The Economics of Bank Supervision

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Introduction

- Bank supervision as opposed to regulation:

  Regulation: Defining rules: bank ownership, permissible activities, minimum capital/liquidity requirements
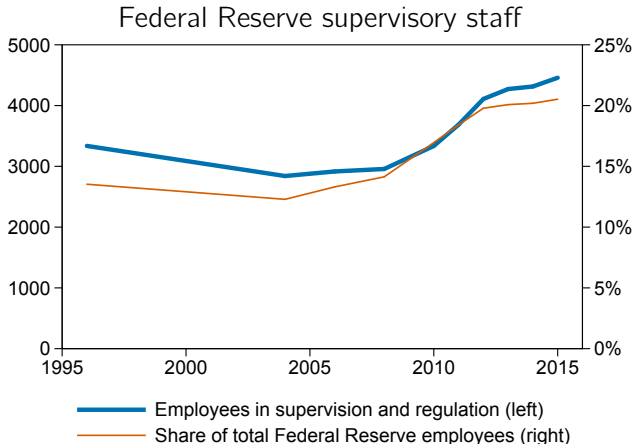
Introduction

- Bank supervision as opposed to regulation:

  Regulation: Defining rules: bank ownership, permissible activities, minimum capital/liquidity requirements

  Supervision: Compliance with rules and preventing/detecting "unsafe and unsound" practices

- Supervision is resource intensive (monitoring & intervention)

- This paper: Use new data on Fed examiners' hours; what's the impact of supervision? How are resources allocated?

Why study allocation of supervisory resources?

Federal Reserve supervisory staff

Employees in supervision and regulation (left)
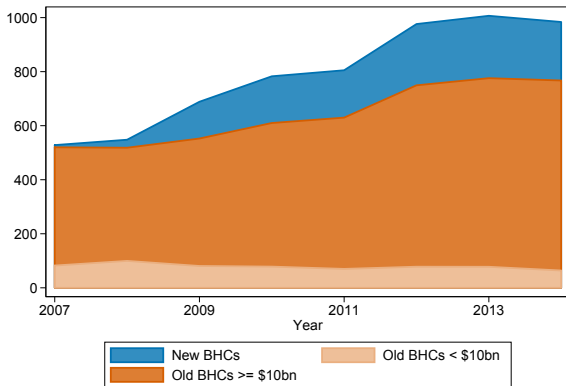Share of total Federal Reserve employees (right)

Source: FRB Annual Reports

- Enhanced supervisory framework post-financial crisis (stress tests) ➔ large increase in supervisory staff: too much, too little or about right?

Assessing resource allocation (1/2)

- New BHCs under Fed supervision drive large portion of increase (extensive vs intensive) …

Source: Hours data

Assessing resource allocation (2/2)

- … but need a framework to interpret data:

	2002-2006		2007-2009		2010-2014	
	Small	Large	Small	Large	Small	Large
Total Assets ($ bn)	801	9980	1049	14419	1066	15802
Total Yearly Hours (thousands)	83	347	100	488	104	807
Total Yearly Hours / Total Assets ($ bn)	104	35	96	34	98	51
$\sigma(ROA)$ (%)	0.56	0.61	0.80	0.85	0.68	0.66
Probability of Failure (%)	0.00	0.00	0.66	0.31	0.25	0.06

- More hours at larger banks (rows 1&2) but at declining rate (row 3)
- Post-2009:
  - Increase in intensity at large banks, decline at small banks
 - Higher risk, especially at small banks

Rest of the talk

1. Resource allocation for a bank in isolation:
   - Establish main determinants
   - Motivating model assumptions
2. Allocation with multiple banks:
   - Model
   - Estimation
   - Impact of supervision and aggregate resource allocation

Data description

Three data sources:

1. Recorded hours spent by Fed supervisors (12 Fed districts)

2. Fed composite supervisory ratings RFI (BOPEC pre-2006):

$$\underbrace{1 \quad 2}_{\text{satisfactory}} \quad \underbrace{3 \quad 4 \quad 5}_{\text{unsatisfactory}}$$
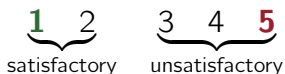
3. Balance sheet and income data from reg filings (Y9-C)

