Banking Deregulation and Innovation

Journal of Financial Economics, 2013

Chava[1], Oettl[1], Subramanian[2], and Subramanian[3]

[1]Scheller College of Business
Georgia Institute of Technology

[2]Robinson College of Business
Georgia State University

[3]Indian School of Business

BCG Lab Seminar, 24 January 2014

Background

- Financial development and economic growth.
- Financial deregulation impacts firm-level innovation.

- Banks are important in financing young, private firms.
- Young, private firms are key drivers of innovation.
- There are two forms of deregulation: intrastate/interstate.

Research Questions

- Do intrastate and interstate deregulation have different effects on young, private firms?
- Do the level and risk of innovation change due to intrastate and interstate deregulation?
- If so, does the change affect the economic growth?

Main Findings

- Interstate deregulation increase the innovation by young, private firms.
- Intrastate deregulation decrease the innovation by young, private firms.
- Banks deregulation affects the economic growth through innovation.

Literature

- The effects of financial development on economic growth.
  - Aghion and Howitt (1992), Jayaratne and Strahan (1996), Black and Strahan (2002), Kerr and Nanda (2009), Beck, Demirgüç-Kunt, Laeven, and Levine (2008), Beck, Demirgüç-Kunt, and Maksimovic (2004).
- The role of banks in financing young, private firms.
  - Berger (2010), Nanda and Nicholas (2012), Robb and Robinson (forthcoming), Berger and Udell (1998).

Literature (continued)

- Economic growth and innovation especially by young, private firms.
  - Akcigit and Kerr (2011), Acs and Audretsch (1987, 1988, 1993), Zucker, Darby and Brewer (1998), Kortum and Lerner (2000), Samila and Sorenson (2010), Darby and Zucker (2003).
- Intrastate banking deregulation and bargaining power.
  - Jayaratne and Strahan (1998), Strahan (2002), Berger, Kashyap and Scalise (1995), Cole, Goldberg and White (2004), Berger, Miller, Petersen, Rajan and Stein (2005).

Literature (continued)

- Interstate deregulation and competition.
  - Berger, Kashyap, and Scalise (1995), Hubbard and Palia (1995), Berger (2010), Strahan (2002), Stiroh and Strahan (2006).
- Contrasting prediction of banks' market power and innovation.
  - Berger, Hasan, and Klapper (2004), Black and Strahan (2002), Karceski, Ongena , and Smith (2005), Cetorelli and Strahan (2006).
  - Rajan (1992), Petersen and Rajan (1994, 1995), Cetorelli and Gambera (2001), Bonaccorsi di Patti and Dell'Ariccia (2004), Cetorelli (2004).

Hypotheses on Intrastate Deregulation

Negative Effect of Intrastate Deregulation

Hypothesis 1.

Intrastate deregulation led to a decrease in the level of innovation by young, private firms.

Hypothesis 2.

Intrastate deregulation led to a decrease in the number of innovative projects undertaken by young, private firms that have payoffs in the “high” and “low” tails.

Hypotheses on Interstate Deregulation

Positive Effect of Interstate Deregulation

Hypothesis 3.

Interstate deregulation led to an increase in the level of innovation by young, private firms.

Hypothesis 4.

Interstate deregulation led to an increase in the number of innovative projects undertaken by young, private firms that have payoffs in the “high” and “low” tails.

Data Source and Observations

- United States Patent and Trademark Office (USPTO)
- National Bureau of Economic Research (NBER)
- 1,581 observations.
  - 51 states $\times$ 31 years (from 1975 to 2005)
- Private, young firms:
  - No GVKEY, 3 or less patenting experience.

Key Variables

- Dependent variables:
  - The level of innovation:
    - Number of patents,
    - Number of citations (the importance of a patent).
  - The risk of innovation:
    - Number of patents with “high” citations (4th quartile).
    - Number of patents with “low” citations (1st quartile).
- Independent variables:
  - Banking deregulation:
    - Dummy variables ‘Intra’ and ‘inter’.

