The entrepreneurial university in the “pro-patent era”: Lessons from the US experience

David C. Mowery
Haas School of Business
University of California, Berkeley

Outline

- The “entrepreneurial university” in the United States.
- Can a university be an “entrepreneur”?
- Origins and effects of the post-1980 “pro-patent era” for the US university.
- Implications.
- Conclusions: Benefits and risks of patent-focused strategies for technology transfer.

The entrepreneurial university

- “The university is undergoing a cultural transformation to play a significant role in the knowledge-based society as an entrepreneur…” (Etzkowitz and Zhou).
- Widely identified with US universities, and MIT in particular (Etzkowitz).
- US land-grant university system (including MIT) pursued such linkages and missions for much of the 20th century.
  - Some universities (Stanford, MIT) have aided growth of high-technology regions (Silicon Valley, Route 128).
  - Others (Carnegie-Mellon), no less “entrepreneurial,” have had less regional impact.

Structural characteristics of 20th-century US higher education

- Large scale of national “system.”
- No centralized (e.g., federal) administrative control.
- Heterogeneous institutional structure (public; private; secular; religious; large; small).
- Dependence by many institutions on “local” sources of financial & political support.
- Inter-institutional competition for resources, prestige, faculty.
- These characteristics created strong incentives for collaboration with local industry & agriculture throughout the last century.
  - Curriculum development responding to industry needs.
  - Research collaboration.
  - Personnel exchange.
  - Support for technology diffusion.
  - Patenting and licensing.

Other factors contributing to the postwar US “entrepreneurial university”

- Venture capital
- Labor mobility between industry and academia.
- Large-scale federal funding of academic research.
  - Important roles played by “mission agencies”: DoD, NASA, Atomic Energy Commission, during early postwar period.
  - Since the early 1970s, rapid growth of biomedical R&D funding => more than 70% of federally funded academic R&D now is provided by National Institutes of Health.
  - National Science Foundation accounts for much smaller share of academic R&D.
- All of these factors in the postwar “entrepreneurial university” are largely external to the university.

Can a university be an “entrepreneur”?

- There are major differences between a university and the individual entrepreneur or the entrepreneurial firm.
- Since the Middle Ages, universities have had an internal structure and governance system that contrast with those of firms.
  - Goal structure is not unified around “profit” or “shareholder returns.”
  - Faculty governance rather than “top-down” or hierarchical system.
- Universities’ internal structure and “missions” are more complex, diverse than those of firms.
  - Agreement on “core competences” or on actions to exploit them is far more difficult.
- Adaptation to change in policy, incentives varies greatly among internal components of the institution.