➜ Quarterly 1998q1 to 2014q4 for BHCs with assets $\geq$ \$1 billion

Federal Reserve Bank Districts

Federal Reserve Bank System

Baseline specification for supervisory hours

Log(Hours)	(1)		(2)		(3)		(4)	
Log(Assets)	0.96***	[0.02]	0.68***	[0.11]	0.68***	[0.11]	0.68***	[0.11]
Rating = 2	0.23***	[0.05]	0.15**	[0.06]	0.15**	[0.06]	0.15**	[0.06]
Rating = 3	0.94***	[0.09]	0.70***	[0.09]	0.69***	[0.09]	0.69***	[0.09]
Rating = 4	1.31***	[0.11]	1.08***	[0.11]				
Rating = 5	1.61***	[0.16]	1.36***	[0.16]				
Rating 4, 5					1.16***	[0.11]	1.69***	[0.32]
Rating 4, 5 × Log(Assets)							-0.07**	[0.03]
FEs: t, d, BHC	Y,Y,N		Y,Y,Y		Y,Y,Y		Y,Y,Y	
Adj. R^2	0.49		0.56		0.56		0.56	
#Obs. | #BHCs	17969 | 785		17969 | 785		17943 | 780		17943 | 780	

- Size elasticity less than one: 0.96 across, 0.68 within
  - ➔ Suggests scale economies

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- Size elasticity less than one: 0.96 across, 0.68 within
  - ➜ Suggests scale economies
- Monotonic response to higher risk (rating)
  - Δ hours for rating 1 ↗ 3: +94% across, +70% within
  - ➜ Increase equivalent to doubling of assets
- Negative interaction between size and risk (model)

Supervisory hours for largest banks

Log(Hours)	(1)		(2)		(3)	
Log(Assets)	0.56***	[0.10]	0.43***	[0.16]	0.63***	[0.07]
Large BHC	0.40***	[0.15]	0.38**	[0.16]		
Post-2008 × (Large BHC)					0.55***	[0.10]
Post-2008 × (Small BHC)					-0.23***	[0.06]
Log(N BHC Subsidiaries)			0.13*	[0.07]		
Log(N BHC Employees)			0.10	[0.17]		
Asset Conc. (HHI)			-0.48	[0.76]		
Loan Share			0.51	[0.78]		
FEs: t, d, BHC, Rating	Y,Y,Y,Y		Y,Y,Y,Y		N,Y,Y,Y	
Adj. R^2	0.56		0.55		0.56	
#Obs.	#BHCs	17969	785	16845	716	17969	785

- Lit. and policy (TBTF, DFA) suggests large banks special
- Allow for break at $10 billion (adjusted) assets
- Large banks have about 40% more hours after controls
- Post-08 Δlog(Hours)$_{large}$ = 55% vs Δlog(Hours)$_{small}$ = -23%

Hours Allocation to Multiple Banks: Model

- Supervisors monitor banks and intervene based on their findings
- Data do not distinguish monitoring vs intervention ➜ Focus on intervention
- Model has three main ingredients:
  1. Next period default probability depends on current risk (rating) and supervision
  2. Potential economies of scale in supervision; resources fixed at Fed district level in the short run
  3. Default externalities differs at the largest BHCs

Probability of default

- Probability of default is affine in a Cobb-Douglas combination of a function of rating (rating $R_i = 1, \ldots, 5$) and scale-free supervision intensity s_i:

$$\mathsf{PD}(R_i, s_i) \propto \frac{r(R_i)}{s_i^{\sigma}}$$

- σ measures effectiveness of supervision (elasticity of PD to s_i)

- Hours-cost function to achieve s_i:

$$h(s_i, A_i) = s_i A_i^{\alpha}$$

- When $\alpha < 1$ ➜ economies of scale in supervision

Optimal allocation

- Supervisor solves:

$$\min_{\{H_i\}} \left\{ \sum_i \text{PD}\big(R_i, h^{-1}(H_i, A_i)\big) \, N(A_i) \right\} \quad \text{subj to} \quad \sum_i H_i = \bar{H}$$

where the spillover externality $N(A_i) = n_i A_i$:

$$n_i = \begin{cases} 1 & \text{for } A_i \leq \$10 \text{ billion} \\ n & \text{for } A_i > \$10 \text{ billion and } t \leq 2008 \\ \hat{n} & \text{for } A_i > \$10 \text{ billion and } t > 2008 \end{cases}$$

Model solution

- Optimal hours:

$$H_i = \left(\frac{\sigma r(R_i)\, n_i}{\mu} \right)^{\frac{1}{1+\sigma}} A_i^{\frac{\alpha\sigma+1}{1+\sigma}}$$

