

Lifting the veil on patents and inventions

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IPSDM 2014

November 17th

The value of patent data

The screenshot shows a Google Scholar search results page. The search query is "patent data" "innovation", which has yielded approximately 16,900 results in 0.13 seconds. The results are listed in a table with columns for article titles, authors, and publication details. The first result is "Innovation and spillovers in regions: Evidence from European patent data" by L. Bottazzi and G. Peri, published in the European Economic Review in 2003. The second result is "Innovation in Israel 1968–1997: a comparative analysis using patent data" by M. Trajtenberg, published in Research Policy in 2001. The third result is "Spatial patterns of innovation: evidence from patent data" by S. Breschi, published in The organization of economic innovation in Europe in 1999. The fourth result is "Networks of inventors and the role of academia: an exploration of Italian patent data" by M. Balconi, S. Breschi, and F. Lissoni, published in Research Policy in 2004. The fifth result is "Technology as a complex adaptive system: evidence from patent data" by L. Fleming and Q. Sorenson, published in Research Policy in 2001. The page also includes a sidebar with filters for articles, case law, and my library, and a search bar at the top.

patent data" "innovation" x
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Innovation and spillovers in regions: Evidence from European patent data
L Bottazzi, G Peri - European Economic Review, 2003 - Elsevier
This paper estimates the effect of research externalities in generating **innovation**. We use R&D and **patent data** for European Regions in the 1977–1995 period. We find that spillovers are very localized and exist only within a distance of 300 km. The estimates are robust to ...
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Innovation in Israel 1968–1997: a comparative analysis using patent data [PDF] from tau.ac.il
M Trajtenberg - Research Policy, 2001 - Elsevier
The Israeli high-tech sector is widely regarded as a hotbed of cutting-edge technologies, and as the growth engine of the Israeli economy in the 1990s and beyond. In this paper we present a close-up portrait of **innovation** in Israel for the past 30 years, with the aid of ...
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Spatial patterns of innovation: evidence from patent data
S Breschi - The organization of economic innovation in Europe, 1999 - books.google.com
The last few years have witnessed a renewed and increasing interest on the part of economists in the geographical dimension of economic phenomena. Such revived attention in issues of economic geography rests ultimately upon the recognition of the essential ...
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Networks of inventors and the role of academia: an exploration of Italian patent data [PDF] from researchgate.net
M Balconi, S Breschi, F Lissoni - Research Policy, 2004 - Elsevier
... Networks of inventors and the role of academia: an exploration of Italian **patent data** ... Data from **innovation** surveys have provided useful additional evidence on the impact of other academic activities, such as meetings and informal contacts with university researchers (Mansfield ...
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Technology as a complex adaptive system: evidence from patent data [PDF] from ncue.edu.tw
L Fleming, Q Sorenson - Research Policy, 2001 - Elsevier
... Technology as a complex adaptive system: evidence from **patent data**. ... This research typically focuses on commercial **innovation** rather than technological invention (Schumpeter, 1939 and

The value of patent data

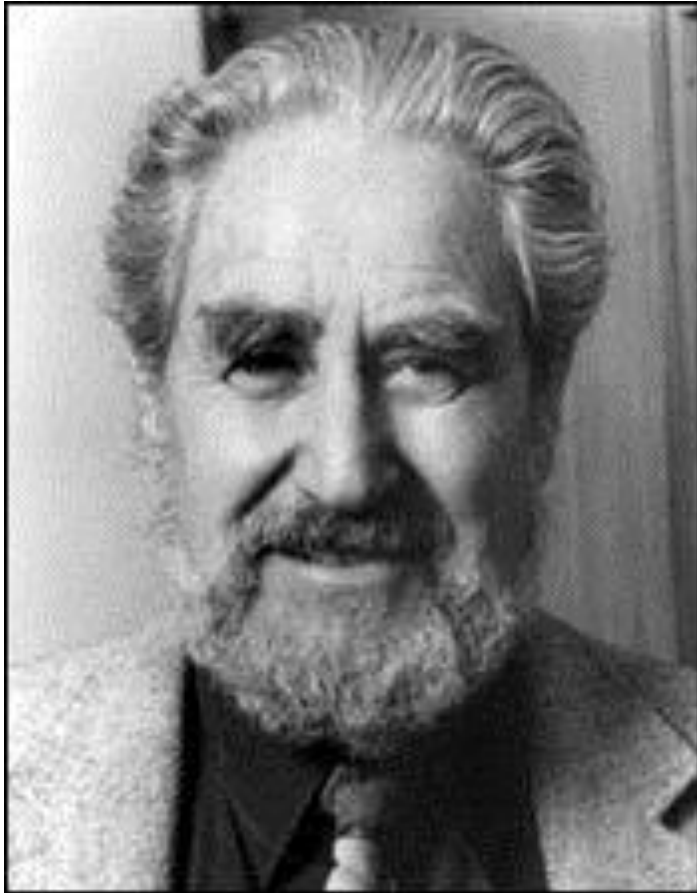
Collaboration Networks,
Structural Holes, and
Innovation: A
Longitudinal Study

