Debtor rights, credit supply and innovation

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Research question

How do debtor-friendly bankruptcy laws affect innovation?

- Settings more tolerant for failure lead to more innovation
  - Acharya &Subramanian (2009), Tian &Wang (forthcoming)

- Unexplored: role of credit supply when debtor protection changes

Related literature

- Corporate bankruptcy law and large firm innovation:
  - Stronger corporate debtor rights *increase* innovation by large firms (Acharya & Subramanian, RFS 2009)
  - They argue that the driving mechanism is that more debtor rights provides a setting more tolerant to failure, necessary for innovation
  - Cross country study
    - Uses the Djankov, McLiesh and Shleifer (2007) country time-varying index.

Our focus

- Focus on individual inventors and small firms (<500 employees)
  - Credit supply channel (fall in credit availability) may be stronger than for large firms

- We study how changes in US *personal* bankruptcy laws affect innovation
  - We exploit changes of personal bankruptcy law within US states
  - We measure innovation using small firms and inventors patent applications

U.S. Personal Bankruptcy Law

- Main personal bankruptcy procedure is Chapter 7
  - Future earnings exempt from obligation to repay ("fresh start")
  - Debtors must turn over any unsecured assets above a predetermined exemption level
    - Exemption = maximum asset value that can be shielded from creditors in a particular state
- Two types of exemptions:
  - Homestead exemptions: for equity in residences
  - Personal property: We consider only cash, jewelry, motor vehicles, and wildcard
  - We add the two types of exemptions into a single measure
- Large cross-sectional variation (from zero exemptions to unlimited exemptions)

Exemption changes 1995-2005

Year	*States changing exemption levels*
1995	CA, ME, NV, NH
1996	MN, VT, WV, WY
1997	MT, NE, NV, NH, UT
1998	HI, MI, MN, NJ, PA, RI, SD, WA
1999	AK, DC, ID, MT, RI, UT, WA
2000	CO, DC, LA, MA
2001	AZ, GA, HI, ME, MI, MT, NJ, PA, RI
2002	NH, WA, WV
2003	CA, ME, MO, NV
2004	AK, AZ, HI, KY, MD, MA, MI, MN, MO, NH, NJ, PA, RI
2005	DE, IN, NV, NY, OK

Exemption changes 1995-2005

Magnitude of change	*States changing exemptions*
Exemptions <$25K	AK, AZ, CA, DC, GA, HI, ID, IN, KY, LA, ME, MD, MI, MN, MO, MT, NE, NV, NH, NJ, OK, PA, RI, SD, UT, WA, WV, WY
$25K < Exemptions <$50K	CO, ME, MT, NV, NH
$50K < Exemptions <$100K	AZ, MT, NV, NY, RI, VT
$100K< Exemptions	DE, DC, MA, NV, NH

Exemptions

- Example:
  - Consider an entrepreneur with personal debts

Scenario	Debtor keeps...	Creditor gets...
EXEMPTION ≥ H. EQUITY	HOME EQUITY	0
EXEMPTION < H. EQUITY	EXEMPTION	HOME EQUITY – EXEMPTION

Personal bankruptcy and small firms

- Designed for consumers, but can also affect small firms:
  - Unlimited liability firms whose owners are legally liable for the firm's debts
  - Limited liability firms because lenders typically require owners to personally guarantee their loans.
  - Many small firms use personal debt to finance their firm

- Start-ups rely heavily on bank debt (Robb & Robinson 2012)
  - Bank debt is 40% of firm's initial start-up capital

Competing effects of debtor protection

- Tolerance for failure effect: higher exemption levels provide partial wealth insurance to debtors
  - Increase innovation and exploration by existing firms
    - (Landier 2006, Manso 2011, Nanda & Rhodes-Kropf 2012)

- Credit supply effect: banks anticipate moral hazard and opportunistic behavior from borrowers
  - Reduce credit availability
    - (Gropp, Scholz, and White, 1997; Berkowitz and White, 2004; Berger, Cerqueiro, and Penas 2011; Cerqueiro and Penas, 2011)
  - → firms shift resources away from R&D
    - (Nanda & Rhodes-Kropf 2012)

Research design

- Study effect of changes in state-level bankruptcy exemption laws on innovation
  - Patenting activity captures innovation (e.g., Hausman, Hall & Griliches,1984; Hall, Jaffe &Trajtenberg, 2001; Balasubramanian & Sivadasan, 2011)
- Study role of credit supply
  - External finance dependence (Rajan & Zingales, 1998)
  - Local banking market HHI; concentrated bank market → less funding for innovation (e.g., Benfratello et al., 2008; Chava et al., forthcoming; Cornaggia et al., forthcoming).