Table 1: Descriptive Statistics

	Panel A: all firms				*Panel B: private firms*				*Panel C: public firms*			
Variables	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max
Patents	849.15	1,718.73	0	19,535	296.57	522.2	0	6,485	559.15	1,266.32	0	13,541
Patents≤3 yrs	184.77	383.77	0	5,332	125.15	243.96	0	3,332	61.71	149.5	0	2,072
Patents > 3 yrs	664.38	1,379.32	0	14,329	171.42	304.95	0	3,153	497.44	1,144.56	0	11,498
Citations	12,539.45	29,322.47	0	378,168	4,283.3	9,157.76	0	116,817	8,349.62	21,056.84	0	263,879
Citations≤3 yrs	3,048.53	8,141.2	0	118,574	2,011.74	4,953.52	0	70,637	1,068.78	3,362.21	0	52,033
Citations > 3 yrs	9,490.92	22,000.61	0	259,594	2,271.55	4,501.08	0	53,217	7,280.83	18,272.08	0	211,846
1st Quartile cites	243.17	473.64	0	4,945	86.19	147.67	0	1,569	159.2	353.34	0	3,450
1st Quartile cites ≤3 yrs	47.81	93.36	0	1,320	32.08	57.88	0	820	16.38	38.99	0	534
1st Quartile cites > 3 yrs	195.36	393.55	0	3,736	54.11	99.57	0	890	142.82	323.11	0	2,937
4th Quartile cites	204.45	477.38	0	5,844	69.75	149.35	0	1,987	136.22	342.18	0	3,979
4th Quartile cites ≤3 yrs	50.4	131.49	0	1,757	33.45	82.74	0	1,124	17.46	51.39	0	678
4th Quartile cites > 3 yrs	154.05	357.62	0	4,087	36.29	71.17	0	883	118.76	298.31	0	3,310
Intra dereg.	0.71	0.45	0	1	0.71	0.45	0	1	0.71	0.45	0	1
Inter dereg.	0.59	0.49	0	1	0.59	0.49	0	1	0.59	0.49	0	1

- Younger firms are innovative.
  - A patent by younger firms has 16.5 citations, while
  - A patent by older firms has 14.3 citations.

