

Patents and Innovation: An idiosyncratic review of the evidence

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- Patents and incentives for R&D
 - Direct effect (net!)
 - Indirect effects
 - Cumulative innovation
 - Thickets, trolls and other nightmares from the nursery
- Patents and access
 - Monopoly pricing
- Patents and the market for technology
 - Patents and specialized technology suppliers

Patents and R&D: The bottom line

- Patents and incentives for R&D
 - The evidence is mixed – patents may create problems but patents also provide incentives for innovation
- Patents and access
 - Monopoly pricing – This is a major cost of patents
- The first order benefit of the patent system may be in lubricating the market for technology and encouraging a division of innovative labor.
- Many of the problems caused by patents are because patents are poorly written, in legalese, to claim as much while disclosing as little. The use of standard terms, and greater transparency about patents and patentees, may be very helpful.

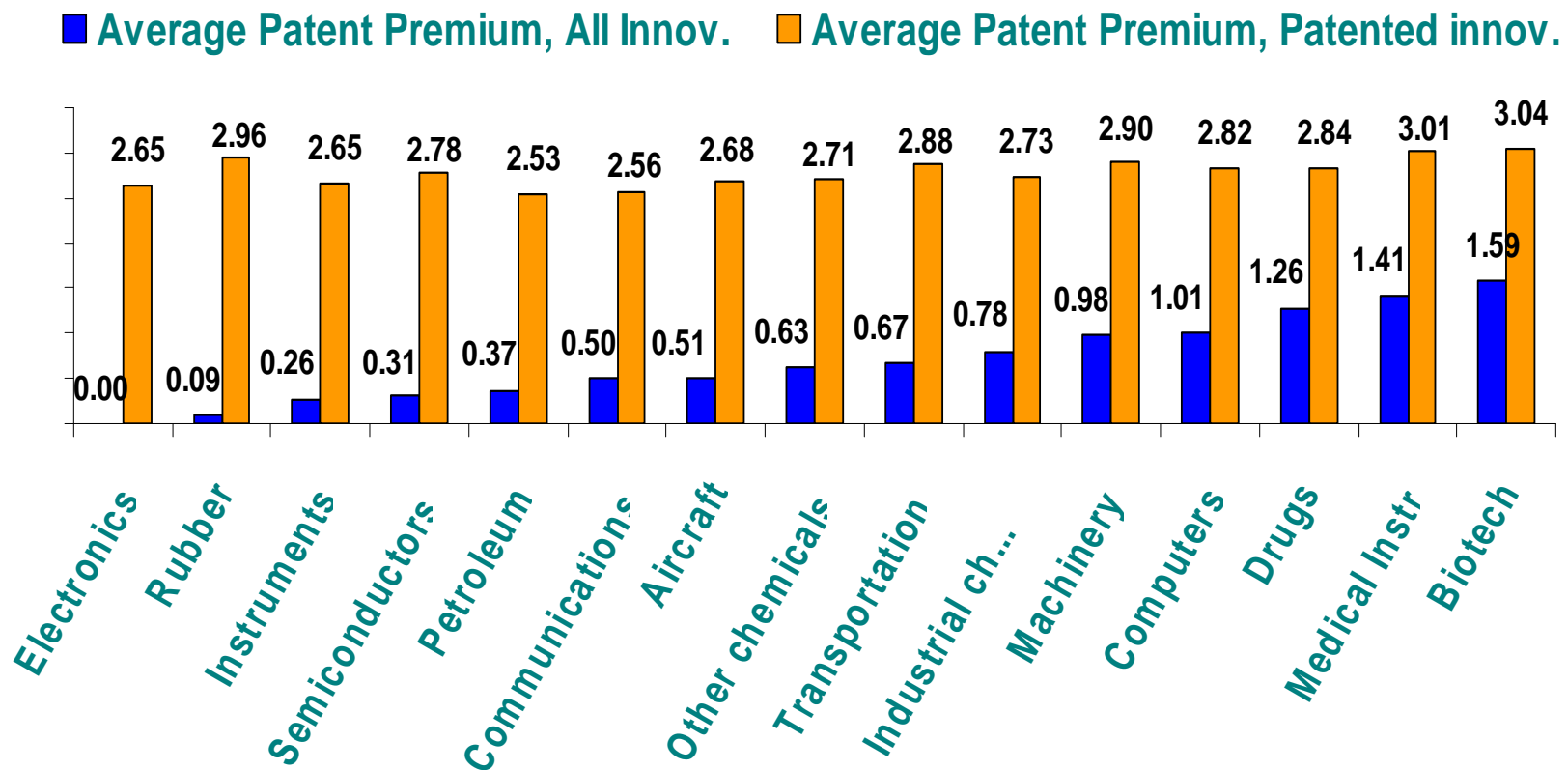
Patent protection and the development of R&D intensive industries

- Patents are important but not first order for R&D incentives, *with some exceptions*
 - *Pharma, med devices, biotech, scientific instruments ...*
- Patent protection and the development of synthetic dyes
 - Anthony Travis; Peter Murmann; Paul Hohenberg
 - Germany, Switzerland – initially develop dyes without patent protection
 - Britain failed despite headstart, raw materials, lead users ... and patents
 - important \neq useful
 - “bad patents” are harmful.
 - Fuchsine patent in 1860s in France; Business method patents or gene fragment patents in US in 2000.
 - “Good patents” may be useful;