Data sources

- Hand collected bankruptcy exemption levels
- USPTO patent data (1995 – 2005)
  - Patent characteristics (subclass, state, year, small vs. large)
  - Innovation measures: number, quality, riskiness
- FDIC
  - Bank concentration measures
- US Census
  - Income, home prices, population

Selected summary statistics

N=19,800

Variable	Mean	Std. Dev.	Min	Max
Exemptions ($100,000s)	2.00	3.36	0.05	10.60
Patents by Small Companies and Ind. Inventors	10.47	32.09	0.00	899.00
Patents by Small Companies	10.04	31.23	0.00	881.00
Patents by Large Companies	30.93	107.71	0.00	3100.00
Number of Small Companies	7.04	18.15	0.00	506.00
Ratio of Small Company Patents to Companies	0.97	0.72	0.00	13.00
5-Year Forward Citations	1.33	2.08	0.00	76.50
Num. Patents w/ 5-Yr Fwd Cites in Upper 75%	2.12	8.27	0.00	315.00
Num. Patents w/ 5-Yr Fwd Cites in Lower 25%	4.43	12.77	0.00	312.00
Number of Subcategories in which Firm Patents	1.23	0.12	1.00	1.92
Median Income ($1,000s)	40.49	7.17	24.88	63.37
House-Price Index	129.33	26.89	88.96	268.18
Population Density	182.69	249.38	1.06	1176.92

Empirical framework

$$E[Innovation_{sct}] = \exp(\alpha_s + \delta_c + \delta_c * trend + \lambda_t + \beta Exemption_{st} + X_{st})$$

- Poisson fixed effects models with robust standard errors (clustered at state level)
- Fixed effects for state (*s*), subcategory (*c*) and year (*t*)
- Subcategory trends
- Time-varying state controls: income, home prices, population
- Sample period: 1995 - 2005

Number of patents

Impact of exemptions on patent counts

	Patents by Small Firms & Inventors			Patents by Small Firms	Patents by Private Small Firms
Exemptions	-0.022**	-0.028**	-0.028**	-0.029**	-0.026**
	[0.010]	[0.013]	[0.013]	[0.014]	[0.011]
Calendar Year Effects	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time-Varying State Specific Vars	No	Yes	Yes	Yes	Yes
Subclass Fixed Effects	No	No	Yes	Yes	Yes
Subclass*Trend	No	No	Yes	Yes	Yes
Observations	19,800	19,800	19,800	19,800	19,800
Log Likelihood	-128595	-128588	-57873	-56961	-38529

Counterfactual: large firms

	Patents by Large Firms		
Exemptions	0.018	0.014	0.014
	[0.021]	[0.017]	[0.017]
Calendar Year Effects	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes
Time-Varying State Specific Vars	No	Yes	Yes
Subclass Fixed Effects	No	No	Yes
Subclass*Trend	No	No	Yes
Observations	19,800	19,800	19,800
Log Likelihood	-486640	-486158	-216945

Timing of exemptions

	Patents by Small Firms	Patents by Large Firms
Exemption change (-3,-1)	-0.022	-0.024
	[0.027]	[0.051]
Exemption change (0,3)	-0.048**	0.012
	[0.024]	[0.043]
Exemption change (t≥4)	-0.022	-0.007
	[0.021]	[0.031]
Calendar year effects	Yes	Yes
Subclass fixed effects	Yes	Yes
State fixed effects	Yes	Yes
Observations	19,800	19,800