An alternative view of the university

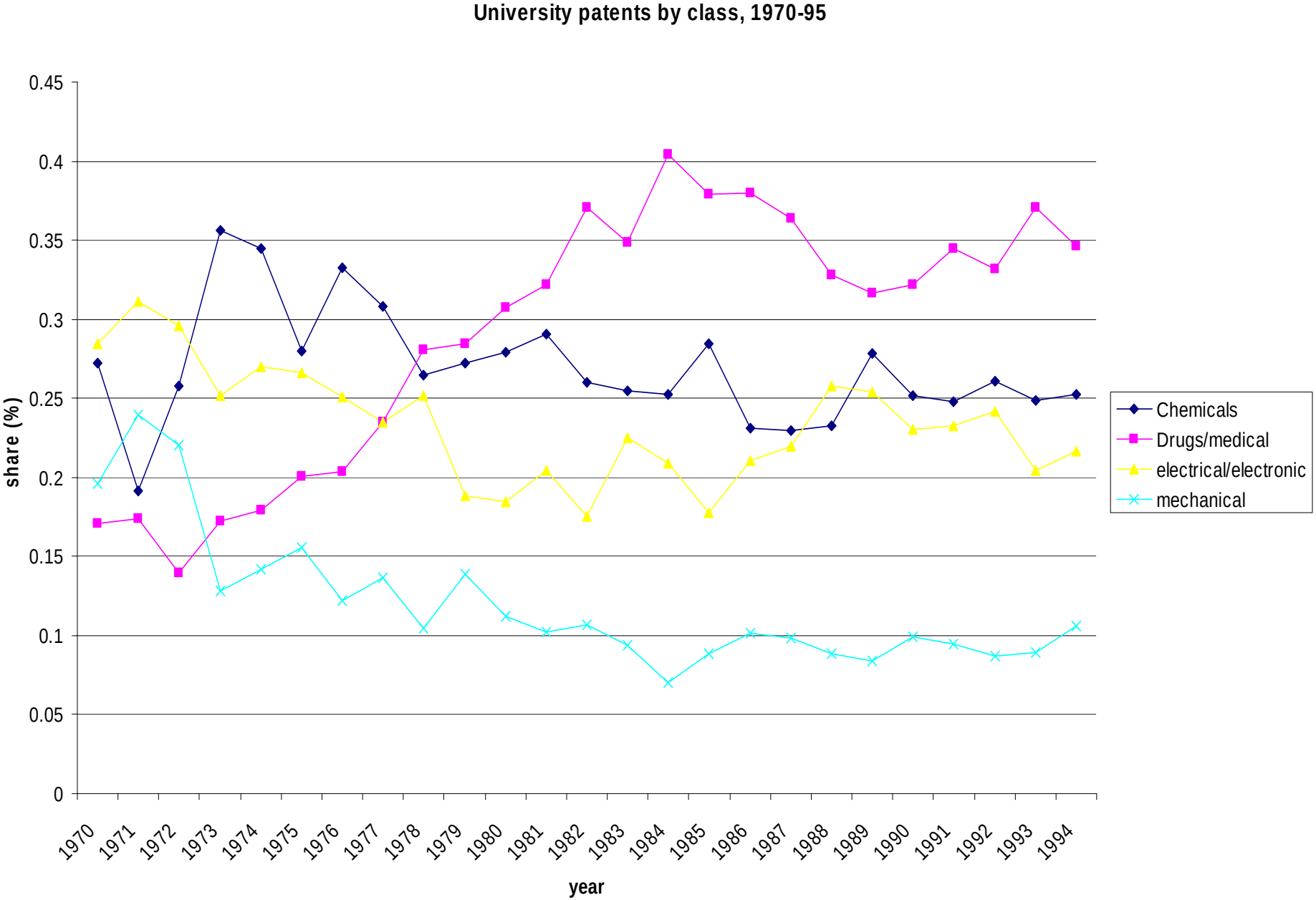
- Universities and industry interact through diverse, interdependent channels:
  - Training and industry employment of scientists and engineers.
  - Published research.
  - Faculty consulting.
  - Conference-based and other informal interactions with industry researchers.
  - Establishment of new firms by faculty, graduates, and other researchers.
  - Patents and licenses for university inventions.
- Surveys of US industrial R&D managers indicate that (outside of pharmaceuticals), patents are relatively unimportant channels of interaction.
  - But these surveys focus on relatively large firms.
- Two-way flow of people, ideas, information.
- Interaction with industry typically is concentrated among a few fields or departments within universities, which vary across universities.

An alternative view of the university (2)

- Much university research resembles “open-source” innovation:
  - Liberal dissemination of results aids research progress.
  - Technically sophisticated contributor/user population.
  - Quality of individual contributions evaluated by peers.
  - Rewards are “reputational” rather than solely financial.
  - Modularity: Individual academic disciplines and subdisciplines support specialized focus.
- But US universities since 1980 have emphasized patenting and licensing of research results. Why?
  - Change in federal IPR policy, including Bayh-Dole Act of 1980.
  - Universities’ expectation of financial returns.
  - Belief that patent licensing is essential to university-industry collaboration and technology transfer.
- Japanese, many European universities now emphasize a “patent-centered” model of technology transfer.
  - “emulation” of perceived success of the “Bayh-Dole model.”