Fig 1.a: Patenting Rates and Intrastate Deregulation

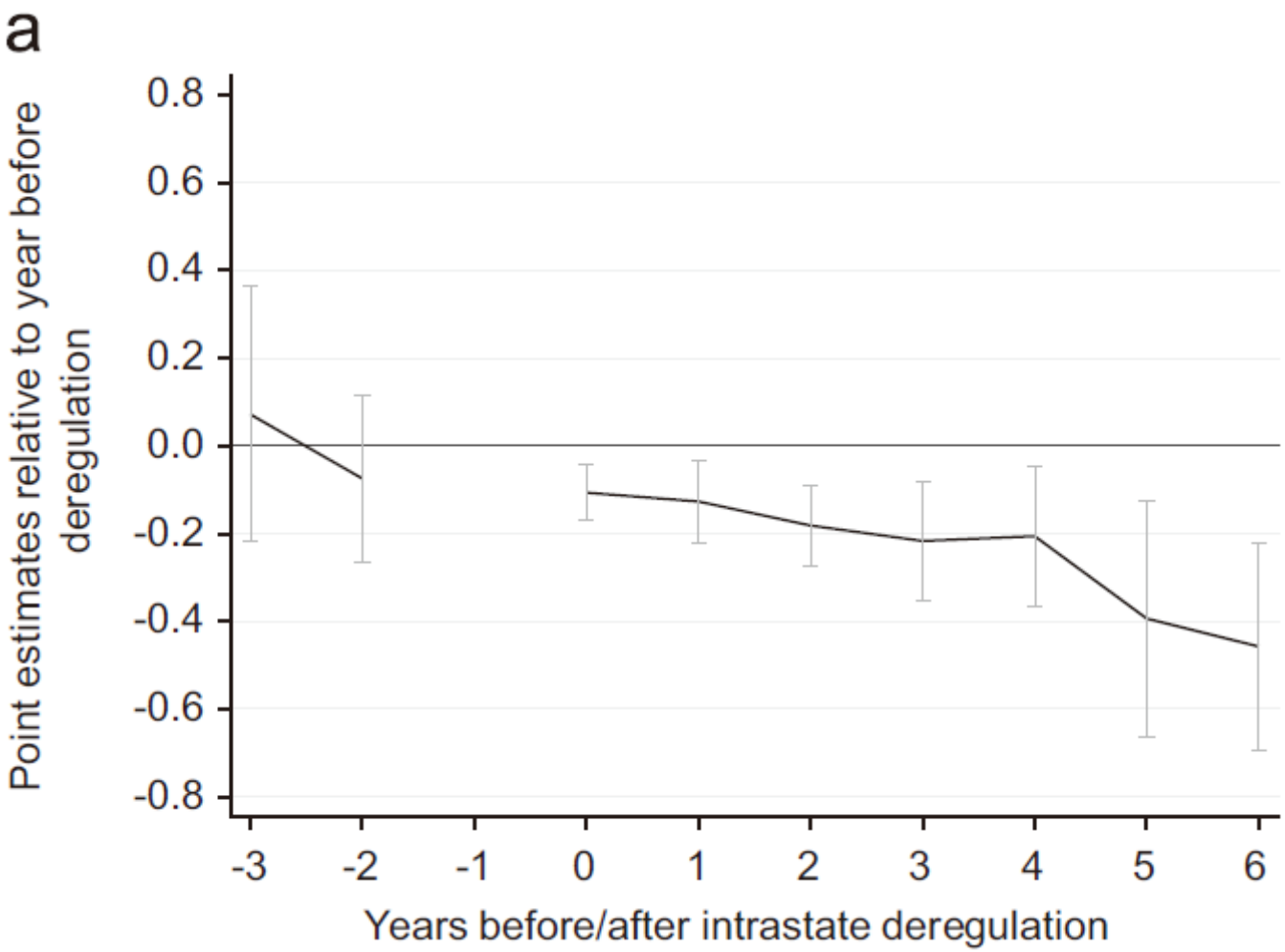
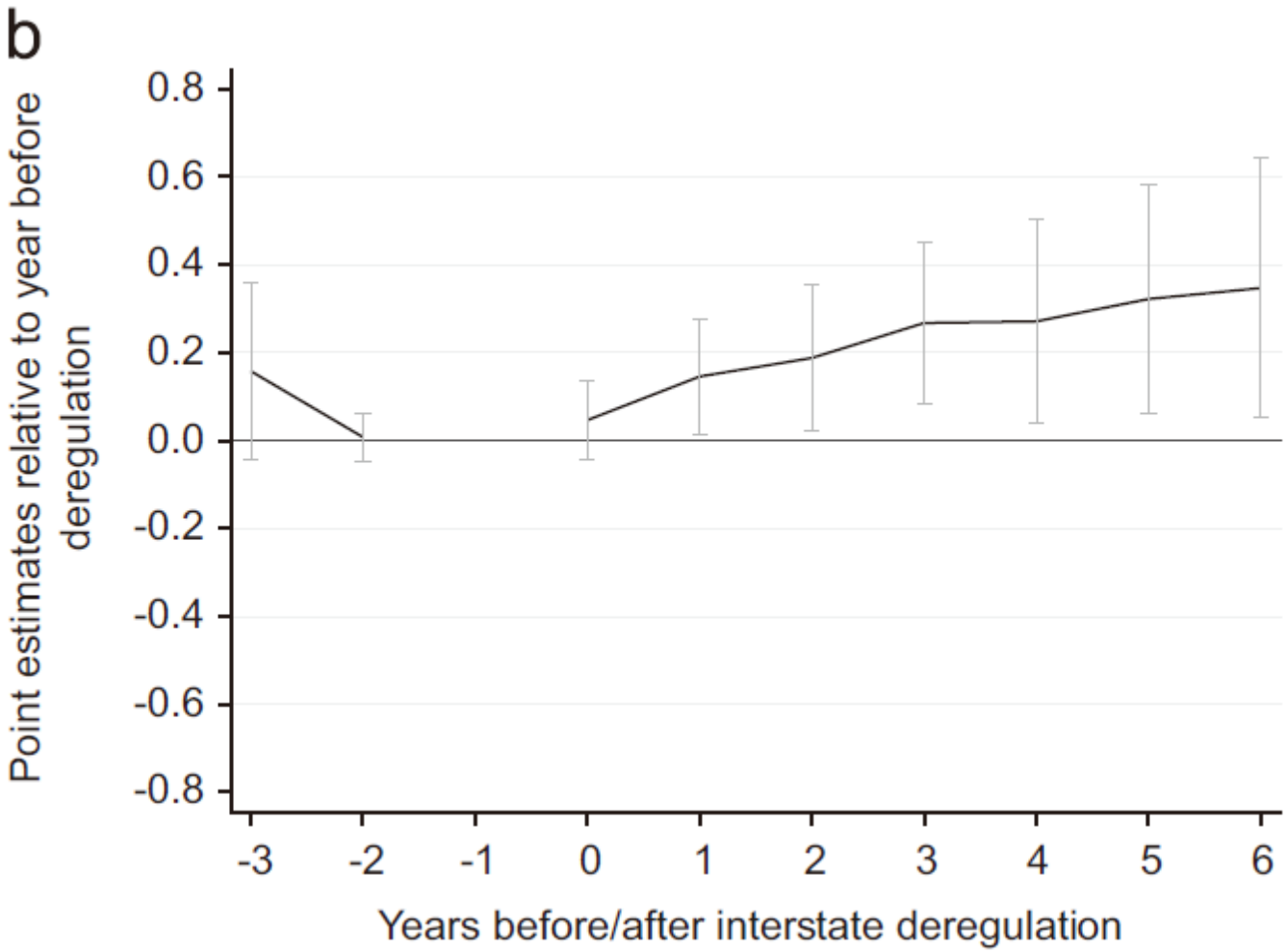


