

***Dynamics of Innovation, R&D
Cooperation, Competition and
Productivity***

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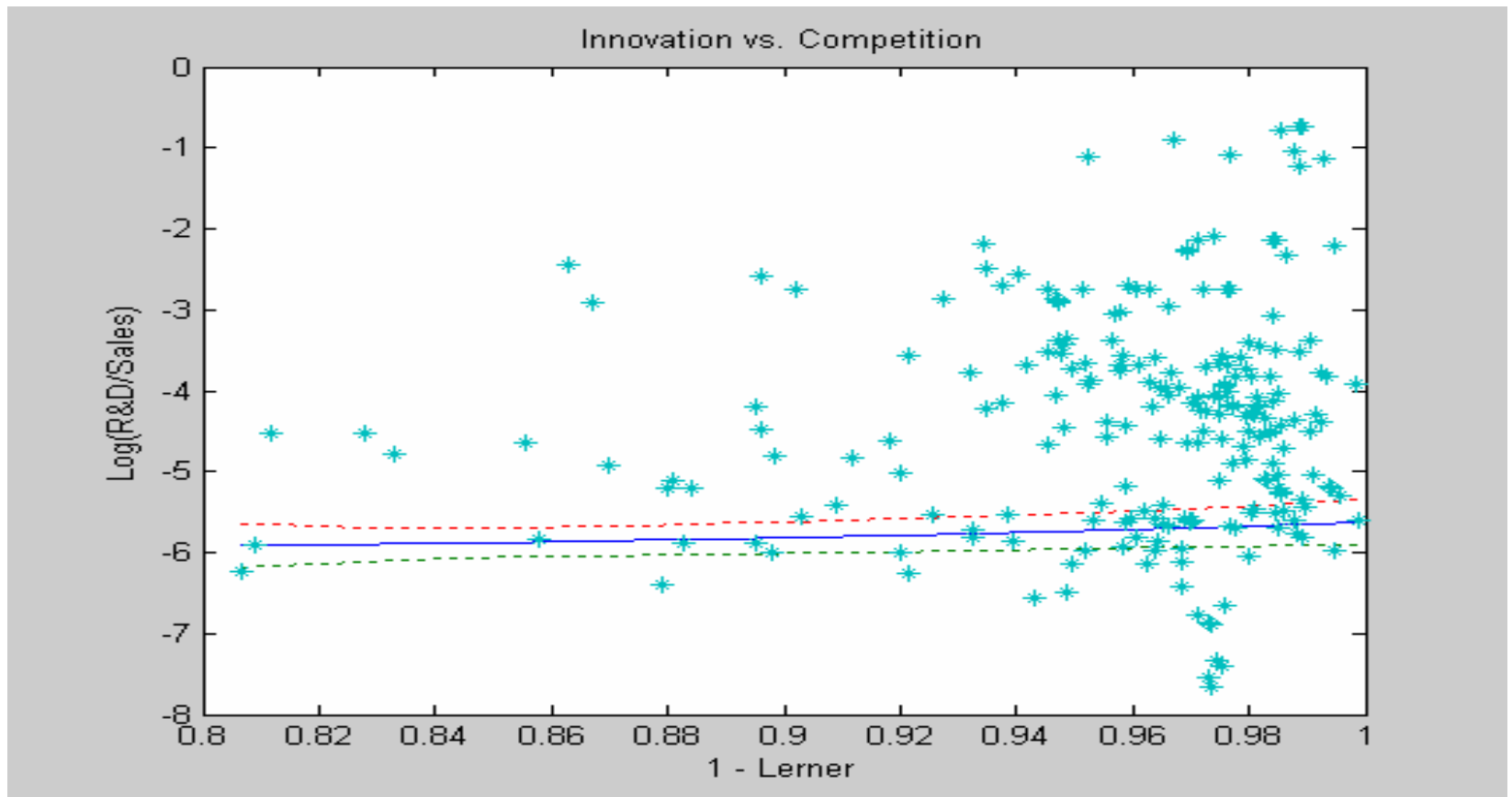
RQ1. The relationship between innovation and competition

- Relationship between innovation and competition is U-shaped (based on data for 25 industries 1997-2005):
 - (i) firms with high levels or low levels of competition are the most innovative.
 - (ii) Results are robust to two alternative measures of innovation: R&D expenditure and counts of patents.
 - (iii) Measure of competition:

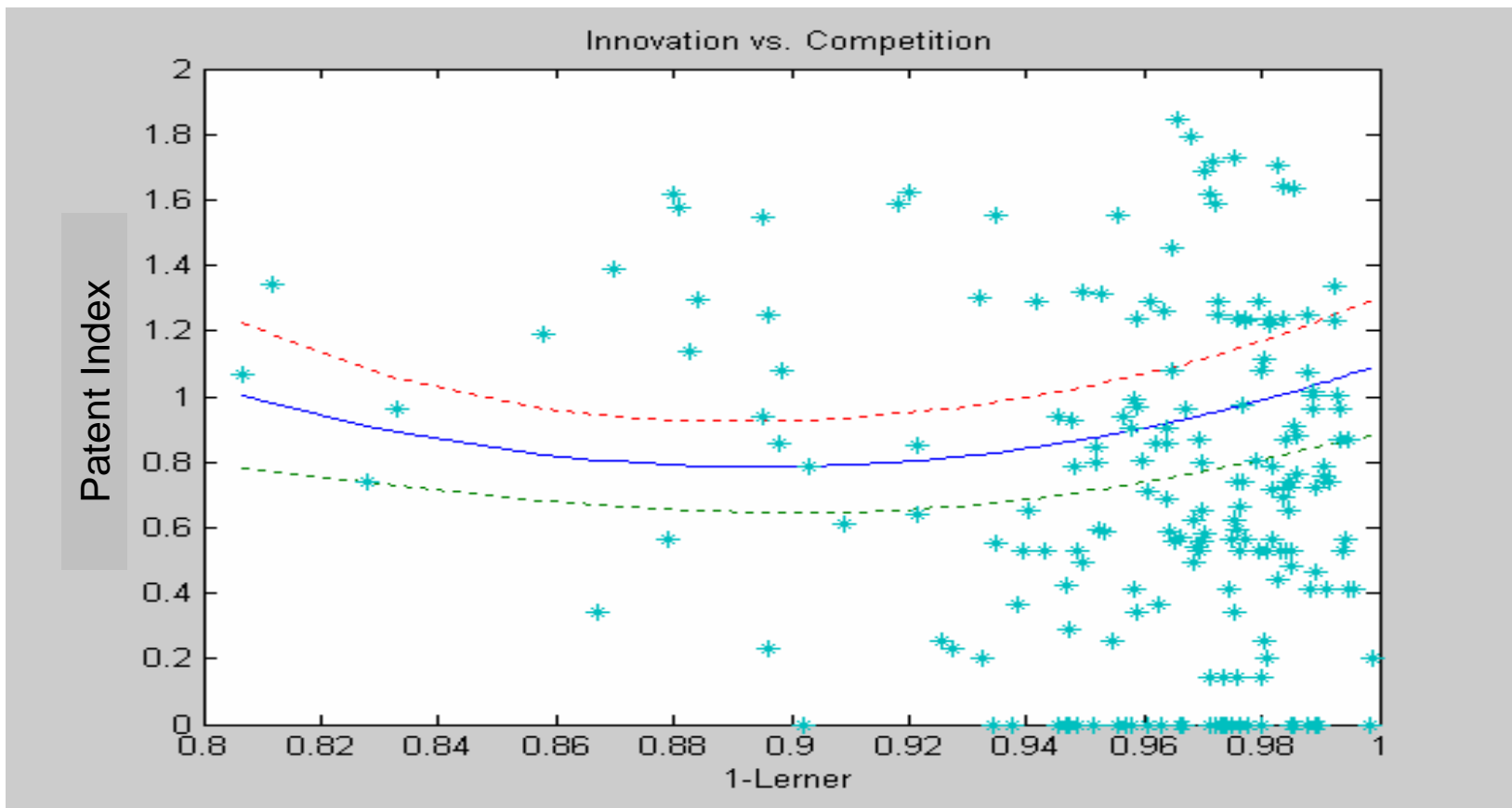
$$c_{jt} = 1 - \frac{1}{N_{jt}} \sum_{i \in j} l_{it}, \quad \text{with} \quad l_{it} = \frac{\text{operating profit} - \text{costs of capital}}{\text{sales}}$$

