Where do patent measures fall short in the life sciences?

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Patent Statistics as Economic Indicators: A Survey

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I am indebted to my friends and collaborators for many ideas and comments. Parts of this survey borrow heavily (often verbatim) from our earlier work on this topic, especially from Griliches, Ariel Pakes, and Bronwyn Hall (1987), Griliches, Hall, and Pakes (1988), and Griliches (1989). I am indebted to the National Science Foundation (PRA85–12758 and SES 82–08006) and the National Bureau of Economic Research Productivity Program for financial support of this work and to B. Hall, A. Pakes, K. Pavitt, M. Schankerman, and F. M. Scherer for their comments on an earlier draft. The first draft of this survey was begun while I was a guest of the Rockefeller Foundation at the Bellagio Study and Conference Center in Italy. An earlier version of this paper was presented as the W. S. Woytinsky Lecture of 1989 at the University of Michigan.

Overheard at a Catskills Resort
(one guest to another):
—The food is so terrible here.
—Yes. And the portions are so small.

There are well-known problems with patent statistics

In most sectors patents not as important as other means of appropriating returns to R&D investments

Not all important inventions are patented (differences across firms, sectors in propensity to patent; trade secrecy and tacit knowledge)

Not all patents are important inventions: skew-distributed value of underlying inventions

Patent citations to measure knowledge flows and spillovers “contaminated” by examiner citations

Typically hard to link patents to products and actual outcomes of interest

There is also a belief that these issues are less prominent in life sciences

In most sectors patents not as important as other means of appropriating returns to R&D investments

Exception: pharmaceuticals

Not all important inventions are patented (differences across firms, sectors in propensity to patent)

Exception: pharmaceuticals

Not all patents are important inventions: skew-distributed value

True, but on average higher in pharmaceuticals

Patent citations to measure knowledge flows and spillovers “contaminated” by examiner citations

Examiner citations much less prominent in pharmaceuticals; applicants conduct more through prior art searches there to “bullet proof” patents

Hard to link patents to specific products and actual outcomes of interest

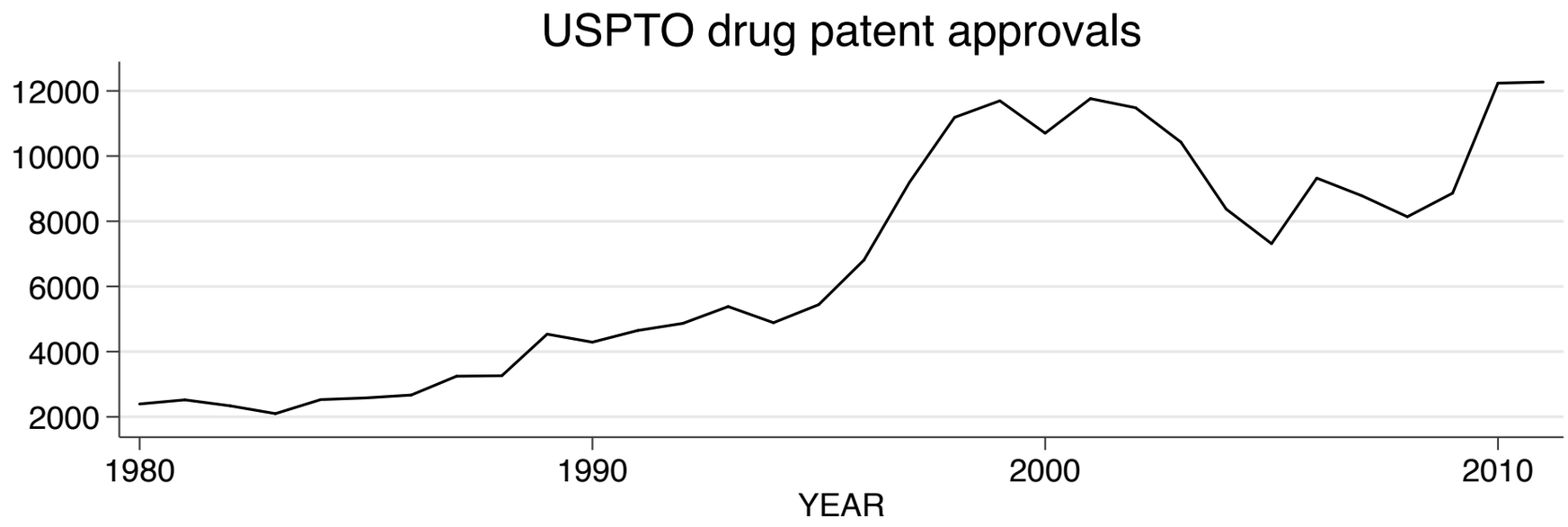
Pharmaceuticals as a discrete product field; Drug patents can be linked to drug products using FDA’s Orange Book