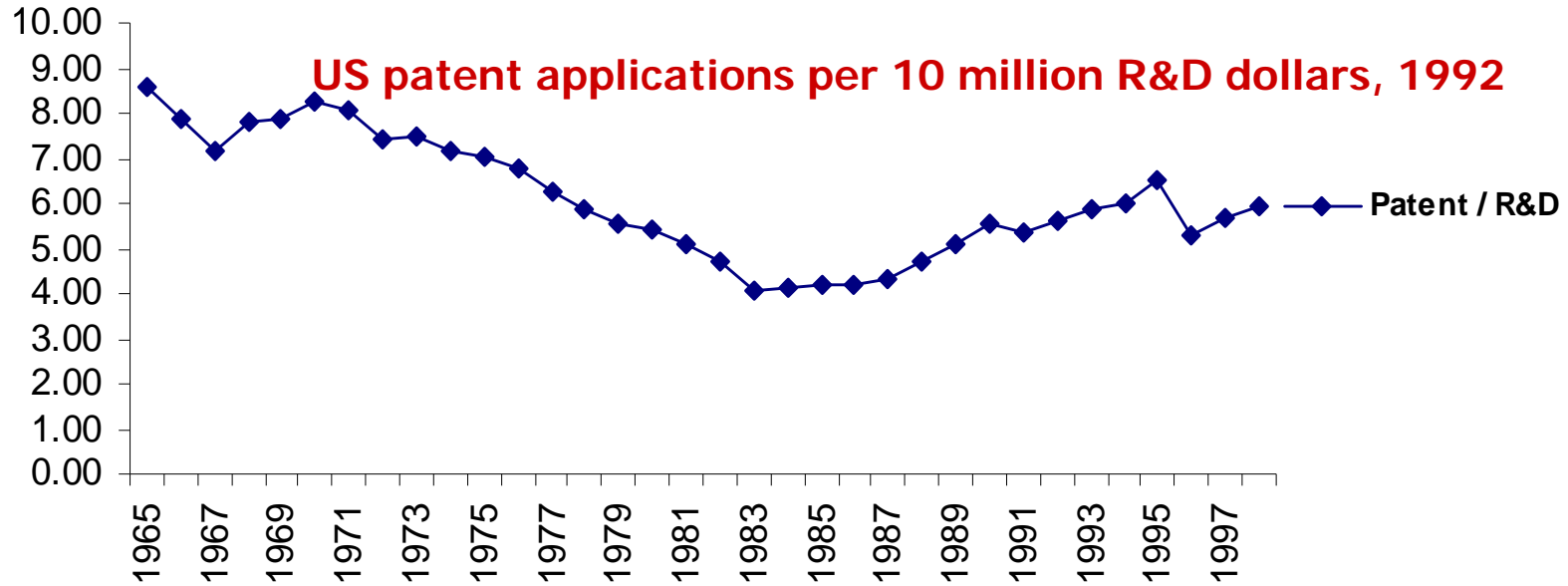
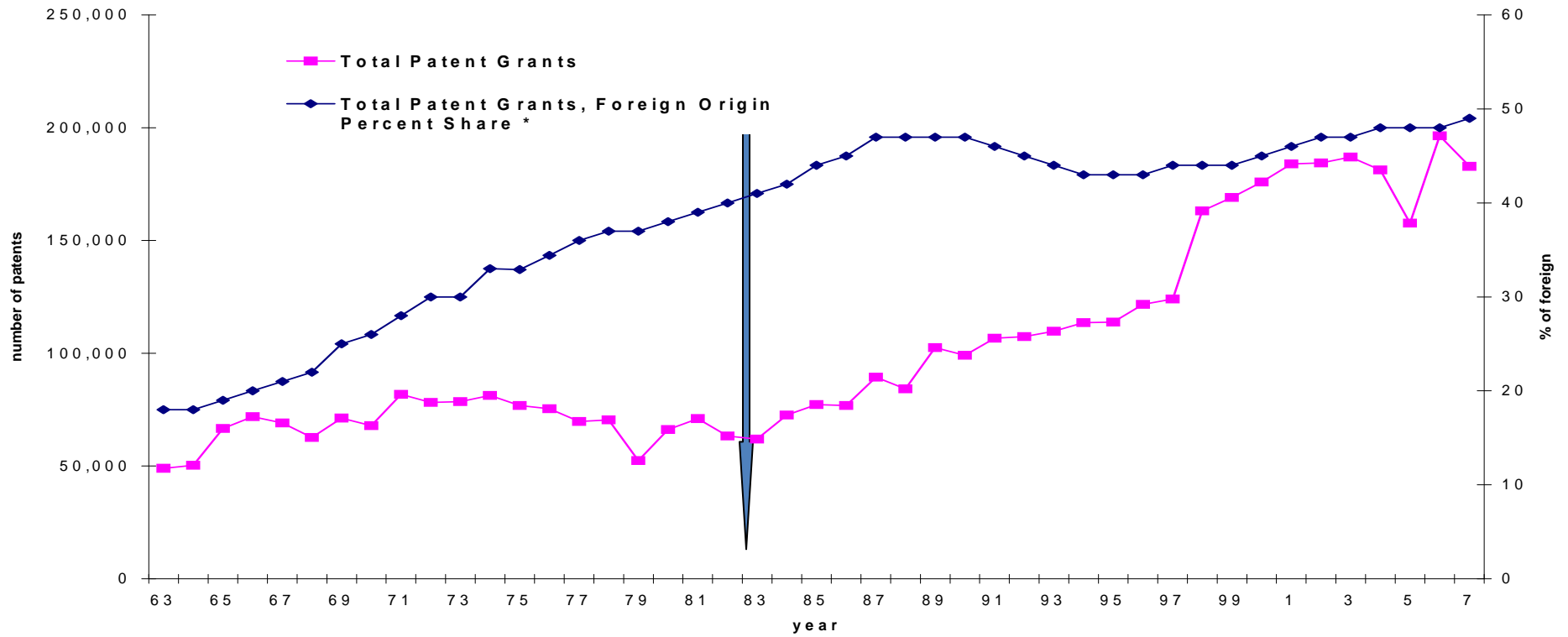
Patent value and R&D incentives: more mixed microevidence