Credit supply

External financial dependence

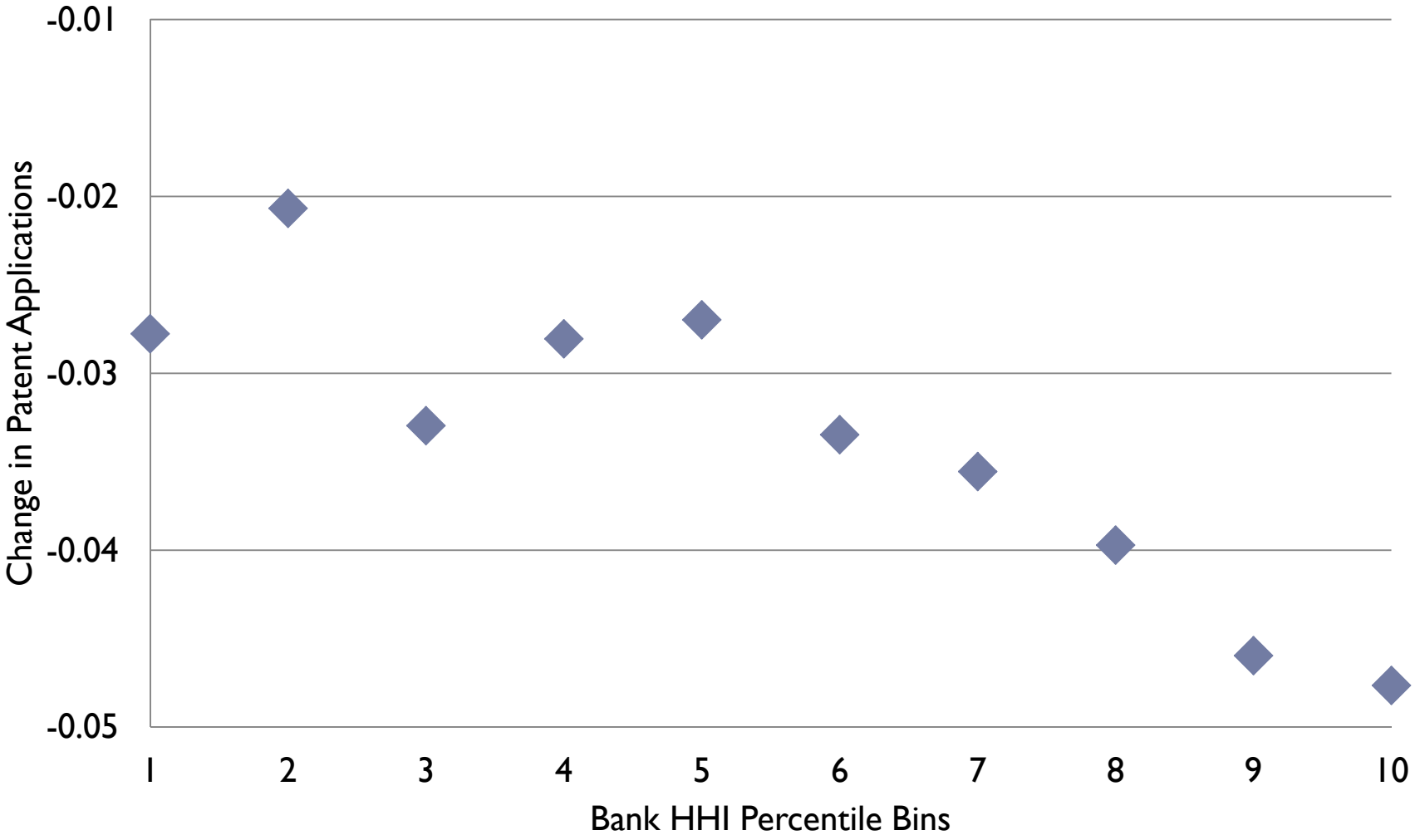
	Low External Financing Dependence	High External Financing Dependence
Exemptions	-0.017	-0.038***
	[0.014]	[0.012]
Calendar Year Effects	Yes	Yes
State Fixed Effects	Yes	Yes
Time-Varying State Specific Vars	Yes	Yes
Subclass Fixed Effects	Yes	Yes
Subclass*Trend	Yes	Yes
Observations	9,900	9,900
Log Likelihood	-24274	-27650

Exploring the credit channel
Empirical framework, MSA level

$$E[Innovation_{mct}] = \exp(\mu_m + \delta_c + \delta_c * trend + \lambda_t + \beta Exemption_{mt} * Bank\ HHI\ Bins_{mt} + X_{st})$$

- Poisson fixed effects models with robust standard errors
- Fixed effects for MSA (*m*), subcategory (*c*) and year (*t*)
- Time-varying state controls
- MSA-level bank HHI
- Sample period: 1995 – 2005

Bank concentration



Innovation quality

Patent impact

5-year forward citations

Year Sample	All	< 2005	< 2004	< 2003	< 2002	< 2001	< 2000
Exemptions	-0.027	-0.023	-0.021	0.010	-0.011	0.003	0.081
	[0.026]	[0.034]	[0.038]	[0.041]	[0.050]	[0.067]	[0.405]
Calendar Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Varying State Specific Vars	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Subclass Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Subclass*Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,800	18,000	16,200	14,400	12,600	10,800	9,000
Log Likelihood	-27598	-25560	-22992	-20149	-17018	-13861	-10746

