Patents:
Their Effectiveness and Role

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Prepared for the FTC/DOJ Hearings on Competition and Intellectual Property Law in the Knowledge-Based Economy
February 20, 2002

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Major sources of support: Alfred P. Sloan Foundation, National Science Foundation, Center for Global Partnership

Background

- A strengthening and broadening of patent protection over the past 20 years
  - 1982 Creation of CAFC and pro-patent trends in the courts
  - Expansion of what is patentable and who can patent
- Dramatic growth in corporate patenting over past two decades

Cause for questioning both public and private policies

- Forty year empirical legacy: patents not central to protection in most U.S. industries
  - Drug industry is exception
- Recent theoretical work
  - Effects of stronger (e.g., broader) patents on R&D unclear, especially in industries where innovation builds on prior innovation.
- Casts doubt on the presumed role of patents in stimulating innovation in most industries.

Overview

- Survey-based evidence on effectiveness of patents in protecting inventions
- Uses of patents across industries
- The “quid pro quo”- a cross-national study of patent disclosures and their importance
- Impact of patenting on R&D incentives in the U.S. manufacturing

Data

- Carnegie Mellon Survey (CMS) administered to R&D lab managers in the U.S. manufacturing sector in 1994.
- 1478 of 3,240 labs responded; 46% response rate (54% adjusted rate)
- U.S. sample broadly representative of firm size distribution
- Also reporting on comparable Japanese survey (643 of 1,219 labs responded; 53%)