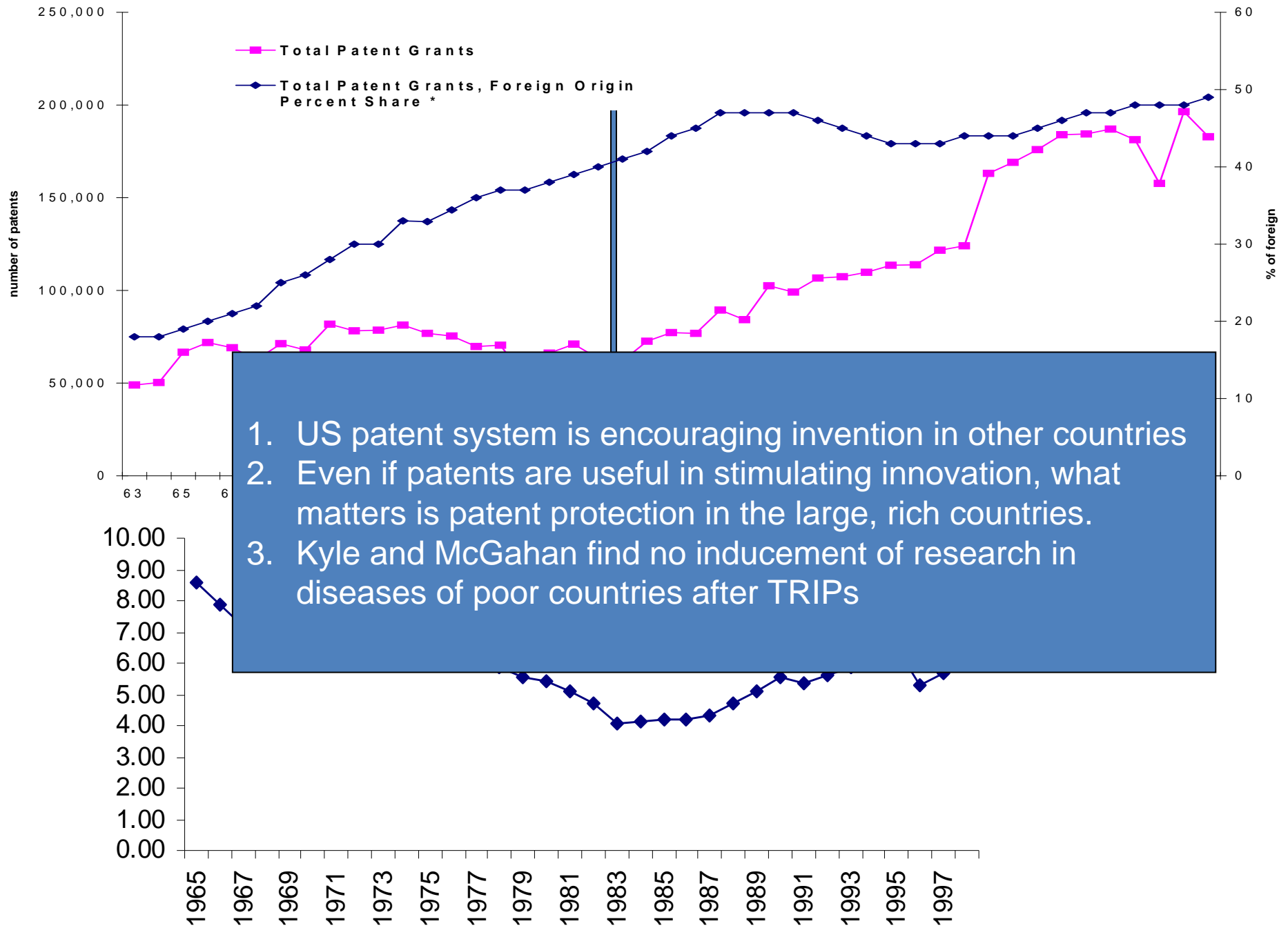
- Patent value: “If patents are to encourage R&D, then they must be valuable”
 - Patent Renewal
 - Schankerman, Pakes – 10-30K per patent for 1980s European patents
 - Bessen -- \$80K for 1991 US patents.
 - Deng -- \$90-\$100K for French and German patents
 - Equivalent Subsidy Ratio = Value of patents/R&D (Schankerman) ~25%.
 - Bessen – Much smaller estimate
 - Bessen and Maskin (2000) and Bessen and Hunt (2007): patents hurt SW R&D.
 - “Natural experiment”
 - Kyle and McGahan – Patent protection stimulates R&D in pharma in developed countries (though not in developing countries)
 - Branstetter and Sakakibara – very little stimulus in Japan
 - Survey – Infer value using R&D investment
 - Arora, Ceccagnoli, and Cohen – ESR = 33%. Also find significant stimulus
 - Direct Survey – PatVal project (Harhoff, Gambardella, Varspargen et al.)
 - Avg patent value ~ \$3-6 million

Patent protection is valuable, even in industries where patents not valuable on average.

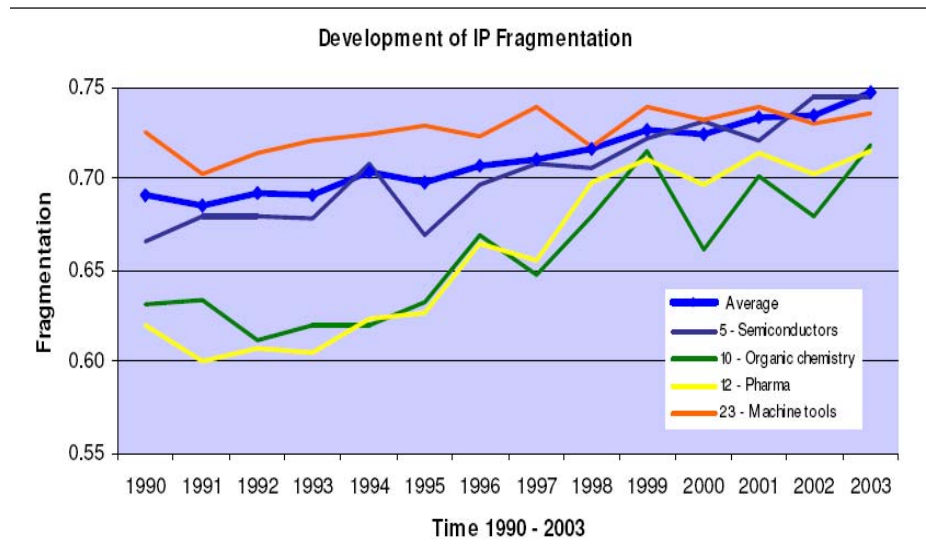


(source: Arora, Ceccagnoli and Cohen)





Thickets and patent fragmentation



Source: Cockburn, MacGarvie and Mueller, 2008

- Exist
 - Potential to create trouble
 - Radio technology in early 20th century
 - Some evidence on actual trouble
 - e.g., Cockburn et al. various.

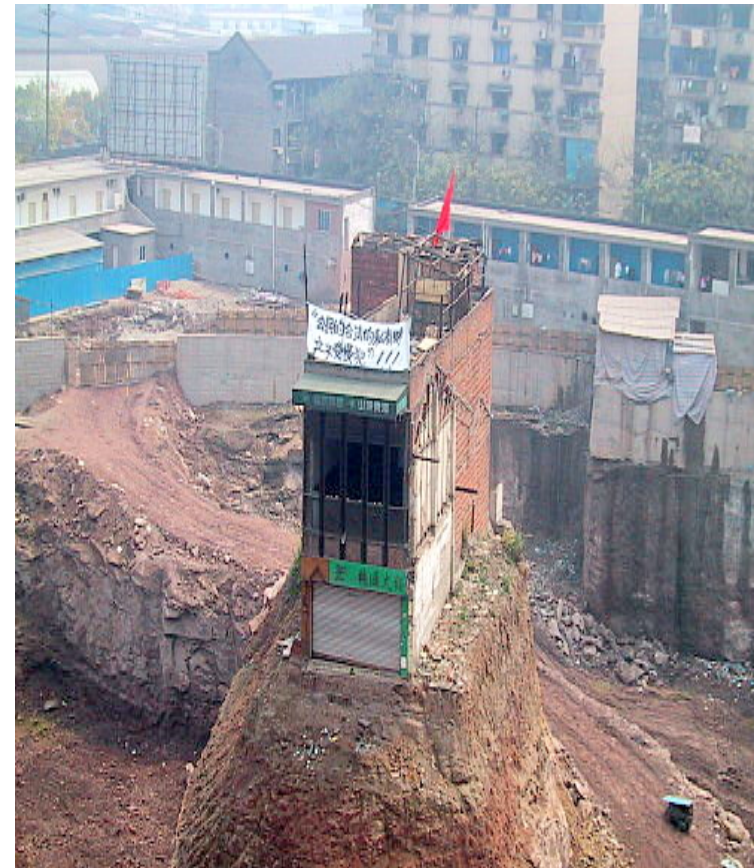
- Substantial litigation costs (and perhaps rising) (e.g., Lanjouw and Schankerman, 2003)
 - Suits filed per R&D dollar increase
 - Suits/patent stable
 - and so is entry of small firms, technology specialists, ...
(more on this later)
 - firms facing more fragmented IP landscapes have lower market values in software (Noel and Schankerman, 2006) but not in but not in 3G mobile telephony (Geradin, Layne-Farrar and Padilla (2006)