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To assess the effects of a firm's network of relations on innovation, this paper elaborates a theoretical framework that relates three aspects of a firm's ego network—direct ties, indirect ties, and structural holes (disconnections between a firm's partners)—to the firm's subsequent innovation output. It posits that direct and indirect ties both have a positive impact on innovation but that the impact of indirect ties is moderated by the number of a firm's direct ties. Structural holes are proposed to have both positive and negative influences on subsequent innovation. Results from a longitudinal study of firms in the international chemicals industry indicate support for the predictions on direct and indirect ties, but in the inter-firm collaboration network, increasing structural holes has a negative effect on innovation. Among the implications for interorganizational network theory is that the optimal structure of interfirm networks depends on the objectives of the network members. ●

But...



“Not all inventions are patentable. Not all inventions are patented and the inventions that are patented differ greatly in their ‘quality’, in the magnitude of inventive output associated with them.”

Griliches (1990, p. 1169)

and...

*“A patent is a legal right to exclude. In an industry where the pace of technology is rapid and firms advance quickly upon innovations made by others, firms may patent for **strategic reasons** [...] to recoup investments in R&D. [...] But the **importance** of patent rights and their use may **vary** among firms even **within one industry** over time.”*

Hall & Ziedonis (2001, p. 125)

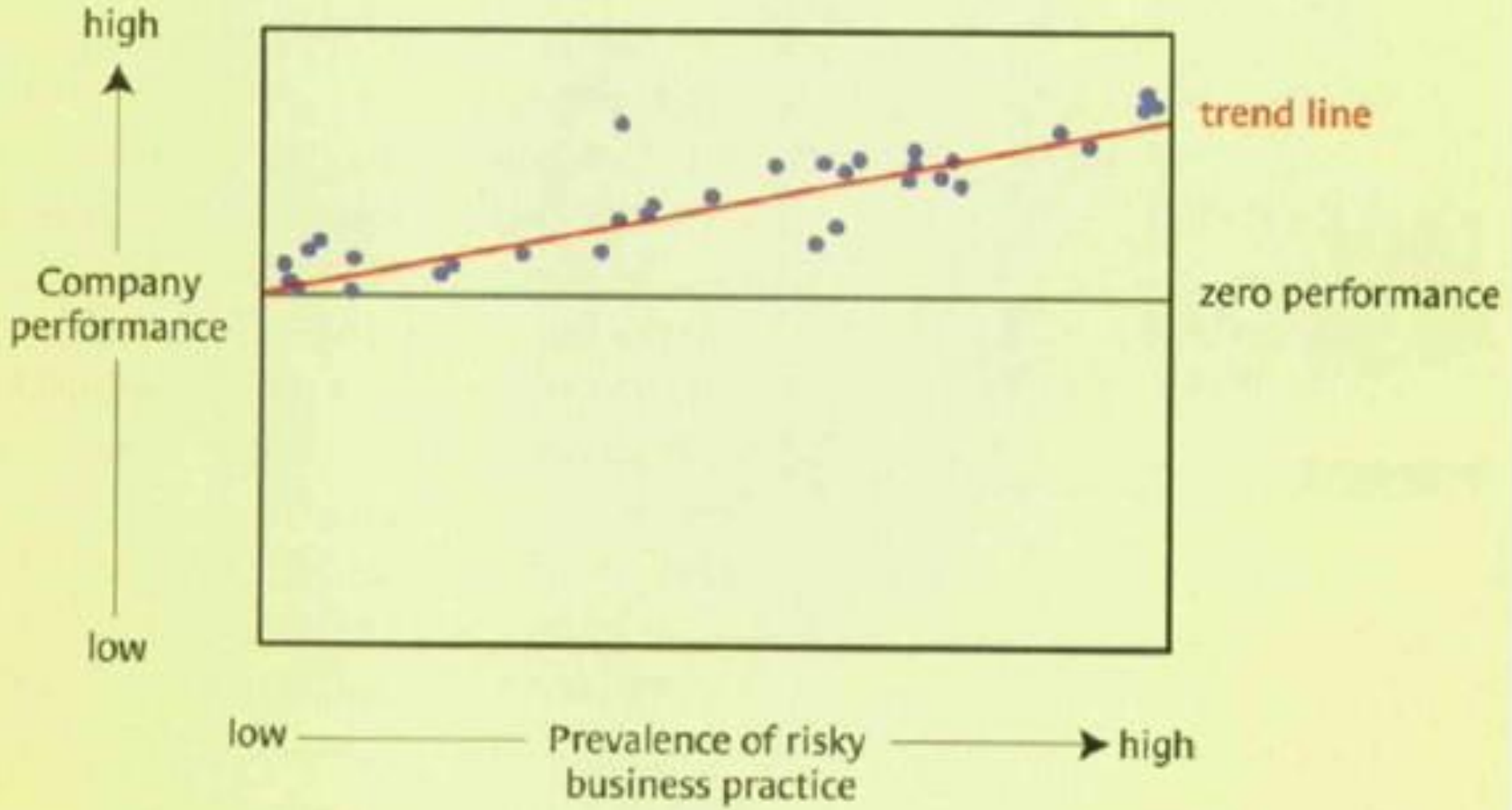


So what?