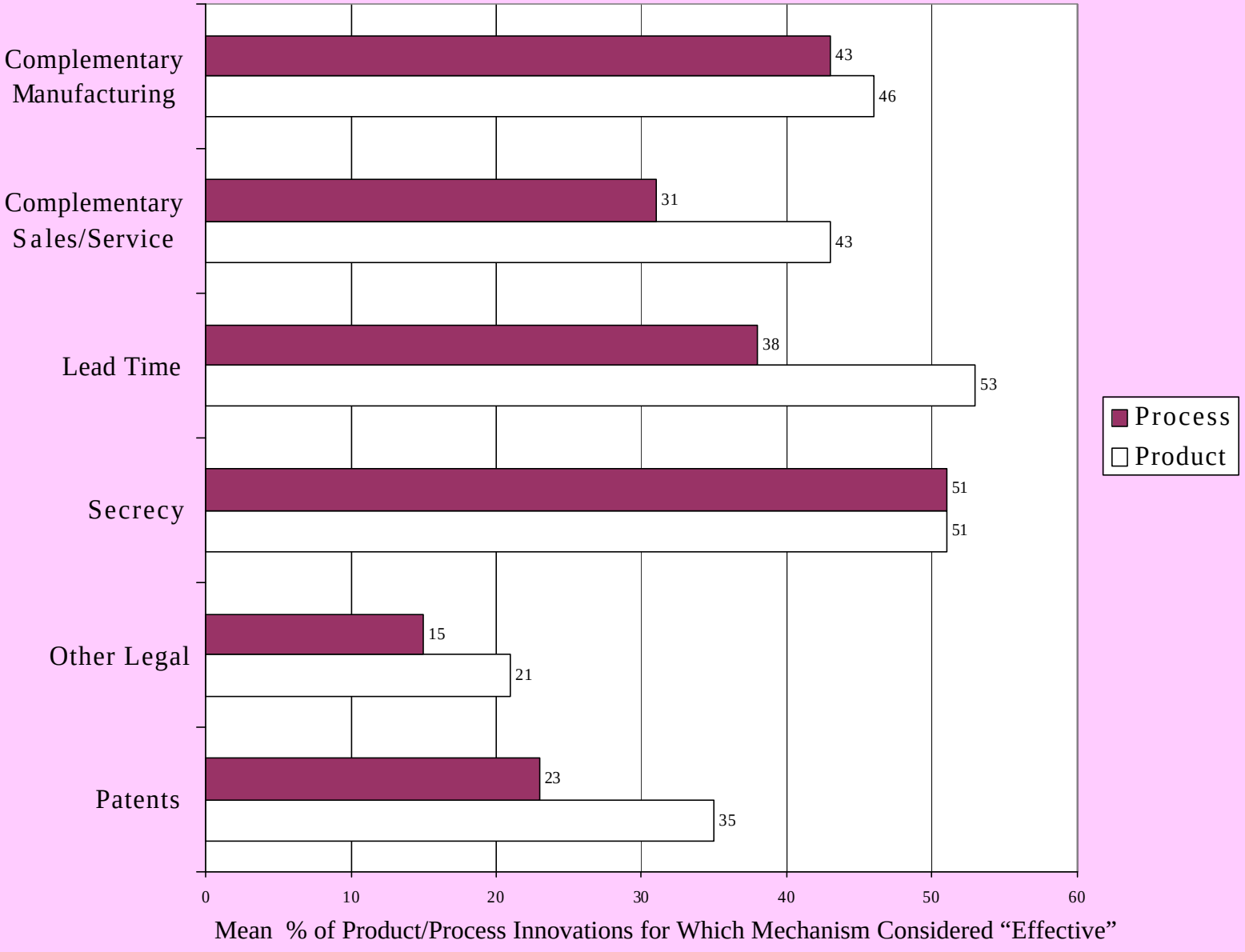
Patent effectiveness

- Context: A variety of mechanisms for protecting firms' inventions
  - Secrecy
  - Lead time
  - Complementary sales and service
  - Complementary manufacturing capabilities
  - Patents
- Effectiveness
  - Measure: % of firm's innovations for which a mechanism was effective in protecting competitive advantage from that innovation

Relative effectiveness of mechanisms

- Since mechanisms not mutually exclusive, “effectiveness” reflects centrality to strategy
- For product innovations
  - Top mechanisms overall: Secrecy and lead time
  - Patents least effective overall
    - Relatively effective in drugs and med. equipment.
    - Less effective in semiconductors & communic. equipment
- Do not conclude patents do not stimulate R&D even where less effective

Effectiveness of Appropriability Mechanisms for Product and Process Innovations



Limits on patent effectiveness: Why firms do not patent

- **Most important reasons for not applying (exclusive)**
  - Demonstration of novelty (32%)
  - Information disclosure (24%)
  - Ease of inventing around (25%)
- Negative partial correlation between firm size and defense cost (r = -.18) as reason not to patent, perhaps helping to explain why larger firms report (product) patents to be more effective (r=.22).

How are patents used?

- Need to consider how patents are used across industries to help understand how they may affect innovation and, possibly, competition.

Reasons to patent for aggregate sample

Reasons (nonexclusive)	Products	Processes
– Prevent copying	96%	78%
– **Patent blocking**	82	64
– **Prevent suits**	59	47
– **Use in negotiations**	48	37
– Enhance reputation	48	34
– Licensing revenue	28	23
– Measure performance	6	5

Industry differences

- When **number of patents per commercializable innovation are great**, unlikely that any one firm holds all necessary rights, fostering **mutual dependence** =>cross-licensing negotiations

Implies different uses of patents in “complex” vs. “discrete” product industries

- Complex product industries: Where a product protected by numerous (e.g., hundreds) patents (e.g., computers, communications equipment)
- Discrete product industries: Where a product protected by relatively few patents (e.g., drugs, chemicals)

Uses of patents by industry type

- **Complex product industries**: Patents used to block rival use of complements and thus assure inclusion or **“player”** status in cross-licensing negotiations to gain access to rivals’ technologies
- **Discrete product industries**: Patents are used to block substitutes by creating patent “**fences**;” not to compel cross-licensing.

Product patent uses across industry types

Patent Uses	Discrete	Complex
	(patent applic. wtd.)	
– Negotiations	33%	81%
– “Cross-licensing”	10	55
– Player: Block *and* negots.	29	61
– Fences: Block *but not* negs./lics.	45	11

Policy implications of patterns of use in complex product

- Mutual dependence and associated player strategy spawn patent portfolio races, generating costly "arms race." (cf. Hall and Ham [2001] for semiconductors)
- May yield "patent harvesting" where firms are patenting inventions that they would have generated anyway, suggesting may patents have little incentive effect on R&D.
- Portfolio races may also deter entry and associated innovation

Possible benefits

- Extensive cross-licensing among incumbents may also
  - Promote information sharing
  - Avert license stacking and possible breakdowns in negotiations over rights due to large number of claimants

Quid Pro Quo: Disclosure

- Patents supposed to promote innovation in two ways:
  - Appropriability
  - Diffusion
- Disclosure often overlooked in U.S.
- Can patent disclosures importantly affect innovation?
- To consider, compared patenting and related information flows in U.S. and Japan

Importance of R&D-related information flows

- Saves on duplicative R&D
- Complementarity effects, improving R&D productivity and incentives
- May promote entry
- But can diminish appropriability and associated R&D incentive

Intraindustry R&D Information Flows and Appropriability in Japan and U.S.