Patent thickets, Trolls and Anti-commons: Give a dog a bad name and hang him?

- Cumulative innovation:
 - Theory – could interfere but may also promote
 - Joint production of value
 - Evidence – sometimes interfere?
 - Aircraft in 1930s
 - Foundational patents in biotech – e.g., BRCA (breast cancer) interfere with clinical research
- Trolls:
 - Exist
 - Potentially unavoidable
 - Proposals to mitigate problems due to trolls
 - Whose ox is gored?
 - George Westinghouse and the railways (cf. Steve Usselman)

Anti-commons: An uncommon tragedy?

- Uncommon
 - Heller and Eisenberg, Murray and Stern, v Walsh and Co.
 - If scientists are dissuaded from research because they will not be able to patent the findings, this is not evidence of anti-commons; this is evidence that the profit oriented research is shaped by profit.
 - Only evidence is clinical research in America, which is inextricably mixed up with “for-fee” clinical practice.
- Bayh-Dole and unintended consequences
 - US research universities have made a mess of tech transfer and patenting, alienating faculty and angering corporate partners
 - Many smart ones (e.g., Carnegie Mellon University) are learning.



The owners of this [Chongqing "nail house"](#) refused to leave it, thwarting plans for a shopping mall. en.wikipedia.org/wiki/Tragedy_of_the_anticommons

Patents and Markets for Technology

- The first order effect of patents may be on trade in technology
 - the division of innovative labor enhances rate of innovation
 - Edison, Brush, Westinghouse, ..., ...
Rambus, Qualcomm, ... virtually all biotech firms
- Benefits of division of labor will spread, through trade, to other economies
 - SEFs in the chemical industry diffuse technology all over the world
 - OUP, Scientific Design, Haldar Topsoe
 - SEFs encourage entry of smaller firms
 - Lieberman (1989); Arora, Fosfuri and Gambardella (2000).