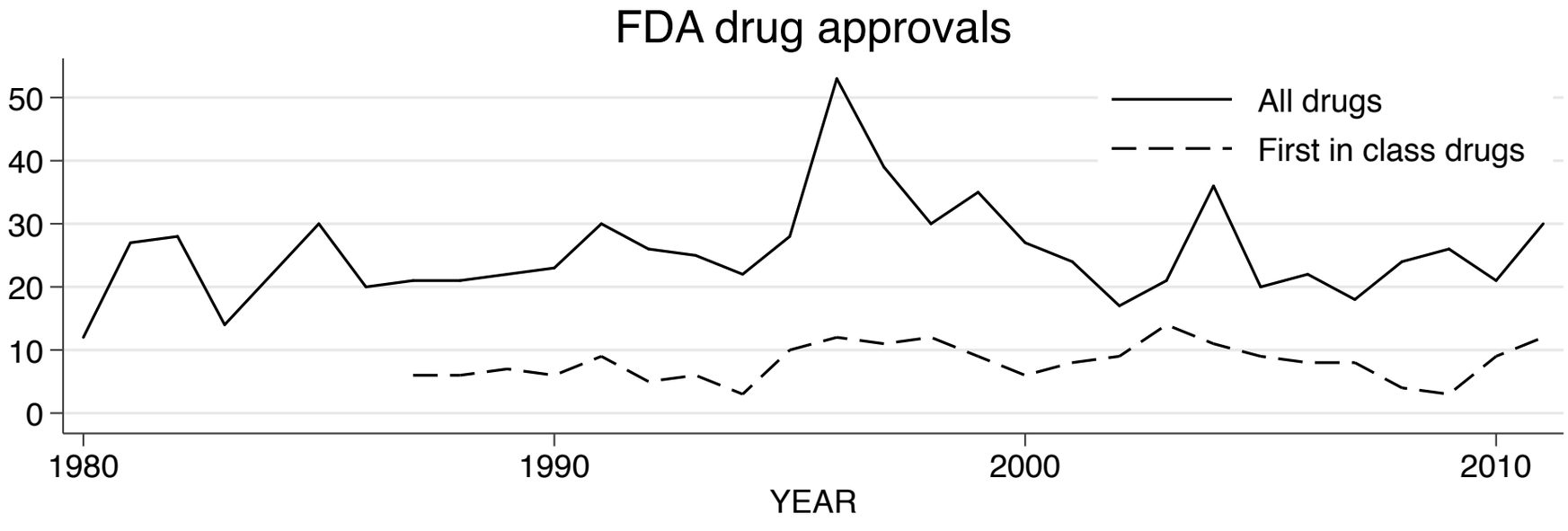
However, the “life science” innovation system is broader than pharma

Medical devices, biotechnology look a lot like “complex product” industries in many ways (High patent-product ratios, defensive patenting, blurry patent boundaries, hard to link to products)

Public sector biomedical research generates research and contributes to “innovation” through non-patent channels (epidemiological research, clinical research, discovery of new uses of drugs, knowledge that particular things don’t work, labor mobility)

Moreover, even in pharma patents miss a lot of the story





Issues with patent-based measures of pharmaceutical innovation

- Weak correlation over time, firm, country in patent grants and number of new drugs introduced (and good new drugs introduced)

- Patent counts more strongly related to research input than output or the quality of innovation; citation and other quality weights help but correlation with actual outcomes (drugs, quality-weighted drugs) remains weak (Abrams and Sampat, 2017)