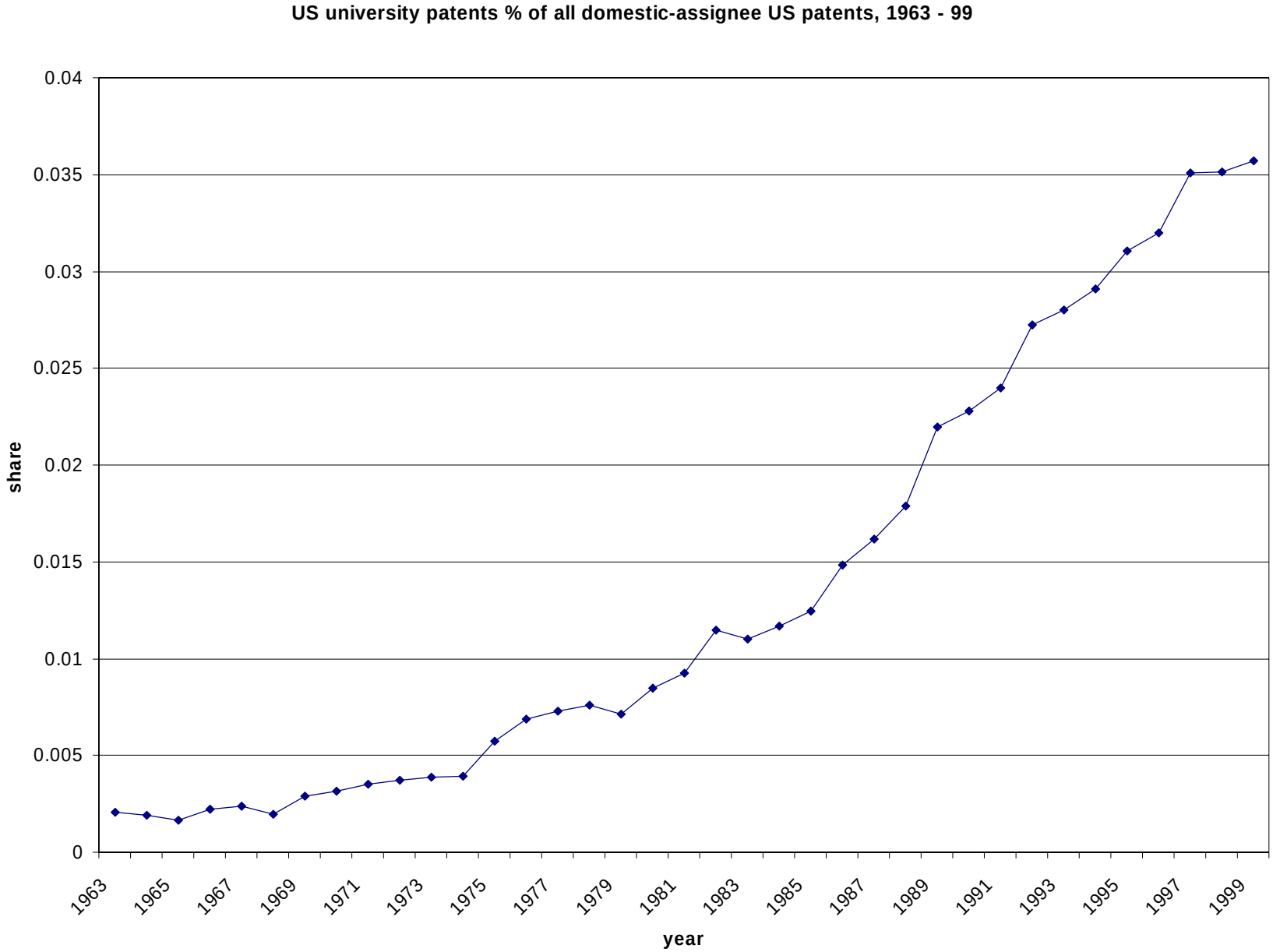
Pre-1980 origins of the "pro-patent era" in US university-industry relations