Patenting and licensing grow strongly worldwide after mid 1980s

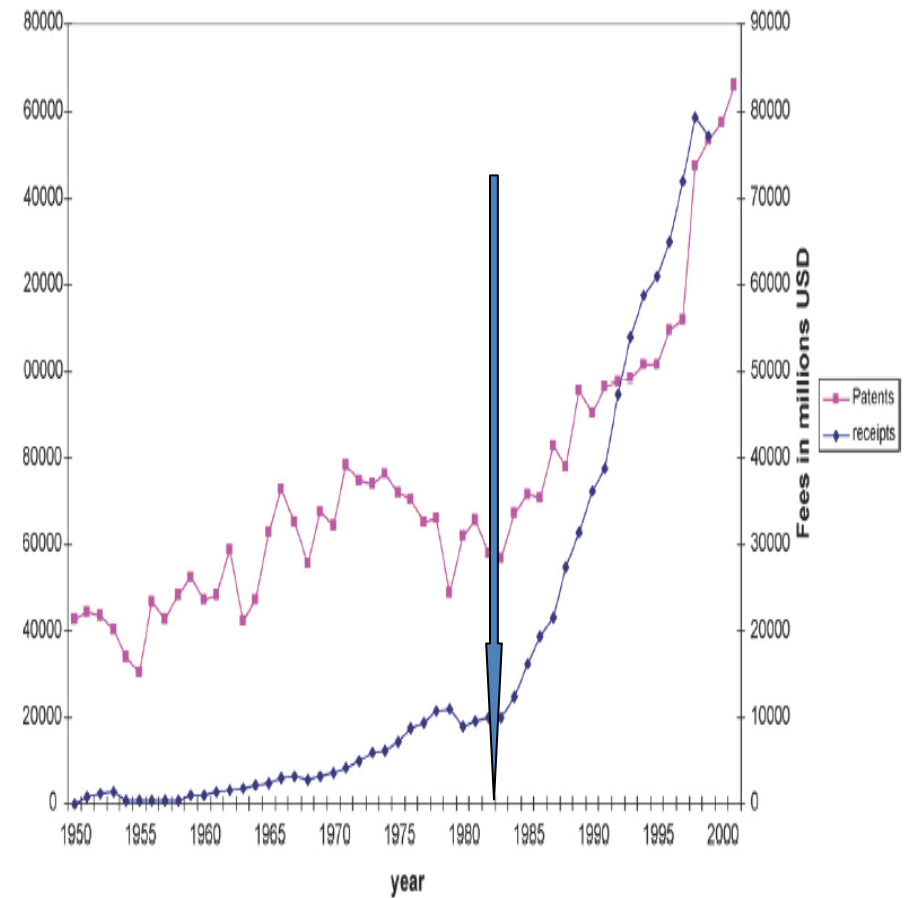
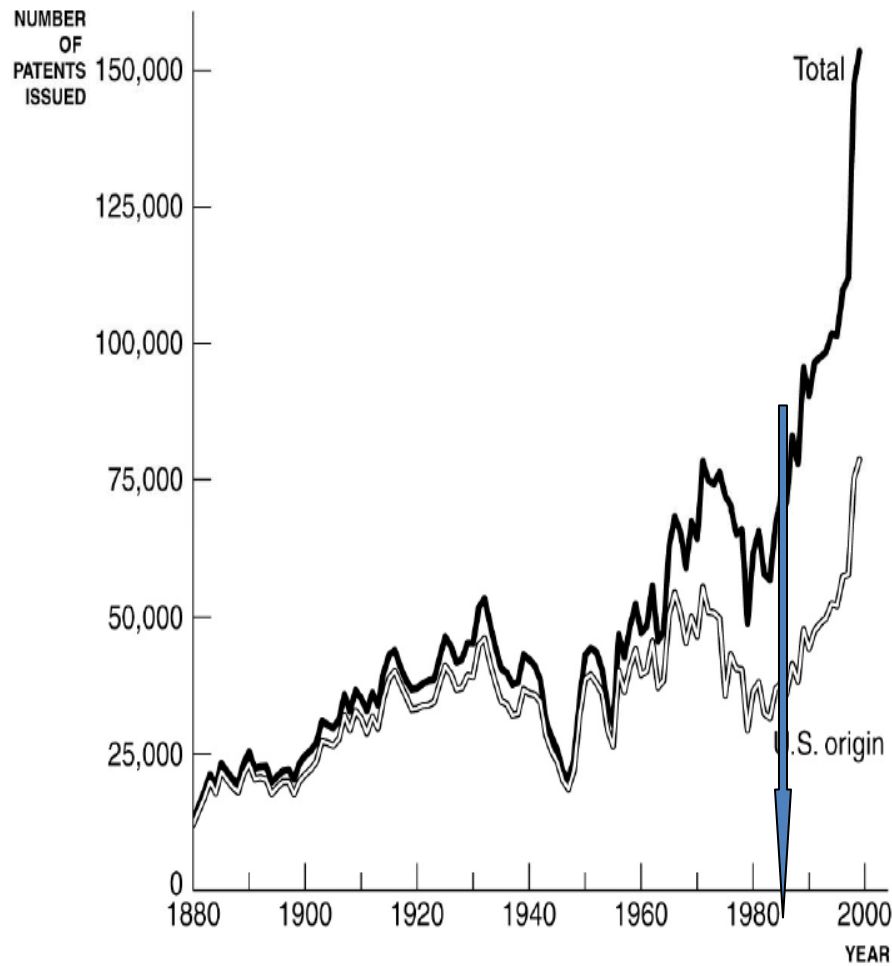
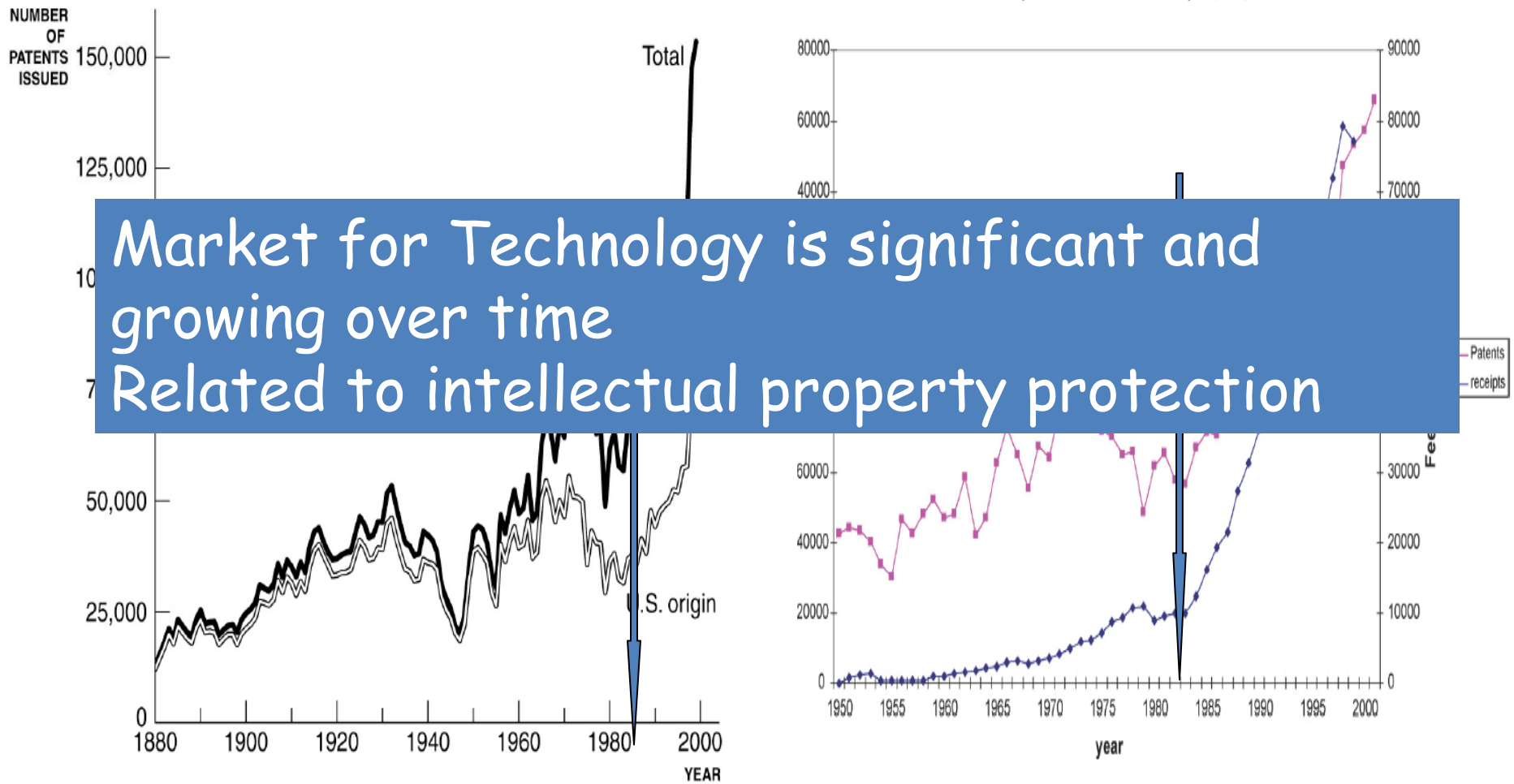


Fig. 2. Growth in non-US held patents and worldwide royalty and license revenues.

Patenting and licensing grow strongly worldwide after mid 1980s



Market for Technology is significant and growing over time
 Related to intellectual property protection

Fig. 2. Growth in non-US held patents and worldwide royalty and license revenues.

