Do patents mitigate financing constraints?

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Current Research

- Most studies provide evidence that innovative firms are financially constrained (Harhoff 2000, Brown et al. 2012, Cincera et al. 2016)
- Studies on the mitigation of financing constraints are focusing on the **institutional framework** and the **relationship** between firm and investor (Beck et al. 2007, Shane & Cable 2002)

Many innovative firms have patents that might mitigate financing constraints

Patents as Quality Signal

- Patents serve as **quality signal** to external resource provider (Long 2002)
- Firms' patenting activity reduces the reliance on internal liquidity for financing R&D (Hottenrott et al. 2016)

H1: Past patenting activity has a positive effect on firms' investment rate.

Patents as Loan Collateral

- New: Patents serve as a **source of finance** by offering them for loan collateral

> **H2:** Patent pledging activity increases firms' investment rate.

- Lenders do not just rely on observable information they also gain a protection

> **H3:** Pledged patents have a stronger impact on firms' investment rate than their patent activity.

Data

- Detailed financial historic data of all Swedish firms between 1998-2015 from the **Swedish Company and Registration Office** (Serrano Panel Data)
- Bibliographic data for all patents applied by Swedish firms from **PATSTAT**
- All pledged patents in Sweden during 1980-2015 and data on change of ownership from **PRV**