Patent generality

Based on how many different patent subclasses cite this patent

Year Sample	All	< 2005	< 2004	< 2003	< 2002	< 2001	< 2000
Exemptions	0.013	0.018	0.028**	0.031**	0.031*	0.016	0.018
	[0.010]	[0.011]	[0.012]	[0.013]	[0.017]	[0.013]	[0.030]
Calendar Year Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Varying State Specific Vars	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Subclass Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Subclass*Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,800	18,000	16,200	14,400	12,600	10,800	9,000
R-squared	0.297	0.245	0.207	0.190	0.181	0.177	0.172

Patent originality

Based on how many different patent subclasses this patent cites

	Num. of Subclasses Cited by Patent
Exemptions	0.006
	[0.007]
Calendar Year Effects	Yes
State Fixed Effects	Yes
Time-Varying State Specific Vars	Yes
Subclass Fixed Effects	Yes
Subclass*Trend	Yes
Observations	19,800
R-squared	0.149

Innovation riskiness and firm exploration

Most and least cited patents

Most Cited Patents (number in top 25% of citations for all patents filed in year and subclass)

Year Sample	All	< 2005	< 2004	< 2003	< 2002	< 2001	< 2000
Exemptions	-0.058***	-0.054***	-0.067***	-0.071***	-0.091***	-0.062*	0.108
	[0.010]	[0.012]	[0.016]	[0.018]	[0.026]	[0.035]	[0.273]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,800	18,000	16,200	14,400	12,600	10,800	9,000
Log Likelihood	-25927	-23707	-21270	-18701	-16003	-13413	-11041

Least Cited Patents (number in bottom 25% of citations for all patents filed in year and subclass)

Year Sample	All	< 2005	< 2004	< 2003	< 2002	< 2001	< 2000
Exemptions	-0.024	-0.052**	-0.075*	-0.089*	-0.103*	-0.045	-0.337**
	[0.019]	[0.025]	[0.044]	[0.051]	[0.059]	[0.054]	[0.164]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,800	18,000	16,200	14,400	12,600	10,800	9,000
Log Likelihood	-38568	-34940	-31426	-27937	-24293	-20702	-17214

Patent exploration

	Num. of Subclasses in which Firms Patent
Exemptions	-0.025*
	[0.014]
Calendar Year Effects	Yes
State Fixed Effects	Yes
Time-Varying State Specific Vars	Yes
Subclass Fixed Effects	No
Subclass*Trend	No
Observations	550
R-squared	0.098

Summary

- Higher bankruptcy exemption levels:
  - Decrease patent applications for small firms, especially…
    - When dependent on external finance
    - In highly concentrated banking markets

    → Credit supply mechanism decreases innovation

  - Decrease "riskiness" of innovations (tails shrink)
  - Decrease breadth of firm patenting (fewer subcategories)
  - No effect on innovation quality

    → Firms are taking "safer bets"

Contributions

- Counterintuitive effect: Increases in bankruptcy exemption levels have a "chilling effect" on innovation
  - Contrasts to results in Acharya & Subramanian (2009)
  - Consistent w/predictions in Nanda & Rhodes-Kropf (2012)

- Policy-relevant:
  - Other countries have adopted or intend to adopt more debtor friendly bankruptcy systems, imitating the US
    - France: *procedure de sauvegarde*
    - Public policy often has unintended effects (Lerner, 2009); firm heterogeneity needs to be considered

Thank you!

Impact of other laws

Year	Number states that change exemptions	of which change corp. income tax	of which change state bank tax	of which change R&D credits	of which change invest tax credits	of which change job tax credit
1995	4	0	1 (CA)	0	0	0
1996	4	0	0	0	0	1(MN)
1997	5	0	0	0	0	0
1998	8	0	0	1(RI)	1(RI)	0
1999	7	0	0	2(MT, UT)	0	0
2000	4	1 (CO)	1 (CO)	0	0	0
2001	9	1 (AZ)	1 (AZ)	1(AZ)	0	0
2002	3	0	0	0	0	0
2003	4	0	0	0	0	0
2004	13	0	0	0	0	0
2005	5	0	0	0	0	0
Totals:	66	2	3	4	1	1