Results

$$Cost\ of\ funds_{bst} = \beta GeoD_{bt} + X'_{bs,t-1}\theta + \delta_b + \delta_{st} + \varepsilon_{bst}$$

Variables	*Total cost of funds* (1)	*Cost of domestic deposits* (2)
1-Herfindahl index of assets across states	0.0441***	0.0481***
	(0.00996)	(0.0103)
Capital-asset ratio(lag)	-1.104***	-0.950***
	(0.0601)	(0.0573)
Return on assets(lag)	-1.586***	-1.969***
	(0.577)	(0.531)
Total assets(lag)	-0.000823***	-0.000580***
	(0.000143)	(0.000158)
Market concentration (MSA)	-0.0186**	-0.0370***
	(0.00760)	(0.00813)
Bank holding company fixed effects	Yes	Yes
State-quarter fixed effects	Yes	Yes
Observations	35,741	35,732
R-squared	0.937	0.945

- Without addressing the endogeneity problems, the economic magnitude is small: coefficients in column (1) indicate that a one standard deviation increase in the diversity measure is associated with an increase in the *total cost of funds* of about 0.56% (=0.128 * 0.0441), equivalent to 0.62 basis points given that the sample mean of *Total cost of funds* equals 1.1 percentage points.

Diversity and Cost of Debts: 2SLS Results

Second-stage results

Variables	Total cost of funds	Cost of domestic deposits
	(1)	(2)
1-Herfindahl index of assets across states	**-1.615*** **	**-1.052*** **
	(0.363)	**(0.286)**
Bank controls	Yes	Yes
Bank holding company fixed effects	Yes	Yes
State-quarter fixed effects	Yes	Yes
Observations	35,229	35,216
R-squared	0.853	0.914

First-stage results

Variables	1-Herfindahl index of assets across states	
	(1)	(2)
1 - Herfindahl index of assets across states (predicted)	**0.771*** **	**0.779*** **
	(0.139)	**(0.139)**
Bank controls	Yes	Yes
Bank holding company fixed effects	Yes	Yes
State-quarter fixed effects	Yes	Yes
F-test of joint significance	30.9	31.5

Economic Magnitude

- Holding other factors constant, a one standard deviation increase in geographic diversification leads to a drop in total cost of funds by 20.7% (=0.128 * 1.615), corresponding to 22 basis points given that the sample mean of *Total cost of funds* equals 1.1 percentage points.

Robustness Tests

- The results are robust to:
  - a subsample period between 1986 – 1997, the full implementation of the Riegle-Neal Act
  - a subsample of BHCs that earn a minimum of 2/3rd of their total revenues in the form of interest income (product mixes)
  - using an alternative geographic diversity measure, *1-Herfindahl index of branch deposits across states* (cross-state dispersion of branch deposits)
  - using *Cost of uninsured funds* as the dependent variable

Mechanism: Risk diversification

- Three measures of the degree to which a state's economy commoves with the economy in other states
  - Federal Reserve Bank of Philadelphia's *Coincident index* (four indicators of state-level economic conditions: nonfarm payroll employment, average hours worked in manufacturing, the unemployment rate, and wage and salary disbursements)

  - *US/State comovement*
  - *Accessible states comovement*
  - *Accessible states comovement-weighted*

Mechanism: Risk diversification

Second-stage results of 2SLS

Variables	Total cost of funds		
	(1)	(2)	(3)
1-Herfindahl index of assets across states	-2.356***	-3.895***	-4.310***
	(0.579)	(1.030)	(1.135)
US/State comovement*			
(1-Herfindahl index of assets across states)	0.790**		
	(0.316)		
Accessible states comovement*			
(1-Herfindahl index of assets across states)		2.136***	
		(0.647)	
Accessible states comovement-weighted*			
(1-Herfindahl index of assets across states)			3.205***
			(0.931)
BHC controls	Yes	Yes	Yes
Bank holding company fixed effects	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes
Observations	35,063	35,229	35,229
R-squared	0.833	0.753	0.728
F-statistics of Weak IV	12.82	9.187	8.815

Extensions: Agency Costs

- Bank opacity measures: the linguistic features of 10-K reports
  - *10-K length*
  - *Fog index*
    $=0.4 * (\#\ words/\#\ sentences + \text{percentage of } complex\ words)$
  - *Smog index*
    $=1.043 * sqr(\#\ complex\ words * 30/\#\ sentences) + 3.1291$

Extensions: Agency Costs

Second-stage results of 2SLS

	Total cost of funds			
	(1)	(2)	(3)	(4)
1-Herfindahl index of assets across states	-8.812***	-1.821***	-3.334***	-2.741***
	(2.139)	(0.456)	(0.717)	(0.814)
10-K Length* (1-Herfindahl index of assets across states)	0.632***			
	(0.162)			
10-K Length dummy* (1-Herfindahl index of assets across states)		1.128***		
		(0.301)		
10-K Fog* (1-Herfindahl index of assets across states)			0.0900***	
			(0.0224)	
10-K Fog dummy* (1-Herfindahl index of assets across states)				1.941***
				(0.625)
BHC controls	Yes	Yes	Yes	Yes
Bank holding company fixed effects	Yes	Yes	Yes	Yes
State-quarter fixed effects	Yes	Yes	Yes	Yes
Observations	25,853	25,853	25,853	25,853
R-squared	0.878	0.879	0.843	0.788
F-statistics of Weak IV	16.56	16.61	10.67	8.333

Conclusion

- Employing a gravity-deregulation model, we find that exogenous increases in geographic diversity reduce BHCs' cost of debt
- The cost-reducing effects is
  - More pronounced among BHCs headquartered in states with lower macroeconomic covariance with the overall economy, i.e., with greater diversification gains.
  - Significantly weakened among opaque BHCs, where agency costs tend to be higher
- The evidence is consistent with the view that diversification reduces the risk premium demanded by debt holders and agency costs mitigate this effect.

Thank You !

Appendix: Diversity and Cost of Debts: Reduced-form

Reduced-form regressions

Variables	Total cost of funds	Cost of domestic deposits
	(1)	(2)
1 - Herfindahl index of assets across states (predicted)	**-1.245*** **	**-0.819*** **
	(0.186)	**(0.173)**
Bank controls	Yes	Yes
Bank holding company fixed effects	Yes	Yes
State-quarter fixed effects	Yes	Yes
Observations	35,229	35,216
R-squared	0.936	0.944