- Restriction: Small, R&D-active, Swedish firms

Pledged Swedish Patents

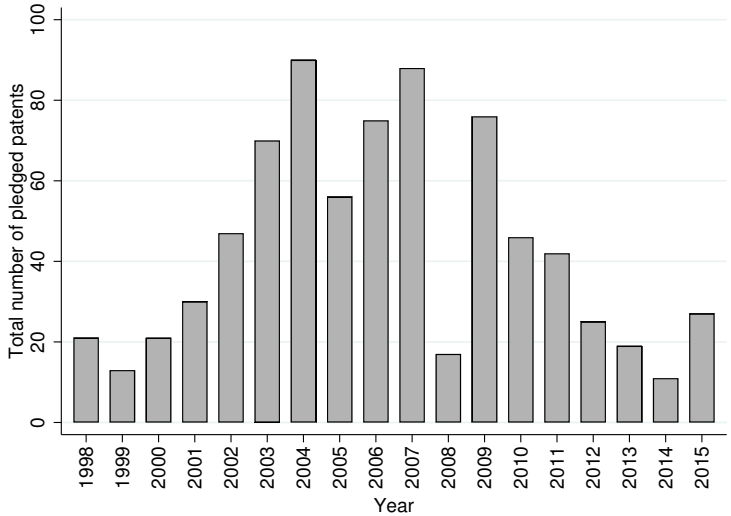

Figure 1: Yearly number of patent pledges

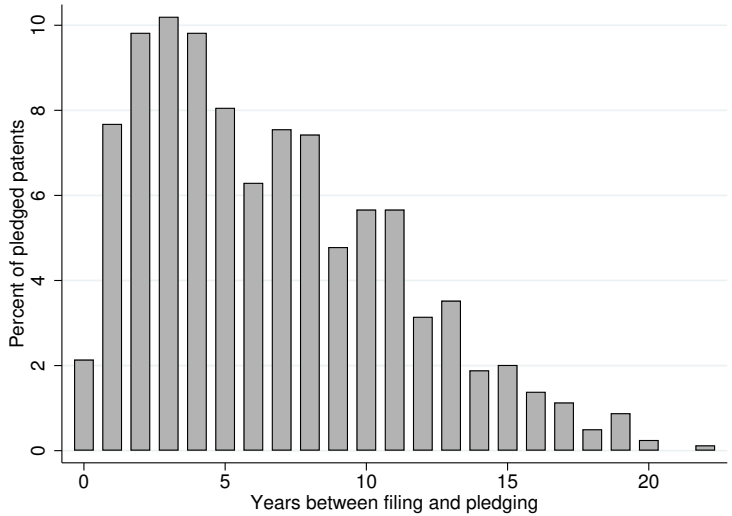

Figure 2: Years between filing and pledging

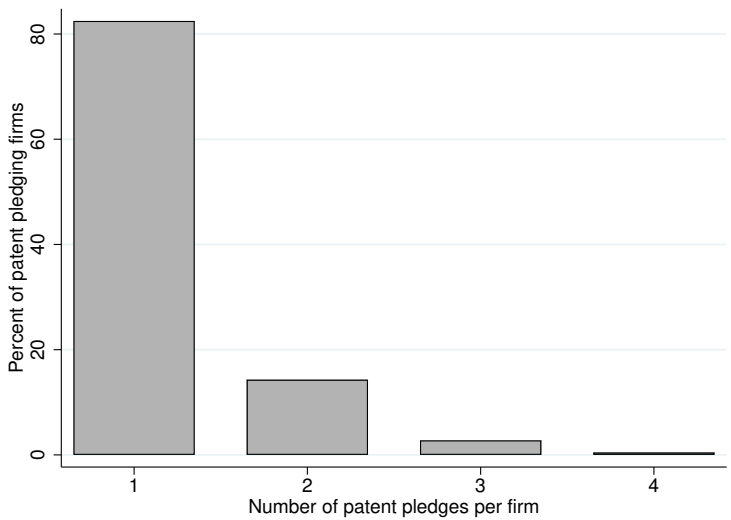

Figure 3: Frequency of patent pledges per firm

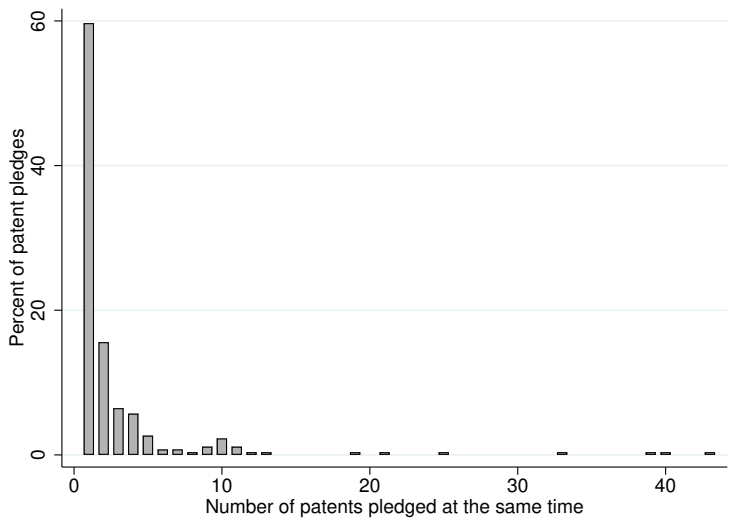

Figure 4: Pledged patent portfolio size

Patent Pledging Swedish Firms

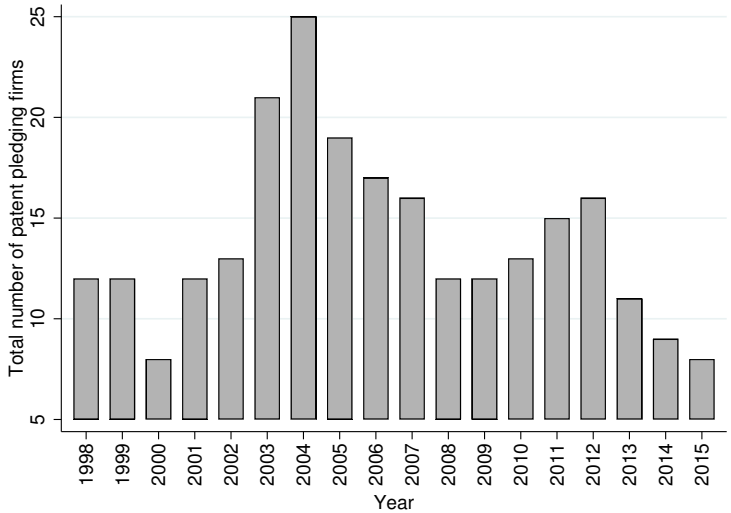

Figure 5: Yearly number of patent pledging firms

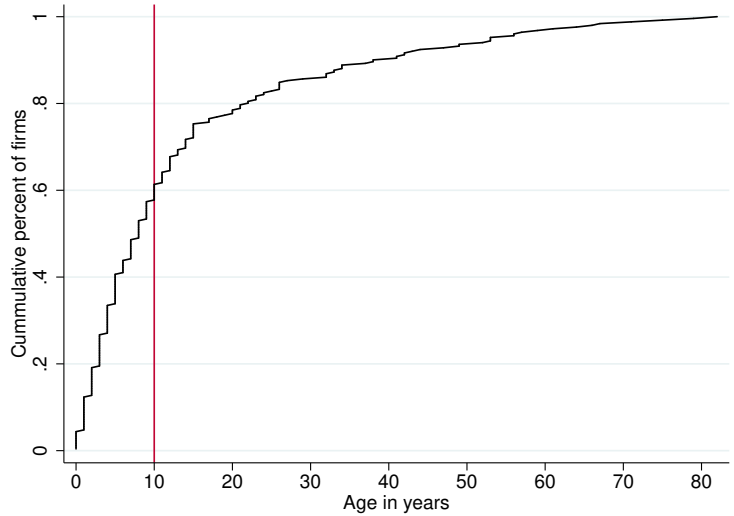

Figure 6: CDF of firms age

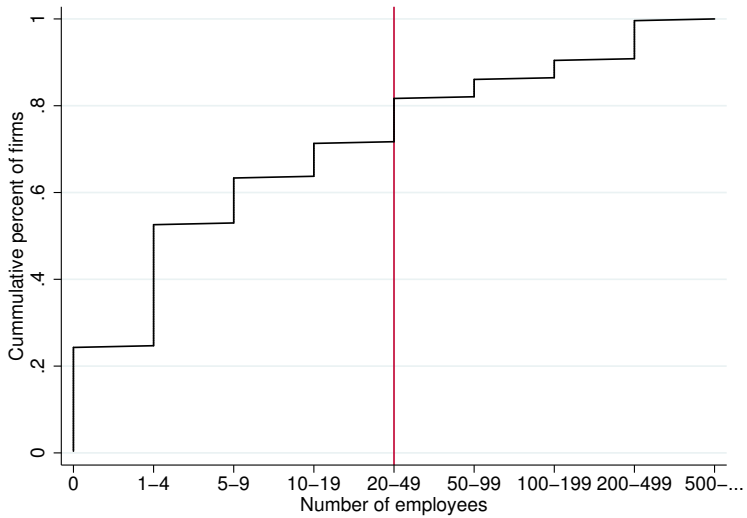

Figure 7: CDF of firms size

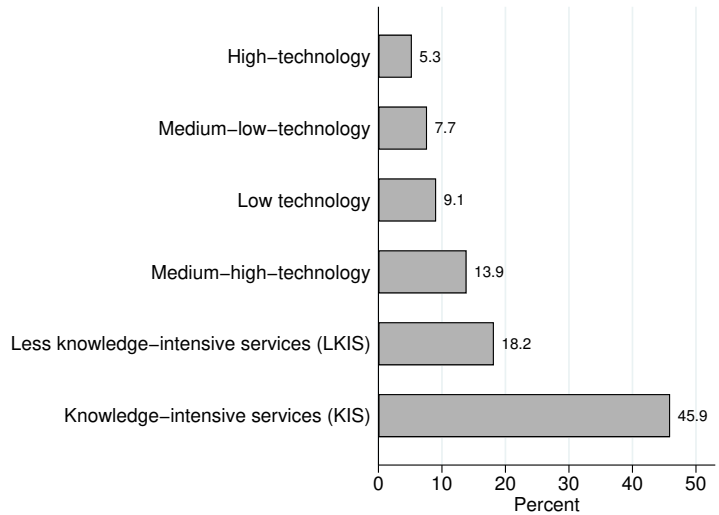

Figure 8: High-tech industry classification

Empirical Analysis

- **Literature:** Cash-flow sensitivity on future investments in a dynamic investment model known as FHP model (Fazzari et al. 1988, Chirinko 1993)
  - Cash-flow is also a predictor for future profitability (Kaplan & Zingales 1997, Farre-Mensa & Ljungqvist 2016)
  - Weak instruments prevent the consistent estimation of a dynamic model (Arellano & Bover 1995, Blundell & Bond 1998)
- **Our Model:** Diff-in-diff estimation in a fixed effects model with additional controls for time-variant firm characteristics

Empirical Model

$$\frac{I_{i,t}}{K_{i,t-1}} = \beta_1 ln(patstock)_{i,t-1} + \beta_2 pledge_{i,t} + \beta_3 pre\_pledge(t-1)_{i,t}$$
$$+ \beta_4 pre\_pledge(t-2)_{i,t} + \beta_5 post\_pledge(t+1)_{i,t} + \beta_6 post\_pledge(t+1+n)_{i,t}$$
$$+ \gamma_1 \left(\frac{WCAP}{K}\right)_{i,t-1} + \gamma_2 sales\_growth_{i,t} + \gamma_3 \left(\frac{D}{K}\right)_{i,t-1} + \gamma_4 ln(assets)_{i,t-1}$$
$$+ \gamma_5 group_{i,t} + d_t + \alpha_i + v_{i,t}$$