- Many granted patents don't reflect significant inventive step

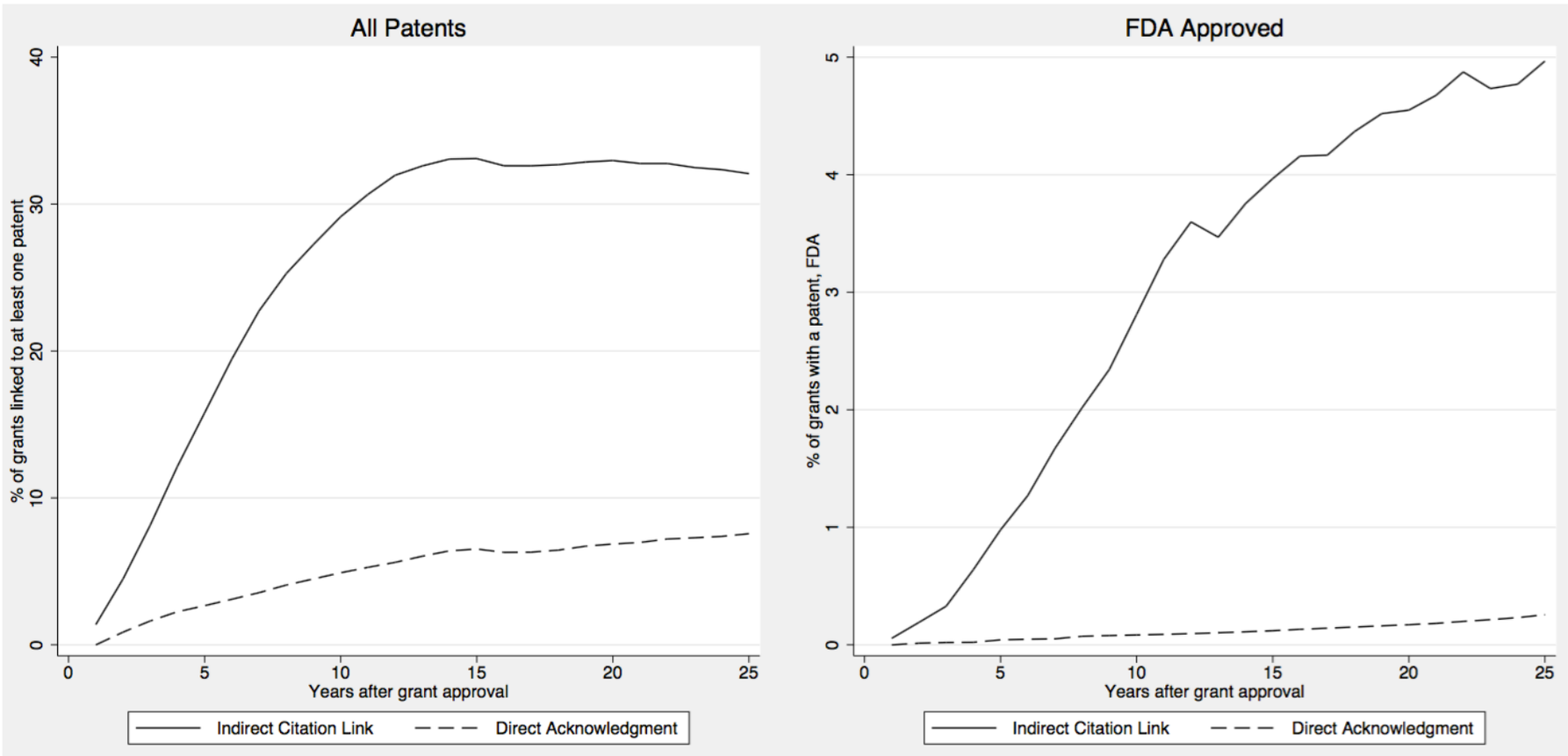
    - Considerable variation across patent examiners in "lenience" (Lemley and Sampat, 2012; Sampat and Williams, 2015)

    - Sharp growth of secondary drug patents, most of which get challenged, and half of which are invalidated when litigated to completion (Hemphill and Sampat, 2010, 2011, 2012)

- In general, hard to untangle the effects of policy changes (especially policies that encourage or strengthen patents) on propensity to patent vs. actually innovation

Promise and perils of using patent data to assess research impact

Figure 1: Grant-Patent lags, direct vs. indirect patenting



Note: Based on a sample of 365,380 NIH grant cycles awarded between the years 1980 and 2007. A grant is *directly* linked to a patent if the patent contains a government interest statement explicitly referencing the grant. A grant is *indirectly* linked to a patent if a publication acknowledges the grant within five years of the start of a particular cycle for the grant, and a patent lists this publication as prior art in the header of the patent document. For each year after approval, the percentage of linked patents is calculated using only grants that have reached that age.

