

Patents, R&D and Market For Technology

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The Knowledge Economy?

- Knowledge has been important for a long time
 - The systematic application of science to economic ends is the hallmark of modern economic growth
- Increasingly independent identity of knowledge as an economic commodity - a market for technology
 - Specialization in knowledge production
- Intellectual property is the institutional counterpart of knowledge as a tradable economic commodity

Overview and Roadmap

- Twin role of patents in innovation
 - Incentives for R&D
 - Facilitate technology trade
- Patents and incentives for R&D (Arora, Ceccagnoli, Cohen)
 - Evidence from recent research
- Patents and markets for technology (Arora, Fosfuri, Gambardella)
 - Specialized technology suppliers – can unbundle innovation from commercialization and manufacturing
 - Implications for entry and competition

Patent and Incentives for R&D

Impact of patent effectiveness on
R&D and patenting behavior

(Arora, Ceccagnoli and Cohen)

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
- We estimate
 - patent premium--the proportional increment to the value of inventions realized by patenting
 - Simulate impact of the patent premium on R&D

Estimated Ex Ante Patent Premium

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

Note: Premium $>1 \Rightarrow$ positive expected return to patenting

% increase in R&D and patenting due if patent premium doubled

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

Patents and Technology Trade

Markets for Technology

(Arora, Fosfuri & Gambardella)

Markets for Technology: A Simple Typology

	Existing Technology	Future Technology or component
Horizontal (with actual or potential rivals)	Union Carbide licensing Unipol polyethylene technology to BP	Sun licensing Java to IBM; R&D joint ventures between rivals
Vertical (Licensing to non rivals)	Licensing of IP cores in semiconductors	Affymax licensing combinatorial technology to pharmaceutical companies

Patents encourage the development of the market for technology

- Increasing licensing and tech trades in 1990s
 - Active or emerging tech markets in
 - chemical processes
 - Biotechnology
 - Semiconductors
 - Technology trading companies and exchanges
- Estimated size of market for technology
 - \$50 billion per year (royalty flows)
 - \$20-35 billion per year (licensing plus R&D)
 - 10-15% of civilian R&D

Share in World exports of chemicals, 1899-1993, by country of origin

	USA	Britain	Germany ¹	Other W. Europe ²	Japan	Other
1899	14.2	19.6	35.0	13.1	0.4	4.2
1913	11.2	20.0	40.2	13.1	1.0	0.3
1929	18.1	17.5	30.9	15.3	1.8	0.4
1937	16.9	16.0	31.6	19.4	3.0	0.3
1950 ¹	34.6	17.9	10.4	20.5	0.8	0.5
1959	27.4	15.0	20.2	21.1	3.1	0.2
1993	13.0	5.2	12.7	13.1	13.0	33.4

Source: Table 2 in Eichengreen, in Arora, Landau, and Rosenberg (eds), 1998
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Buyers of chemical process technologies, by source of technology, 1980-90

Technology Buyer Firm	total number of plants	share of licenses from SEFs	share of in-house technology	share of licenses from other producers
Third World	4068	43 %	3 %	54 %
First World	4905	28 %	37 %	35 %
Large First World	2836	22 %	52 %	26 %
Small First World	2069	37 %	16 %	47 %

IMPLICATIONS

MFT PROVIDES OPTIONS FOR

- Small innovating companies – *Can benefit from innovation even without extensive downstream assets*
- R&D intensive companies – *Capture more value from innovation*
- technology users – *Avoid duplicative R&D*

MFT ENCOURAGES

- Vertical specialization & division of labor
- Entry - *entry barriers are lower*

Patents and Markets for Technology

- Enhance efficiency of knowledge transfer through licensing contracts

Patents can be held as “credible hostages” in technology transactions when non-protected, complementary know-how and services have to be provided. This can reduce the transaction costs in technology trading.

- Disclosure role of patents: The “informative” content of patents can help “define” the MFT

IPR & The Market for Technology: Policy Issues

- Fragmentation of IPRs and “blocking” patents – *semiconductors; biotech*
- Increased litigation costs -- *may especially hurt small innovative firms*
- Inadequate disclosure (e.g., software patents and source code)
- Impact on academic norms