- $\frac{I}{K}$: Capital expenditure to tangible fixed assets
- $patstock_{i,t} = (1-\delta) patstock_{i,t-1} + patapp_{i,t}$ with $\delta = 15\%$
- $pledge_{i,t}$: Dummy if firm has pledged a patent in t
- $pre\_pledge(t-1)_{i,t}$: Dummy one year before firm has pledged a patent
- $post\_pledge(t+1)_{i,t}$: Dummy one year after firm has pledged a patent

Summary Statistics

	Full sample: N=115,888				Firms pledged patents: N=1,153			
	Mean	S.D.	min	max	Mean	S.D.	min	max
I/K	0.757	0.938	0.000	4.554	0.883	1.004	0.000	4.535
Pledged Patents	0.009	0.222	0.000	21.000	0.879	2.046	0.000	21.000
Patentstock	0.258	1.386	0.000	96.270	2.071	3.635	0.000	31.346
$WCAP/K$	8.446	10.137	0.030	46.172	8.033	10.492	0.031	46.172
Sales Growth	0.133	0.286	-0.334	1.133	0.180	0.318	-0.332	1.118
D/K	1.664	2.784	0.000	14.329	2.150	3.112	0.000	14.250
Total Assets	19.745	291.726	0.000	34109.808	24.668	80.126	0.040	1401.000
Age	13.083	12.647	0	135	12.902	12.899	0	77
Group	0.433	0.495	0	1	0.508	0.500	0	1

Total assets in 1000 SEK (SEK/EUR ≈ 0.1)

- Cleaned for irrelevant sectors, M&A's, bankruptcies, outliers.
- Panel contains 14,068 firms observed between 1998-2012.
- 2,425 firms have a positive patent stock. 138 firms have pledged patents.

Main Results

$I_{i,t}/K_{i,t-1}$	Pledgedummy		Pledgestock		Pledgecitestock	
$ln(patentstock)_{i,t-1}$	0.075*	(0.045)	0.076*	(0.045)		
$ln(patentcitestock)_{i,t-1}$					0.051*	(0.030)
$pledge_{i,t}$	0.38**	(0.18)				
$ln(pledgestock)_{i,t}$			0.24**	(0.12)		
$ln(pledgecitestock)_{i,t}$					0.11*	(0.060)
$pre\_pledge(t-1)$	0.20	(0.21)	0.15	(0.21)	0.13	(0.21)
$pre\_pledge(t-2)$	0.25	(0.16)	0.21	(0.16)	0.19	(0.16)
$post\_pledge(t+1)$	0.10	(0.14)	0.048	(0.12)	0.037	(0.12)
$post\_pledge(t+1+n)$	0.30	(0.23)	0.25	(0.23)	0.24	(0.23)
Financial controls	Yes		Yes		Yes	
Year Dummies	Yes		Yes		Yes	
Observations	52430		52430		52430	

Robust standard errors in parentheses

All regressions have a constant

***, **, and * stand for significance at the 1%, 5%, and 10% levels.

- Difference in the coefficients of pledgestock and patentstock is insignificant.
- Results are robust for a restricted sample of firms that applied for patents.

Conclusion and Limitations

- Economically and statistically **significant effect of patent pledging on investments** for small and innovative firms (H2)
- Weak evidence for prior findings on the signalling value of patents (H1)
- No evidence for differences in patenting vs. pledging activity on firms' investments (H3)

Limitations

- Financial variables are likely to be jointly determined with firms' investment rate (simultaneity)

Discussion

Restricted Sample

- Restrict sample for firms with a positive patent stock

$I_{i,t}/K_{i,t-1}$	Pledgedummy	
$ln(patentstock)_{i,t-1}$	0.061	(0.044)
$pledge_{i,t}$	0.35**	(0.18)
$pre\_pledge(t-1)$	0.17	(0.21)
$pre\_pledge(t-2)$	0.23	(0.16)
$post\_pledge(t+1)$	0.070	(0.14)
$post\_pledge(t+1+n)$	0.24	(0.24)
Financial controls	Yes	
Year Dummies	Yes	
Observations	8237	

Robust standard errors in parentheses

All regressions have a constant

***, **, and * stand for significance at the 1%, 5%, and 10% levels

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