Fig 1.b: Patenting Rates and Interstate Deregulation



Results from the Spline Regressions

- Reverse-causal effects are not plausible.
- Decrease in patenting in the year of intrastate deregulation.
- Increase in patenting one year after interstate deregulation.
- Trend continues for at least 6 years.

Empirical Specification

Fixed-Effects Poission Estimation

- Specification 1-4:

$$E[Y_{it}] = \exp(\beta \text{Intra}_{it} + \gamma \text{Inter}_{it} + \delta_t + \phi_i) \tag{1}$$

- Specification 5-8:

$$E[Y_{it}] = \exp(\beta \text{Intra}_{it} + \gamma \text{Inter}_{it} + \delta_t + \phi_i + t\phi_i) \tag{2}$$

- Specification 9-12:

$$E[Y_{it}] = \exp(\beta \text{Intra}_{it} + \gamma \text{Inter}_{it} + \delta_t + \phi_i + \eta_k + t\eta_k) \tag{3}$$

Table 2: Effects on Innovation by Young, Private Firms

Dependent variable	(1) Patents	(2) Citations	(3) 1Q Cites	(4) 4Q Cites	(5) Patents	(6) Citations	(7) 1Q Cites	(8) 4Q Cites	(9) Patents	(10) Citations	(11) 1Q Cites	(12) 4Q Cites
Intra	−0.266**	−0.381***	−0.213**	−0.397***	−0.260**	−0.374***	−0.209**	−0.388***	−0.267**	−0.391***	−0.206**	−0.405**
	(0.115)	(0.137)	(0.099)	(0.154)	(0.113)	(0.134)	(0.098)	(0.151)	(0.117)	(0.139)	(0.101)	(0.158)
Inter	0.160***	0.150**	0.198***	0.192***	0.158***	0.148**	0.197***	0.189***	0.168***	0.157**	0.205***	0.206***
	(0.058)	(0.070)	(0.069)	(0.072)	(0.057)	(0.069)	(0.070)	(0.071)	(0.062)	(0.074)	(0.073)	(0.075)
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State time trend					✓	✓	✓	✓				
Tech. class FE									✓	✓	✓	✓
Tech. time trend									✓	✓	✓	✓
Observations	1,581	1,581	1,581	1,581	1,581	1,581	1,581	1,581	9,486	9,486	9,486	9,486
Num. states	51	51	51	51	51	51	51	51	51	51	51	51

Private but Mature Firms or Public Firms

- No significant effect of deregulation.
- Only young and private firms are affected.
- Reason: mature firms have other sources of financing.

Table 3: Dynamic Effects

Dependent variable	(1) Patents	(2) Citations	(3) 1Q Cites	(4) 4Q Cites
Intra(≤−2)	−0.160	−0.025	−0.246	−0.108
	(0.180)	(0.139)	(0.226)	(0.168)
Intra(0)	−0.175***	−0.097**	−0.239***	−0.130**
	(0.054)	(0.045)	(0.072)	(0.058)
Intra(1,3)	−0.238***	−0.238***	−0.292***	−0.289***
	(0.090)	(0.073)	(0.112)	(0.091)
Intra(> 3)	−0.484***	−0.512***	−0.484***	−0.585***
	(0.151)	(0.138)	(0.169)	(0.162)
Inter(≤−2)	−0.105	−0.139*	−0.129	−0.139
	(0.081)	(0.072)	(0.111)	(0.098)
Inter(0)	0.000	0.026	−0.038	0.097*
	(0.048)	(0.062)	(0.070)	(0.057)
Inter(1,3)	0.127**	0.121*	0.135*	0.186**
	(0.061)	(0.074)	(0.082)	(0.079)
Inter(> 3)	0.212**	0.186*	0.264***	0.323***
	(0.087)	(0.110)	(0.093)	(0.109)
Year FE	✓	✓	✓	✓
State FE	✓	✓	✓	✓
Observations	1,581	1,581	1,581	1,581
Num. states	51	51	51	51

Explorative/Exploitative and Product/Process

- Exploitative: refinement and extension of existing technologies and incremental innovation.
  - Including self-citation (Sørensen and Stuart, 2000)
- Explorative: experimentation with new alternatives and radical innovation.