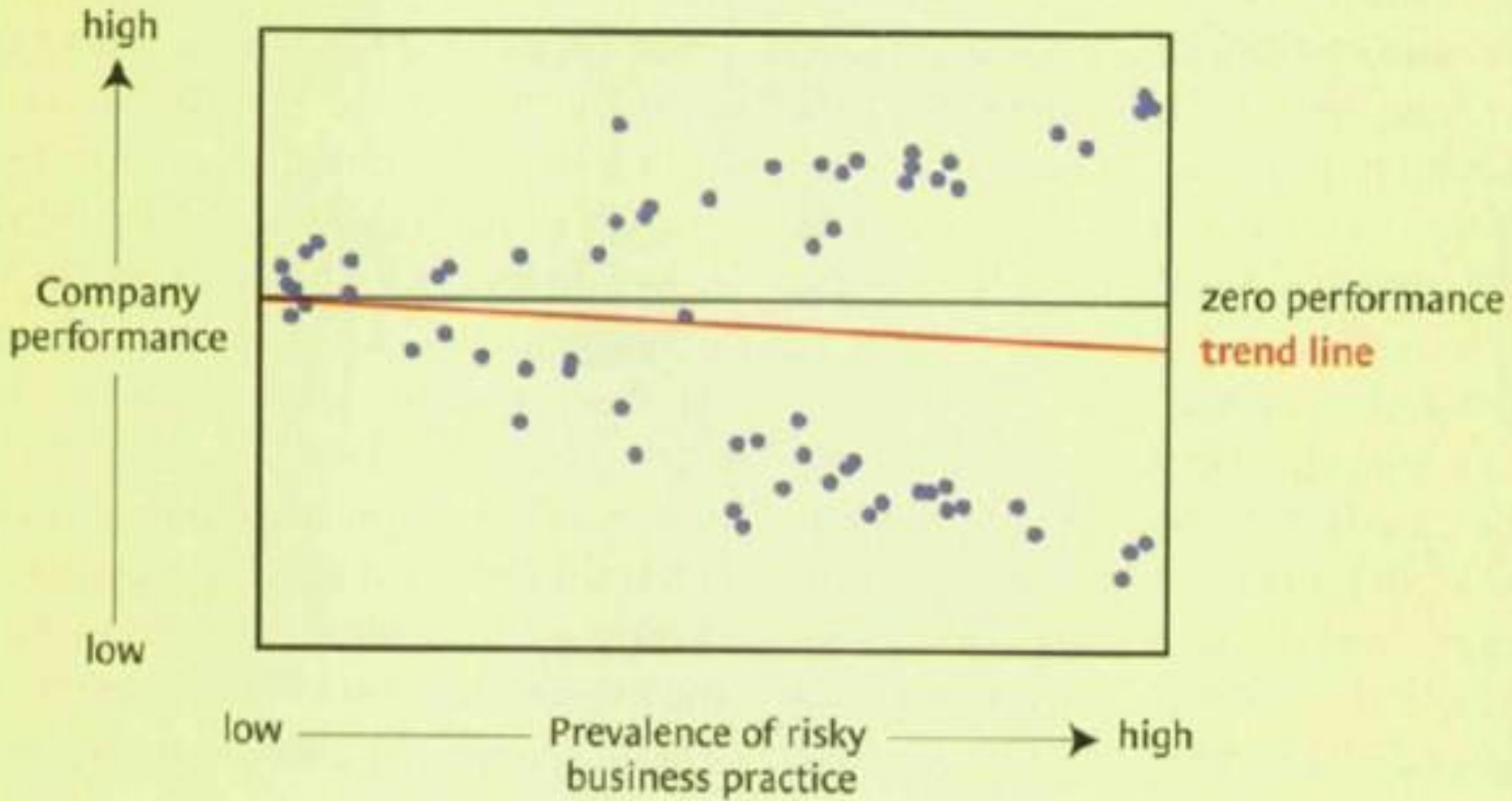
- Take two firms, with firm A and B being the same size
 - Firm A: 50 patent applications, 45 patents granted
 - Firm B: 100 patent applications, 60 patents granted
- Which one is better at innovation?
- What if I told you they had both made 100 invention disclosures inside of the firm?