- Lagrange multiplier on budget constraint (μ):

$$\mu^{\frac{1}{1+\sigma}} = \frac{1}{\bar{H}} \sum_i \left(\sigma r(R_i)\, n_i \right)^{\frac{1}{1+\sigma}} A_i^{\frac{\alpha\sigma+1}{1+\sigma}}.$$

- μ is the shadow value of relaxing $\bar{H}$, or total "risk-adjusted assets" to $\bar{H}$
- $\bar{H}$ fixed at the Fed district level

Estimating model parameters

- FOC in logs:

$$\log H_i = \underbrace{\frac{\alpha\sigma + 1}{1 + \sigma}}_{\beta_A} \log A_i + \underbrace{\frac{1}{1 + \sigma}}_{\beta_{R_i}} \log r(R_i) + \underbrace{\frac{1}{1 + \sigma}}_{\beta_{n_i}} \log n_i - \underbrace{\frac{1}{1 + \sigma}}_{\beta_\mu} \log \mu + \frac{1}{1 + \sigma} \log \sigma.$$

1. Treat μ as a fixed effect ➜ obtain reduced form $\hat{\beta}$
   - Note that $\mu(\beta(\sigma, \alpha, n_i))$
2. Compute $\hat{\mu}$ from $\hat{\beta}$s ➜ estimate $\hat{\beta}_\mu$ and $\hat{\sigma}$
3. From $\hat{\sigma}$ ➜ $\hat{n}_i$ and $\hat{\alpha}$

Estimating Model Parameters

Log(Hours)	(1)		(2)		(3)	
Log(Assets)	0.80***	[0.03]	0.80***	[0.03]	0.55***	[0.10]
Rating = 2	0.24***	[0.05]	0.29***	[0.06]	0.15**	[0.06]
Rating = 3	0.93***	[0.08]	1.01***	[0.09]	0.69***	[0.08]
Rating = 4	1.38***	[0.12]	1.43***	[0.13]	1.13***	[0.11]
Rating = 5	1.80***	[0.17]	1.75***	[0.16]	1.49***	[0.15]
Large BHC	0.35***	[0.11]	0.35***	[0.11]	0.17	[0.15]
Post-2008 × (Large BHC)	0.70***	[0.10]	0.67***	[0.09]	0.76***	[0.09]
Log(mu)			-0.54***	[0.06]	-0.50***	[0.05]
Dist×Date FEs?	Y		N		N	
FEs: t, BHC	N,N		Y,N		Y,Y	
Adj. R^2	0.51		0.49		0.57	
#Obs.	#BHCs	17969	785	17969	785	17969	785

- First stage: include district×date (1)
- Second stage: $\hat{\beta}_\mu = -.5 \rightarrow \sigma = 1$

Discussion of estimates

- Significant economies of scale: $\alpha = .55$

- Spillovers from largest banks relative to small:

$$n_i = \begin{cases} 1.9 & \text{for } A_i > \$10 \text{ billion and } t \leq 2008 \\ 6.6 & \text{for } A_i > \$10 \text{ billion and } t > 2008 \end{cases}$$

- Large implied sensitivity $\sigma = 1$ of PD to the intensity of supervision

- σ estimated from hours allocation; alternative, use an IV approach with PD as an observable

Impact of Supervision

(Fail or R to 4/5)$_{t+1,t+4}$	(OLS)		(OLS)		(IV)	
Post-2008	0.01	[0.01]				
Post-2008 × (Large BHC)	-0.03***	[0.01]	-0.03***	[0.01]		
Log(mu)	0.04***	[0.01]	0.01	[0.01]		
Log(Hours)					-0.03***	[0.01]
Assets, Ratings	Y,Y		Y,Y		Y,Y	
FEs: t, d, BHC	N,N,Y		Y,N,Y		N,N,N	
Adj. R^2	0.57		0.58		0.30	
#Obs.	#BHCs	24861	880	24861	880	17969	785

- IV coefficient is -.03 and $\frac{\partial PD}{\partial log(H)} = -\frac{PD}{\sigma}$ ➜ $\sigma = 2$
- Repeat exercise with $\sigma(ROA)$