- Measure #1: Whether information from rivals:
  - Suggests new R&D projects: J > U
  - Contributes to completion of existing projects: J >> U
- Measure #2: When aware of rival's major R&D project?
  - Japan: 44% of respondents aware prior to development
  - U.S.: Only 16% aware prior to development
- Per more information flow, appropriability is less
  - For unpatented and patented process and product innovations, imitation lags longer in U.S. by 40%-80%.

Why more information flow and less appropriability in Japan?

- Patents may be key
- Policy differences (at time of survey)
  - Priority to first-to-file in Japan versus first-to-invent in U.S.
  - Disclosure 18 months after application in Japan versus upon grant in U.S.
  - Pre-grant (and pre-examination) opposition period in Japan prior to 1996.

Another reason for more disclosure due to patents in Japan

- Compared to U.S., in Japan patent claims interpreted more narrowly and there are fewer claims per patent => more patents per product.
- Implies mutual dependence across firms' patent holdings more pervasive in Japan
  - Uses of patents across **all** Japanese industries resemble uses in U.S. complex product industries (i.e., all are patent complex)

Product patent uses across industry types in Japan

Patent Uses	**Discrete**	**Complex**
	(patent applic. wtd.)	
– Negotiations	84%	86%
– Player: Block and negotiations	83	81
– Fences: Block but not negs./lics.	11	7

Patents are a much more important information source for R&D in Japan

- Compared channels of R&D info. flow across rivals
  - Top five (of 10) in both nations: patents, informal information exchange, products (e.g., reverse engineering), publications, public meetings/confs.
- One of top five channels stands out as much more important in Japan: **patents**
  - First place in Japan, scoring 30% higher than next most highly ranked channel, while in middle of pack in U.S., and absolute score 70% greater than in U.S.

Implications

- Japanese experience suggests patent policy may significantly increase R&D spillovers.
- Also, such policies do not necessarily diminish R&D incentives
  - In U.S. study, found positive effect of R&D info. flows across rivals on industry R&D
  - Also Japan's R&D intensity greater than that of U.S. on average
- Patent reform efforts in U.S. should give at least equal time to disclosure

But do patents “promote the progress of science and the useful arts?”

- In light of finding that R&D relatively “unimportant” in protecting inventions across most U.S. industries, does patenting stimulate R&D, even in such industries?

Impact of patenting on R&D in U.S. manufacturing

- CMU Survey provides data on key variables:
  - % of innovations that firms patent – patent propensity
  - Patent effectiveness
  - Reported number of patent applications
  - R&D
- Paper:
  - estimates patent premium--the proportional increment to the value of inventions realized by patenting
  - simulates impact of the patent premium on R&D

Considerations in analysis

- Account for effect of both appropriability incentive and patent disclosure
- Recognize R&D and patenting driven by many of same variables, and the one affects the other.
- Patent effectiveness driven by managerial capabilities--not just policy and technology--that may also drive R&D

Estimated ex ante patent premia (preliminary)

Note: Premium >1 => positive expected return to patenting

	All Inventions	Patented Inventions
All	0.59	2.76
Semiconductors	0.31	2.78
Biotech	1.59	3.03

Effect of patent premium on R&D (preliminary)

Table: % increase in R&D and patenting with doubling of patent premium

	R&D	Patents/ million $ of R&D
All	33	59
Semiconductor	28	72
Biotech	48	28

Implications

- Positive effect of patenting on R&D overall
  - Even in semiconductors where patents much less effective than other mechanisms.
- We find some degree of “harvesting”--the patenting of inventions that would have been generated anyway--in all industries, but especially where patent premium is lowest

Conclusions

- Many ways to protect inventions
- While patents not as featured as other mechanisms, they stimulate R&D broadly, though more in some industries than others
- Patent disclosures can contribute importantly to R&D information flows
- Pervasive “player” strategy raises policy concerns (i.e., costs and barrier to entry)
- Litigation costs may bar small firms