Significant technology licensing in the US, 2002

Distribution of IRS Receipts for Types of IP-Licensing Service Commodities across Industry Sectors, 2002, Billions of Dollars (IRS + BEA data)

Sector	Licensing of Rights to Use IP Protected as Industrial Property	Licensing of Rights to Use IP Protected by Trademarks	Licensing of Rights to Use IP Protected by Copyright	Licensing of Rights to Use a business format under a franchise	Payments for rights to use Natural Resources and Other intangibles	Total
Manufacturing	59.5	9.4	1.0	2.9	-	72.8
Distributive Services	1.0	6.9	0.1	5.1	-	13.1
Information	1.9	4.9	6.6	0.0	0.1	13.5
Finance and Insurance	0.2	0.7	0.0	1.4	0.0	2.4
Professional and Business Services	3.0	0.2	1.6	1.5	0.4	6.7
Other Industries	1.0	0.7	0.1	4.8	0.8	7.5
Total	66.6	22.8	9.4	15.7	1.3	115.9

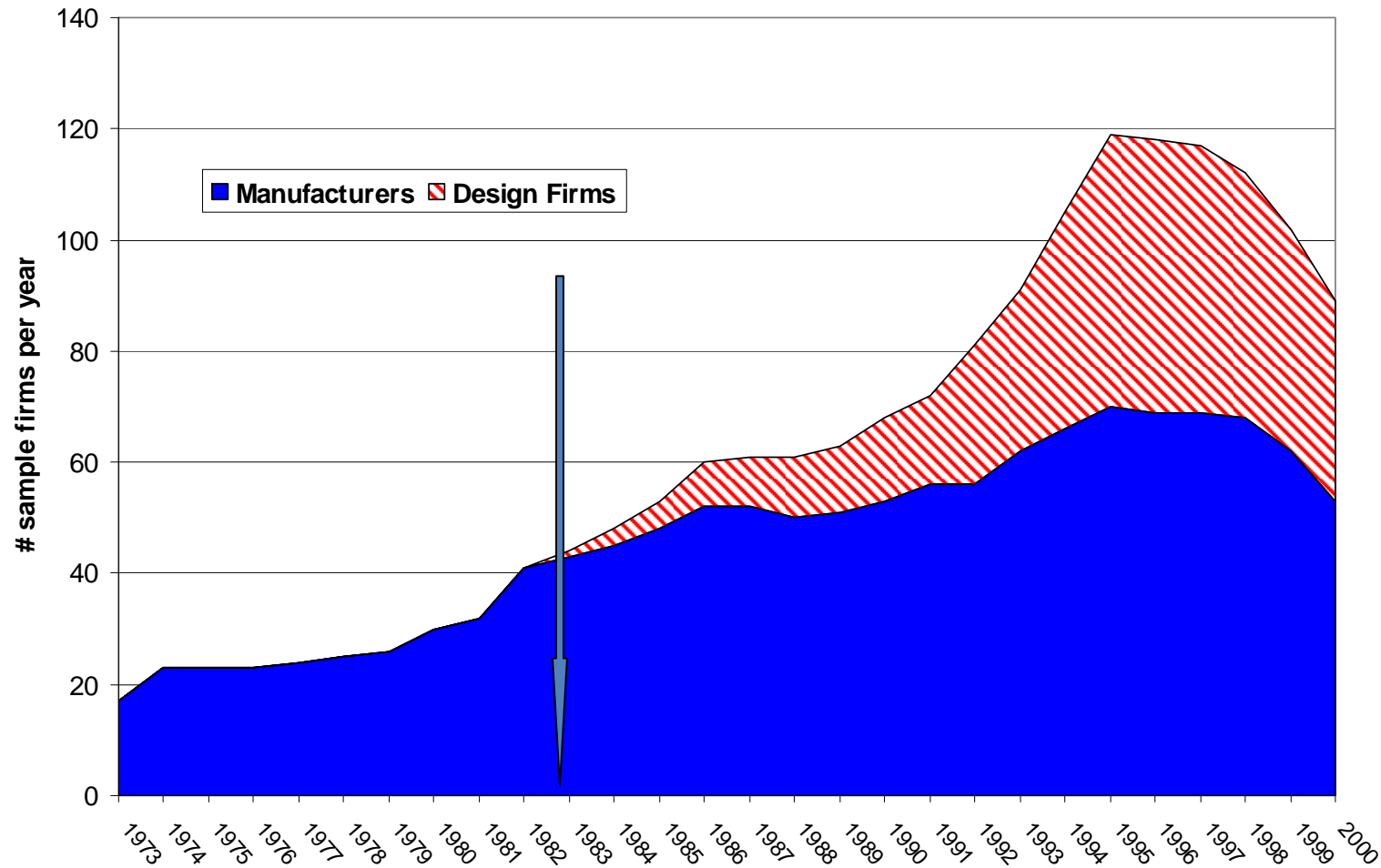
\$30-40Bn for mid 1990s
Arora, Fosfuri & Gambardella, 2001

Carol Robbins,
Dept. of Commerce, 2006, tab 7₁₆

Patents promote entry of specialized design firms in semiconductors

U.S. semiconductor mfg. and design firms, by year

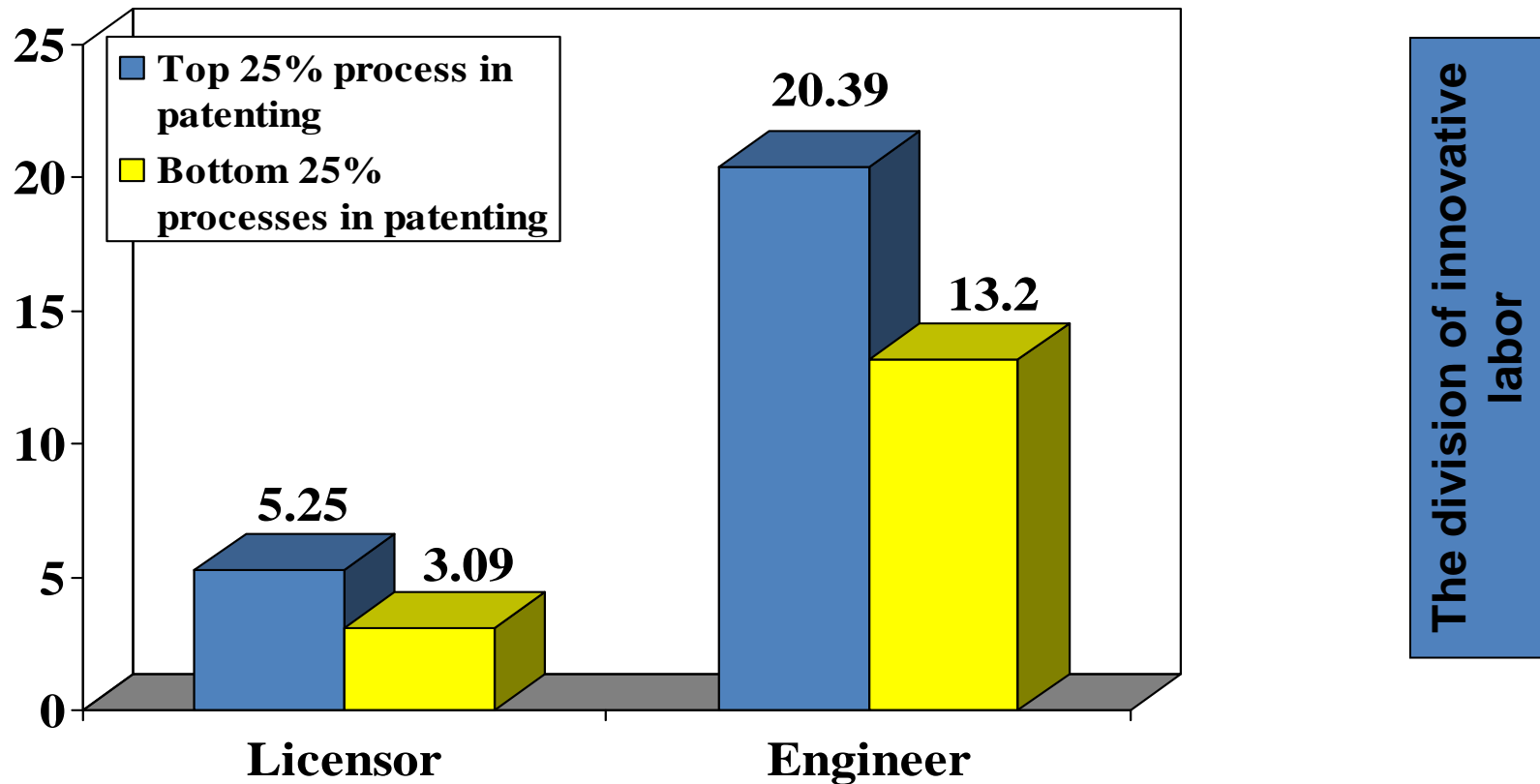
(Ziedonis, 2003, "The Enforcement of Patent Rights in the United States")