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R&D/Sales vs Competition

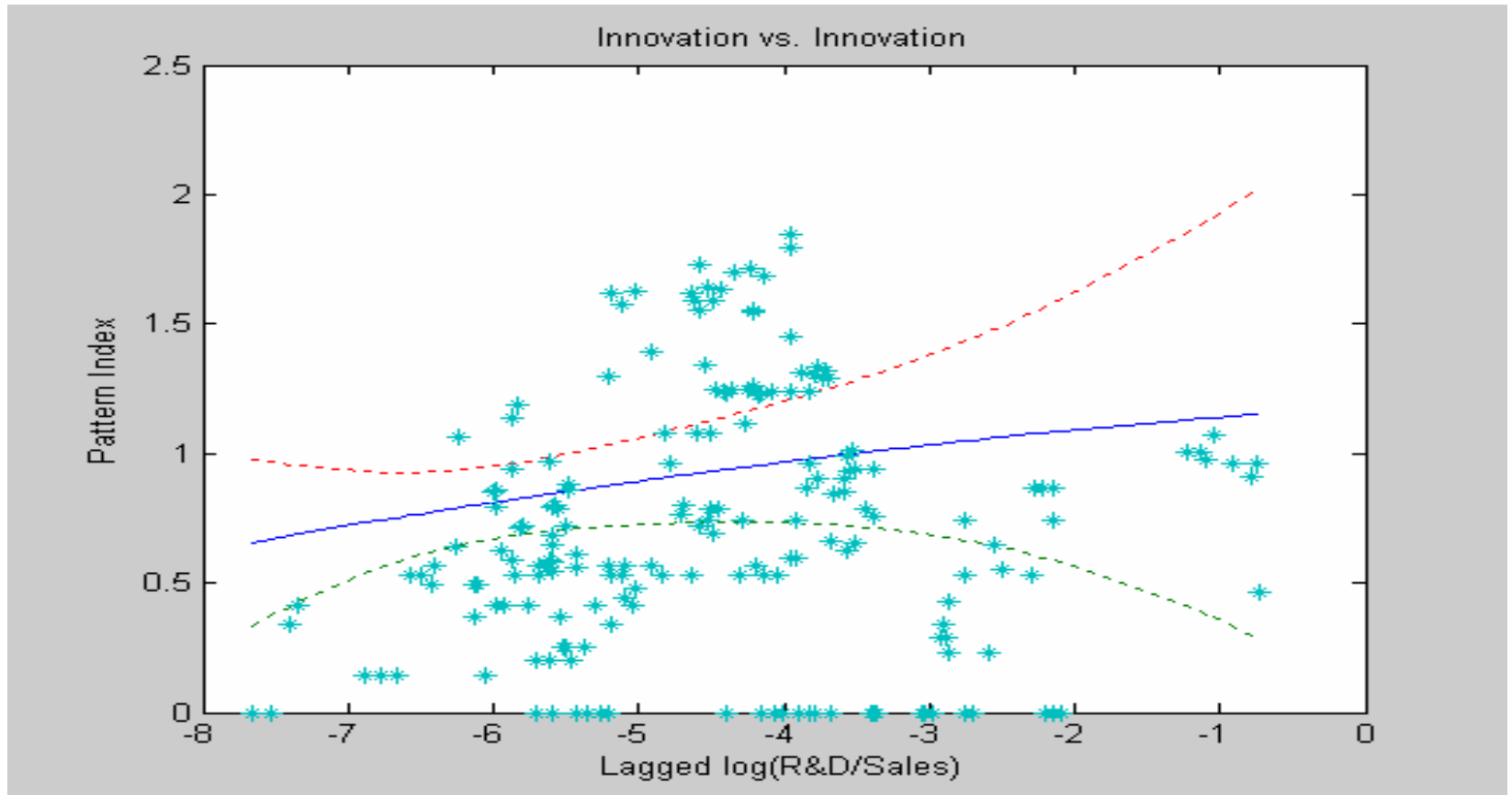


Patent Index vs Competition



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Patent Index vs lagged $\log(R\&D/Sales)$