- Process: improving the efficiency of existing production.
  - Falling into category of Physical or Chemical Processes.
- Product: creation of new products.

Table 4: Explorative/Exploitative and Product/Process

	(1)	(2)	(3)	(4)
Dependent variable	Exploring patents	Exploiting Patents	Product Patents	Process Patents
Intra	−0.273**	−0.164	−0.270**	−0.112
	(0.111)	(0.146)	(0.116)	(0.120)
Inter	0.151***	0.165	0.170***	−0.135
	(0.056)	(0.104)	(0.058)	(0.160)
Year FE	✓	✓	✓	✓
State FE	✓	✓	✓	✓
Observations	1581	1581	1581	1581
Num. states	51	51	51	51

Table 5: States with Fewer Small Firms

Dependent variable	(1) Patents	(2) Citations	(3) 1Q Cites	(4) 4Q Cites
Intra	–0.284**	–0.355***	–0.278*	–0.374**
	(0.141)	(0.135)	(0.144)	(0.161)
Intra ∗ Few small firms	0.264*	0.233*	0.275	0.285
	(0.153)	(0.142)	(0.168)	(0.174)
Inter	0.315***	0.325***	0.330***	0.377***
	(0.072)	(0.069)	(0.087)	(0.078)
Inter ∗ Few small firms	–0.441***	–0.518***	–0.360**	–0.556***
	(0.124)	(0.123)	(0.142)	(0.133)
Year FE	✓	✓	✓	✓
State FE	✓	✓	✓	✓
Observations	1,581	1,581	1,581	1,581
Num. states	51	51	51	51

Table 6: Growth Effects of Banking Deregulation

Innovative industry dummy is based on:	(1)	(2) Patents	(3) Citations	(4) 1Q Cites	(5) 4Q Cites
Intrastate deregulation	1.354**				
	(0.342)				
Intra(−4,−1) ∗ Innovative industry dummy		−0.234	−0.123	−0.118	−0.102
		(0.220)	(0.234)	(0.229)	(0.208)
Intra(0,3) ∗ Innovative industry dummy		−0.338	−0.315	−0.372	−0.331
		(0.226)	(0.245)	(0.233)	(0.210)
Intra(≥4) ∗ Innovative industry dummy		−0.173	−0.225	−0.202	−0.136
		(0.183)	(0.190)	(0.185)	(0.175)
Inter(−4,−1) ∗ Innovative industry dummy		0.127	0.281	0.256	0.269
		(0.226)	(0.247)	(0.237)	(0.214)
Inter(0,3) ∗ Innovative industry dummy		0.394*	0.419*	0.400*	0.353*
		(0.226)	(0.249)	(0.230)	(0.205)
Inter(≥4) ∗ Innovative industry dummy		0.334*	0.461**	0.409**	0.229
		(0.195)	(0.205)	(0.194)	(0.183)
Intra(−4,−1)		−0.269	−0.359	−0.363	−0.377*
		(0.219)	(0.234)	(0.229)	(0.205)
Intra(0,3)		0.800***	0.784***	0.833***	0.791***
		(0.227)	(0.246)	(0.234)	(0.210)
Intra(≥4)		1.011***	1.057***	1.036***	0.981***
		(0.198)	(0.205)	(0.201)	(0.190)
Inter(−4,−1)		2.638***	2.505***	2.527***	2.519**
		(0.249)	(0.270)	(0.260)	(0.238)
Inter(0,3)		3.041***	3.009***	3.029***	3.068***
		(0.242)	(0.261)	(0.245)	(0.226)
Inter(≥4)		2.812***	2.694***	2.744***	2.894***
		(0.231)	(0.238)	(0.231)	(0.223)
State FE	✓	✓	✓	✓	✓
Industry FE		✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
Observations	1,173	20,456	20,456	20,456	20,456
R^2	0.469	0.451	0.451	0.451	0.451

Conclusion

- Finance can affect economy by influencing innovation.
- Intrastate deregulation has negative effects.
- Interstate deregulation has positive effects.

Discussion