- No inference possible!

- Similar issue: inventive teams
 - You cannot observe those teams that worked on inventions which were not patented

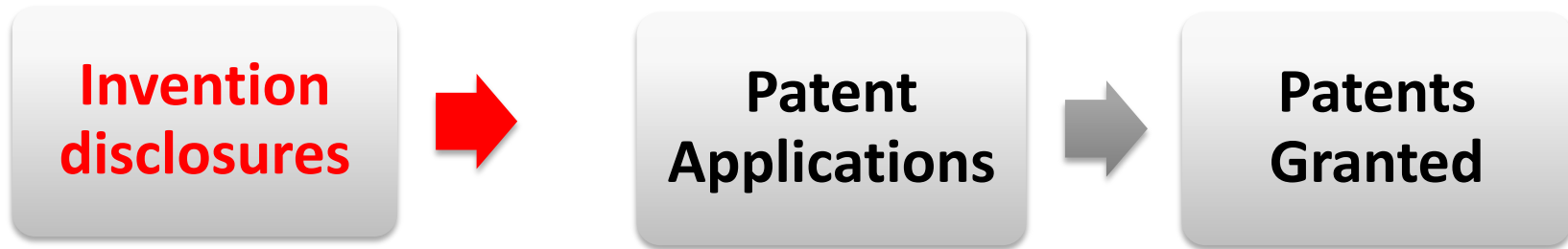
Only Existing Companies



All Companies



What happens inside organizations?