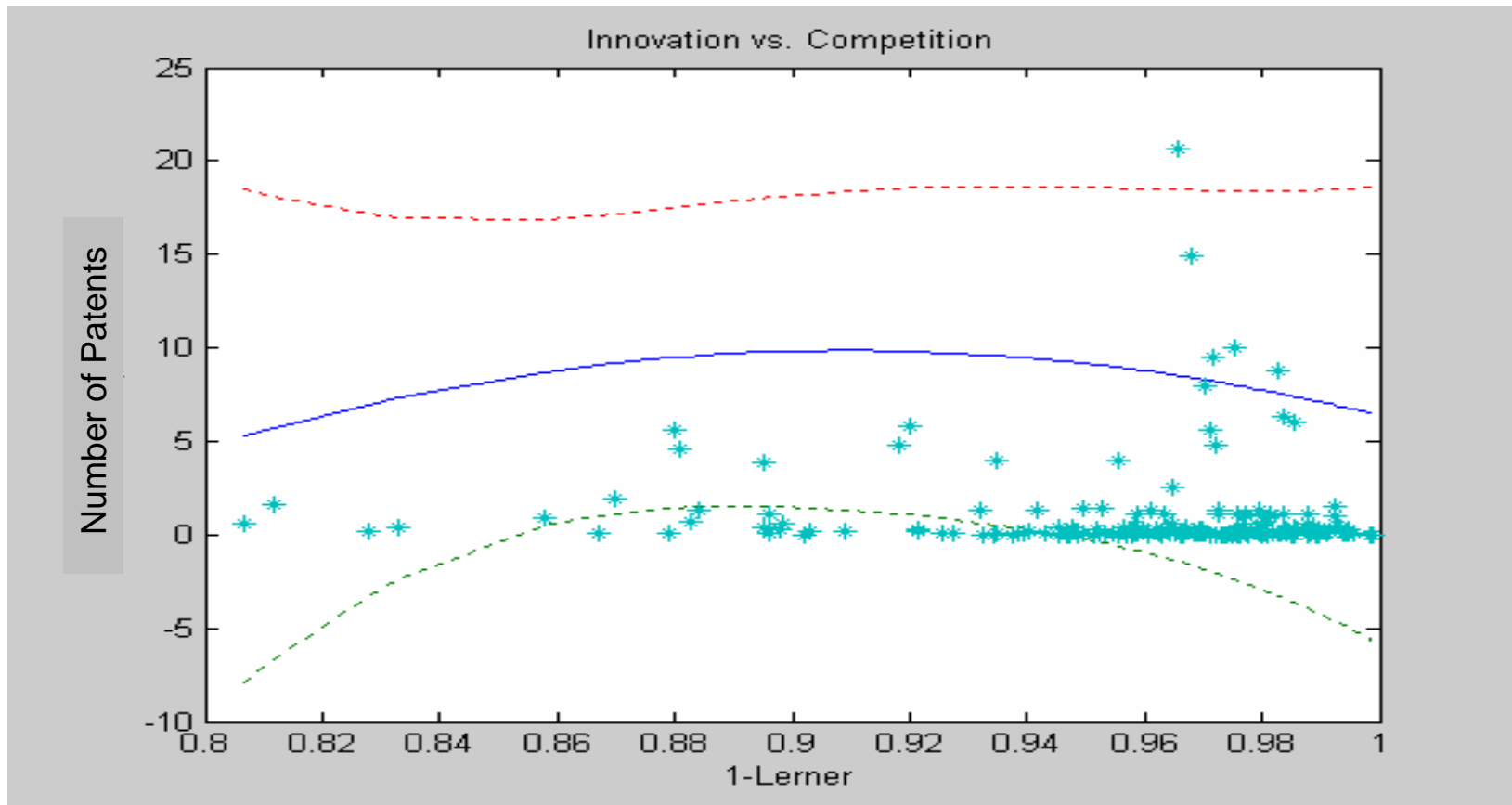


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RQ1. Competition and Innovation

- Alternative approach, Poisson count models as in Aghion *et al.* (2005): an inverted U-shape relationship is confirmed with our patent data.
- ◆ Limitations of this approach:
 - Expectations = variances,
 - No compression of the range for heterogeneous data (patents are concentrated in some firms/industries),
 - More weight to extreme values, e.g. Philips (right part), Shell, and DSM.