Li, Danielle, Pierre Azoulay, and Bhaven N. Sampat. *Science* 356.6333 (2017): 78-81.

Ongoing work

(12) **United States Patent**
Dart et al.

(10) **Patent No.: US 8,969,325 B2**
(45) **Date of Patent: Mar. 3, 2015**

(54) **TRPV1 ANTAGONISTS**

(71) Applicant: **AbbVie Inc.**, North Chicago, IL (US)

(72) Inventors: **Michael J. Dart**, Highland Park, IL (US); **Philip R. Kym**, Libertyville, IL (US); **Eric A. Voight**, Pleasant Prarie, WI (US); **Anurupa Shrestha**, Gurnee, IL (US); **Jerome F. Daanen**, Racine, WI (US); **Tammie K. Jinkerson**, Pleasant Prairie, WI (US); **Ryan G. Keddy**, Beach Park, IL (US); **Sridhar Peddi**, Schaumburg, IL (US); **Arthur Gomtsyan**, Vernon Hills, IL (US); **Michael E. Kort**, Lake Bluff, IL (US); **Gregory A. Gfesser**, Lindenhurst, IL (US); **Kevin R. Woller**, Antioch, IL (US); **Derek W. Nelson**, Highland Park, IL (US)

(73) Assignee: **AbbVie Inc.**, North Chicago, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 72 days.

(21) Appl. No.: **13/716,862**

(22) Filed: **Dec. 17, 2012**

(65) **Prior Publication Data**

US 2013/0172334 A1 Jul. 4, 2013

Related U.S. Application Data

(60) Provisional application No. 61/577,394, filed on Dec. 19, 2011, provisional application No. 61/704,823, filed on Sep. 24, 2012.

(51) **Int. Cl.**

C07D 405/12	(2006.01)
C07D 215/38	(2006.01)
C07D 239/80	(2006.01)
C07D 413/12	(2006.01)

USPC **514/105**; 544/230; 544/284; 544/286; 544/70; 546/15; 546/157; 514/230.5; 514/266.21; 514/266.24; 514/266.3; 514/278; 514/312

(58) **Field of Classification Search**
None
See application file for complete search history.

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The promise of in text citations

Ischemia (e.g. cerebral ischemia) is the shortage or inadequate of oxygenated blood flow to body parts and organs, and often results in dysfunction or damage of tissue. The neuroprotective efficacy of induced hypothermia following or during cerebral ischemia is evident in experimental anima models of stroke (Barone, F. C. et al., *Neurosci. Biobehav. Rev.,* 1997; 2(1), 31-44; Onesti, S. T. et al., *Neurosurgery,* 1991, 29, 369; Coimbra, C. et al., *Acta Neuropathol. (Berl),* 1994; 87, 325; Zhang, Y. et al., *Acta Anaesthesiol. Sin.,* 2001, 39, 65; Yamashita, K. et al., Stroke, 1991, 22, 1574; Ooboshi, H. et al., *Brain Res.,* 2000, 884, 23; Colbourne, F. et al., *J. Cereb. Blood Flow Metab.,* 2000, 20(1-2), 1702; Kawai, N. et al., *Stroke,* 2000, 3, 1982; Maier, C. M. et al., *J. Neurosurg.,* 2001, 94, 90; Maier, C. M. et al., *Stroke,* 1998, 29, 2171). Two trials conducted in cardiac arrest patients have demonstrated improved neurological outcome of inducing hypothermia (Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest: Bernard, S. A. et al., *N. Engl. J.*

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Patent indicators in life sciences: Towards a user guide

Outside of pharma, be careful about claims that patents = innovation (inside pharma, consider linking patents to actual innovation)

Adjust for patent quality, even if imperfectly (citation counts, family size, renewal: see OECD Triadic Patent Family and quality databases). Pay attention to the top of the distribution

In evaluating policies and research impact using patent data, consider whether the policy change is affecting innovation or propensity to patent

Inside the black box:

Nuanced understanding of strategic reasons for patenting, incentives to patent (and not to), incentives to cite (and not to) in particular contexts strengthens most studies

Much of what we can reasonably say using patent data is context specific

Thanks

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