Shadow value of supervisory hours
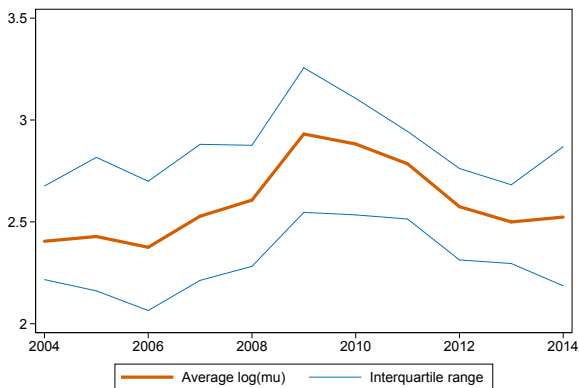
1. Large increase in Fed supervisory staff post 2008
   - More supervisors but also more assets & risk
   - Effects roughly balance out ➔ μ back to 2007 level
2. Large cross-district dispersion remains

Conclusion

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  - Low size elasticity of supervisory efforts (but largest bank discontinuity)

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- New data on supervisory hours to study resource allocation
- Allocation to one bank:
  - Supervisory efforts strongly dependent on bank risk
  - Low size elasticity of supervisory efforts (but largest bank discontinuity)
- Allocation to many banks:
  - Large effect of supervision on outcomes (both model and IV implied)
  - Shadow value of supervisory resources (risk-adjusted total assets to hours) approximately back to 2007; large cross district variation remains

Additional slides

Impact of Supervision: $\sigma(ROA)$

$\sigma(\text{ROA})_{t+1,t+4}$	(OLS)		(OLS)		(IV)	
Post-2008	-0.06***	[0.01]				
Post-2008 × (Large BHC)	-0.09***	[0.02]	-0.10***	[0.02]		
Log(mu)	0.11***	[0.01]	0.02	[0.01]		
Log(Hours)					-0.07***	[0.02]
Assets, Ratings	Y,Y		Y,Y		Y,Y	
FEs: t, d, BHC	N,N,Y		Y,N,Y		N,N,N	
Adj. R^2	0.26		0.33		-0.06	
#Obs. | #BHCs	22537 | 825		22537 | 825		16315 | 747	

Summary Statistics

	All		Small BHCs		Large BHCs	
	Mean	StDev	Mean	StDev	Mean	StDev
Hours	484.36	1357.14	95.53	168.89	1372.02	2202.04
Assets ($ millions)	36026.70	188138.43	2441.27	1611.61	112699.08	328264.78
Log(Hours)	4.14	2.15	3.33	1.73	6	1.87
Log(Assets)	8.43	1.50	7.64	0.54	10.26	1.38
Rating	1.95	0.74	1.98	0.79	1.90	0.63
Rating 4, 5	0.04	0.19	0.05	0.22	0.02	0.13
Log(N BHC Subsidiaries)	2.48	1.31	1.92	0.78	3.78	1.37
Log(N BHC Employees)	7	1.47	6.23	0.63	8.75	1.33
Large BHC	0.30	0.46	0	0	1	0
Log(mu)	2.58	0.47	2.57	0.46	2.59	0.47
ROA SD	0.28	0.32	0.30	0.33	0.25	0.29
Fail/Downgrade4-5	0.06	0.23	0.07	0.25	0.02	0.16
Observations	15364		10684		4680	

OCC Fee schedule

- Office of the Comptroller of the Currency
  - Supervises federally chartered commercial banks
  - Funds itself through fees assessed based on size and risk

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- Office of the Comptroller of the Currency
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  - Funds itself through fees assessed based on size and risk
  - OCC assesment fee schedule in terms of size

If the amount of the total balance sheet assets (consolidated domestic and foreign subsidiaries) is: ($ millions)		The Semiannual Assessment will be:		
Year 2007				
Over	But Not Over	This Amount ($)	Plus	Of Excess Over ($ millions)
0	2	5,480	0	0
2	20	5,480	0.000227454	2
20	100	9,574	0.000181963	20
100	200	24,131	0.000118274	100
200	1,000	35,958	0.000100078	200
1,000	2,000	116,020	0.000081883	1,000
2,000	6,000	197,903	0.000072785	2,000
6,000	20,000	489,043	0.000061932	6,000
20,000	40,000	1,356,091	0.000050403	20,000
40,000		2,364,151	0.000033005	40,000

Source: 12 CFR 8 and OCC bulletins.

OCC assessment fees

- Apply assesment fees to the universe of NA commercial banks:

	log(Fees)	
log(Assets)	0.70***	[0.00]
Rating = 2	−0.01*	[0.01]
Rating = 3	0.40***	[0.01]
Rating = 4	0.68***	[0.01]
Rating = 5	0.69***	[0.01]
Adjusted R^2	0.99	
#Obs.	#NAs	2,866	1,772	

- Size elasticity of fees remarkably similar to Fed hours
➔ Suggests that scale economies generate size elasticity < 1