Aghion et al. reproduced



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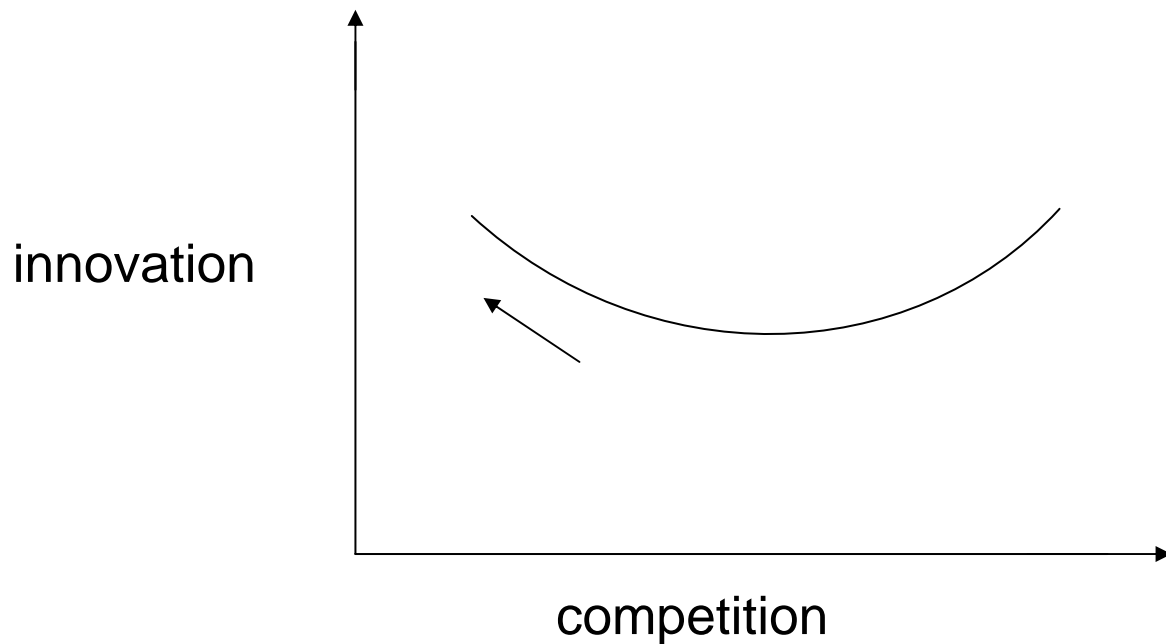
RQ1. Competition and Innovation

- How does U-shape fit into existing literature?
 - ◆ Reconciliation with the Schumpeterian view that there are two main patterns that describe the relationship: creative destruction and creative accumulation
 - ◆ Product Life Cycle Theory (Brouwer *et al.*, 2007.): decreasing part U-shape explained by “oligopolistic shake out”
 - ◆ Empirical studies confirming U-shape: Bound, Griliches, Hall, Jaffe, and Cummins (1984) for the U.S., Cremer and Sirbu (1978) for France, Bertshek (1995) for Belgium, France, and Germany, Gilbert, (2006).

RQ2. Differences across industries (1997 - 2005)?

Industry	AvSales	Av(1-Lerner)	AvR&D	$\frac{AvR\&D}{AvSales}$	Av#Patents
(01) – agriculture	22625.3	.875	60.5	0.002	3.65
(11) – crude petrol.	11809.2	.897	96.22	.008	43.5
(15) – food prod. & bev.	17644.6	.976	244.66	.013	9.31
(17) – textiles	3307.55	.974	15.88	.004	.36
(21) – paper, pulp	3350.44	.988	14.44	.004	.33
(24) – chemicals	33371.33	.951	955.11	.028	3.56
(25) – rubber & plastic	5670.44	.982	38.88	.006	1.03
(27) – basic met.	5886.44	.898	60.33	.010	7.33
(28) – fabricated met.	13433.78	.972	46.77	.003	2.36
(29) – mach. & equip.	15254	.978	421.66	.027	1.93
(30) – office mach.	43804	.958	1019.77	.023	13.61
(31) – electrical mach.	27465	.975	374.11	.013	113.78
(33) – medical instrum.	18973	.920	1262.44	.066	.60
(34) – motor vehic.	12325	.982	144.88	.011	1.90
(36) – furniture	2074.33	.971	36.44	.017	1
(45) – construction	54611.44	.973	48.11	.000	.28
(51) – wholesale trade	49875.33	.965	172.44	.003	1.77
(64) – post and telecom.	805612	.954	52159.33	.064	.55
(65) – financial intermediation	28586.11	.934	85.33	.002	.837
(71) – renting of machinery	26072.11	.977	496.77	.019	.22
(72) – computers	12271.67	.963	183.66	.014	27.2
(73) – research & development	3039	.982	1138.67	.374	3.77
(74) – other business activities	62905.67	.96	168.22	.002	.89
(80) – education	19817.22	.972	2171.11	.109	1.33
(92) – recreational activities	63884.56	.965	2343.22	.036	0

RQ3. How can government stimulate innovation?



RQ3. How can government stimulate innovation under imperfect competition?

- Reversing the “oligopolistic shake-out”
 - ◆ Providing a stimulus to innovation by only rewarding successful innovative programs of relatively dominant firms.
 - ◆ Stimulate mergers and acquisitions of potentially successful innovators
 - ◆ Stimulate cooperation in R&D

Innovation can also be stimulated by stimulating competition in already relatively competitive industries