WHAT WE DO NOT OBSERVE

WHAT WE OBSERVE

“Many of these **unpatented ideas probably did not exceed the threshold of novelty** necessary to obtain a patent. **However** firms are also known to protect **important inventions by using trade secrets** and copyright. This feature of the data should suggest caution in the interpretation of the results. However, **unless there is a systematic bias, the results should be unaffected.**” Audia & Goncalo (2007. p. 13)

We have the data to test this assumption

- Data on invention disclosures (~35K) made by all employees of a large multinational company operating in a complex-product industry
- Each invention disclosure is evaluated and assigned to one of these categories
 1. Not novel ~ 50%
 2. Novel but not useful to the firm (at present) ~ 10%
 3. Novel and useful and it is patented ~ 30%
 4. Novel and useful and it is kept secret ~ 1%

We replicate two papers

- Singh & Fleming (2010)
 - They assess the impact of collaboration on the **variance** of the quality of innovative outcomes (proxied by patent citations) in a wide range of industries
- Audia & Goncalo (2007)
 - They assess the impact of inventors' past success on their future **creativity** (proxied by number of granted patents) in the hard disk drive industry

Our strategy

- First we estimate their models using our patented inventions then we test for the presence of selection bias

How do we test if there is a selection bias?

Heckman two step procedure

1. Estimate the probability that an invention has been protected with a granted patent
2. Estimate the model explaining the main outcome variable using only the subset of granted patents controlling for the inverse Mill's ratio
3. Check whether inverse Mill's ratio is significant

Use data on inventions – are they put forward for patenting?

Instrumenting the decision to file a patent

- The Heckman procedure requires an instrument
 - a variable which affect the decision to patent but does not influence the main outcome variable
- Invention disclosures submitted towards the end of the financial year are less likely to be patented
 - **regardless of their quality** - because the budget set aside for patent filings is running low
- Instrument: Timing of evaluation by the firm

Sources of selection bias

Inventions that are novel but not useful to the firm (at present) ~ 10% of disclosures:

Category	%	% patented
Provisional patent applications	10.1	94.5
Inventions with narrow scope of application	55.8	0.4
Inventions for which patenting does not offer useful protection	7.8	0
'Shelved' inventions – novel but not yet useful	26.3	2.9

Replicating Singh & Fleming

Logit models							
	Singh & Fleming estimates		Our estimates		Our estimates controlling for selection bias		Our estimates using invention disclosures
	High quality	Low quality	High quality	Low quality	High quality	Low quality	Not novel & not useful
Team	0.347**	-0.125**	0.411**	-0.697**	0.402**	-0.634**	-1.063**
Effect size	28%	-9%	5.8%	-4.5%	5.7%	-4.4%	-23.8%
Inverse Mill's ratio					-0.0357	0.207	
Sample	509,840	509,840	~5,000	~5,000	~5,000	~5,000	~35,000

Replicating Audia & Goncalo

Cox Models of the probability of patenting/inventing				
	Audia & Goncalo estimates	Our estimates	Our estimates controlling for selection bias	Our estimates using invention disclosures
Inventor success	0.139*	0.120**	0.109**	0.033**
Effect size	31%	27%	24%	7.5%
Inverse Mill's ratio			-0.237**	
Events	1,665	~5,000	~5,000	~35,000

Replicating Audia & Goncalo

Poisson Models: number of patents/inventions with new technology classes				
	Audia & Goncalo estimates	Our estimates	Our estimates controlling for selection bias	Our estimates using invention disclosures
Inventor success	-0.131*	-0.253**	-0.237**	-0.0615**
Effect size	-30%	-25.5%	-24%	-6%
Inverse Mill's ratio			-0.580**	
Sample	1,665	~10,000	~10,000	~35,000

Key findings and limitations

- We find evidence of selection bias when patents are used to proxy individual creativity but not when patents are used to identify technology breakthroughs
- Effect size of main explanatory variables are significantly different (by factor of 3-6) when we eliminate the source of the bias all together
- Caveat: results might be driven by the low number of secret inventions and relatively low number of novel but not useful inventions

Conclusions

- Be careful in drawing managerial and policy conclusions when using patent data to compare innovative performance across firms
- Consider other outputs of innovation process – e.g. publications
- Complement patent data with primary data on inventors' activities (e.g. PATVAL survey)
- Studies on creativity could exploit data from contexts where the entire range of innovative efforts is observed (e.g. Open source projects, suggestion boxes, idea submissions sites)