The division of innovative labor

Patents promote entry of specialized tech suppliers in chemicals

Average # of Specialized Engineering Firms by process category, 139 process technologies (1980-90)



Source: Arora, Fosfuri & Gambardella, "The division of inventive labor", 2003

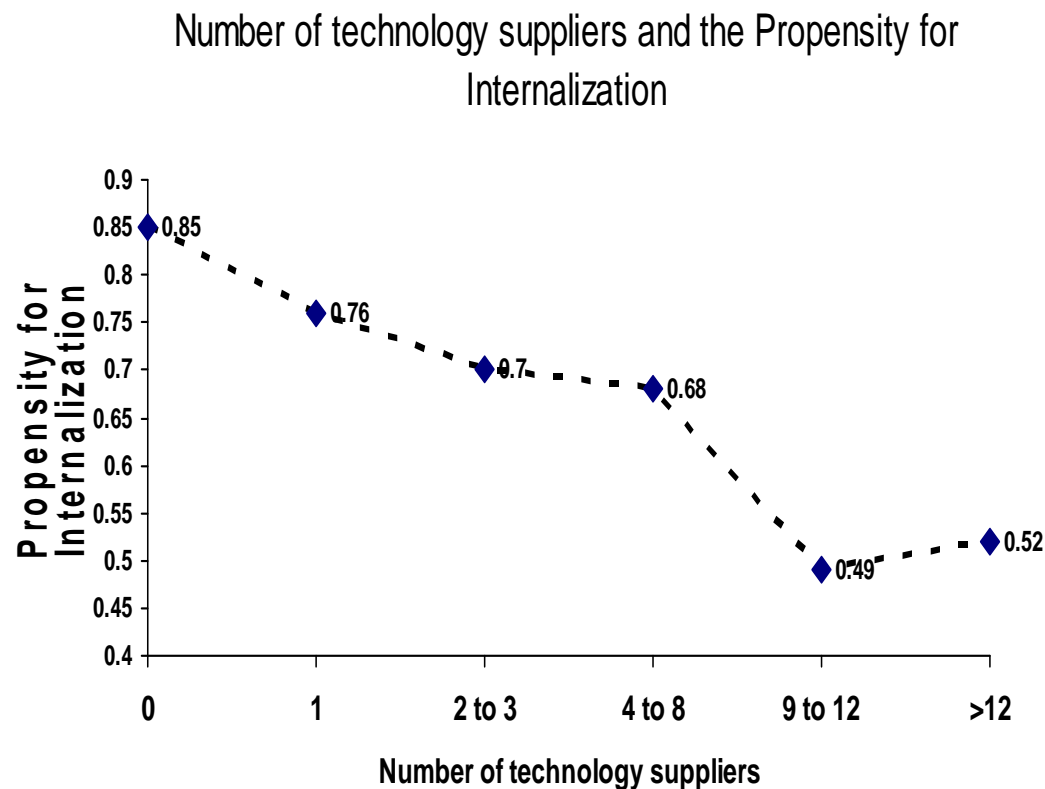
In information security, patent intensive segments (encryption) have functioning technology markets

- Encryption based markets
 - network security (VPN), authentication, & encryption product markets
 - More patent intensive (Giarratana, 2004)
 - **2/3rds of all security patents are encryption patents**
 - Functioning market for technology (Gambardella and Giarratana, 2007)

	Avg # of security patents at entry	Specialized licensors (max over time)	Licensing deals (incl. to users) / producer	% producers with licensed tech
Encryption based markets	12.85 (8.75)	17	0.69 (0.01)	65
Other markets	2.69 (11.35)	0	0.26 (0.02)	13

Competition in technology market increases licensing by all technology holders

Presence of specialized technology suppliers induces chemical MNCs to license their technology rather than invest directly in foreign market



Source: Arora and Fosfuri, 2001

Patents and market for technology: Patents promote licensing by small firms

- Based on CMU Survey, 1991-93
- Patents are used for licensing by smaller firms lacking complementary assets, and for commercialization by larger firms.
- Patents support entry by smaller, research oriented firms

10% increase in Patent Effectiveness Leads to:

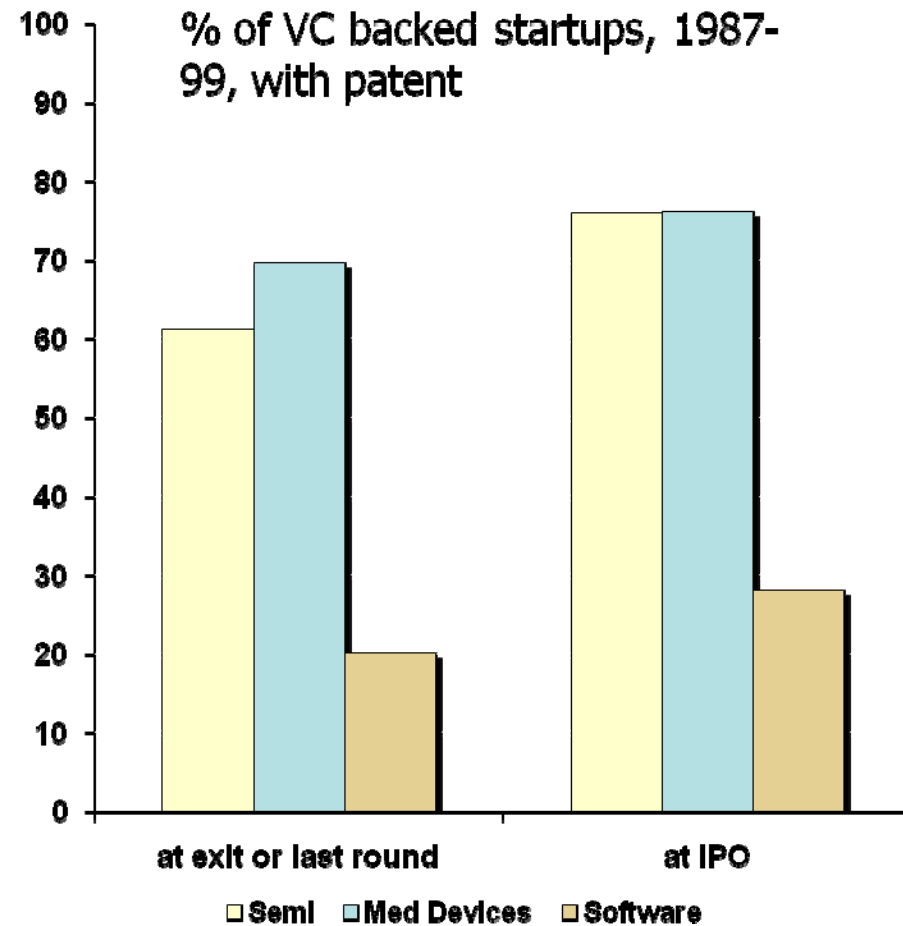
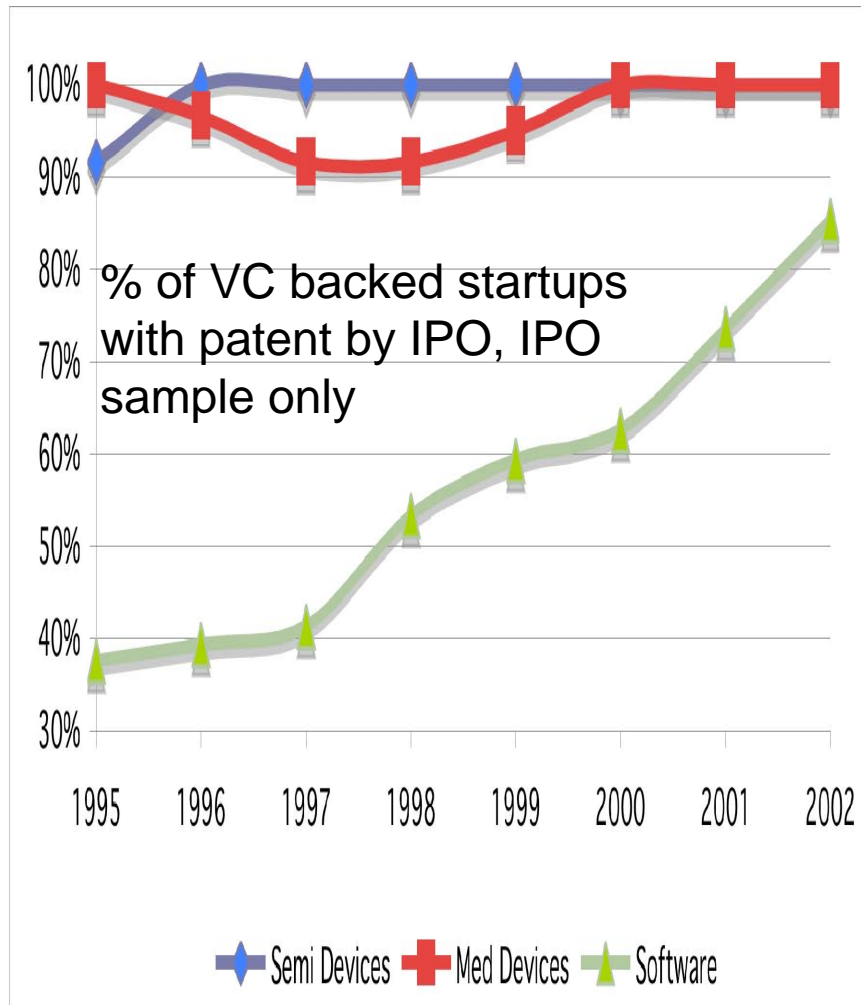
	<u>Small Firm</u>	<u>Large Firm</u>
% increase in licensing propensity	6%	2%
% increase in the propensity to license patented innovations	1%	-3%

Source: Arora and Ceccagnoli. 2006

Gambardella, et al., 2007

1. *By using the PatVal-EU dataset find that the most important determinant of patent licensing is firm size.*
2. *Patent breadth, value, protection, and other factors suggested by the literature also have an impact, but not as important.*

Successful startups in semi-conductors, med devices and even software rely on patents



Source: David Hsu and Rosemary Ziedonis, 2008

Making Patents More Useful: A partial problem statement

- Much (though not all) of the problem is bad patents
- Patents are bad for at least two reasons
 1. The invention is poorly understood – i.e., underlying knowledge base is poor
 2. The claims are written with the intent of claiming as much while revealing as little as possible.
 - Both 1 and 2 are more likely to jointly occur
 - Sometimes there is outright mendacity.
- The “metes and bounds” of the patent are unclear to all except a handful of patent lawyers; even technical experts cannot judge a “legal document”.
- Ambiguity and lack of standards facilitates “submarine” patents, trolls and other bad behavior;
 - Not new; German chemical firms used it to great effect in synthetic dyes a century ago.

Making Patents More Useful: An Orwellian Suggestion

It (the English Language) becomes ugly and inaccurate because our thoughts are foolish, but the slovenliness of our language makes it easier for us to have foolish thoughts.

George Orwell, 1946, "Politics And The English Language"



1. Force patents to be written using (i) standard terms, and (ii) without legal jargon (whose only justification is a futile reach for precision).
2. Patents should be (i) published expeditiously and (ii) transactions in patents (licenses, assignments, beneficial interests) should be recorded and disclosed.