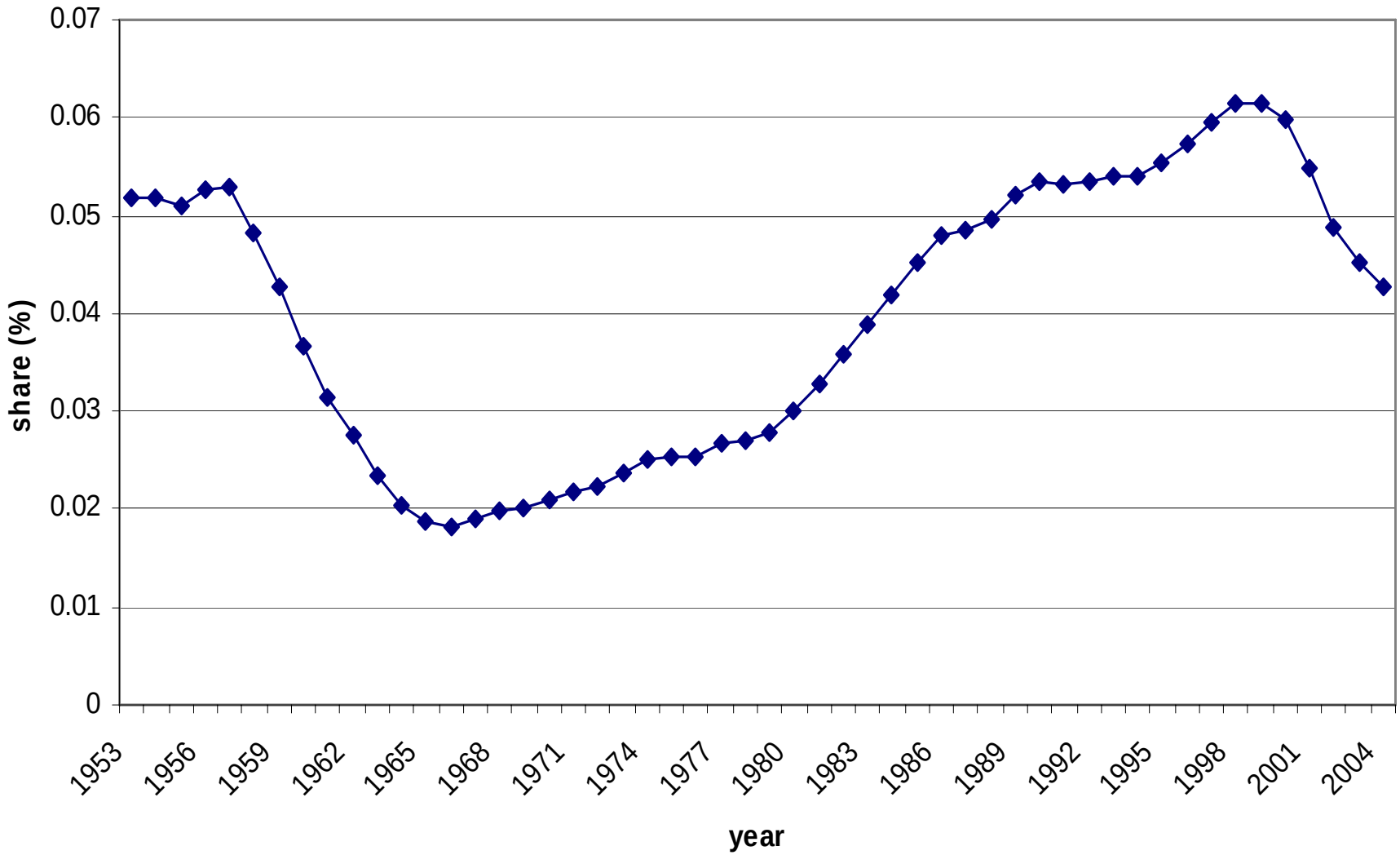
- Many US universities began patenting in the early 20th century.
  - Cottrell (UC professor) founded the Research Corporation in 1912.
  - Wisconsin Alumni Research Foundation established in 1925.
- Most universities avoided direct management role in patenting & licensing before 1970.
  - V. Bush: MIT should avoid appearance of pursuing for-profit activities.
- Significant change during the 1970s:
  - Overall university patenting accelerates.
  - Private universities expand patenting.
  - Biomedical technologies grow as a share of university patenting and licensing.
  - Universities enter direct management of patenting and licensing.
- Frustration by US universities with federal controls on licensing led them to lobby Congress to loosen restrictions.
  - The Bayh-Dole Act, which reduced agency oversight of licensing, is an effect of increased patenting, as much as a cause.
  - The "endogeneity" of Bayh-Dole may limit feasibility and effects of its emulation by other governments.


University patents by class, 1970-95
share (%)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
year
Chemicals
Drugs/medical
electrical/electronic
mechanical

Post-1980 trends in university patenting

- University share of all domestic-assignee US patents grows from 0.85% in 1980 to 3.6% by 1999.
  - US universities account for as much as 11% of “biotechnology” patents by 2000.
- Entry into patenting by universities with little experience.
  - Universities with ≤ 10 patents during 1970-80 accounted for 15% of academic patents in 1975, 36% in 1992.
- Entrant universities receive “lower-quality” patents initially, close “quality gap” with experienced institutional patenters by early 1990s.
  - Quality problems highlight fallacy of counting patents as measure of “technology transfer” performance.
- Industry-funded share of total university research in U.S. grows from 3% in 1980 to 6.1% in 1999, 4.3% in 2004.
  - 2000 – 2004 average share of academic R&D funded by industry (5.0%) is lower than 1957 share (~5.3%).


US university patents % of all domestic-assignee US patents, 1963 - 99
share
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
year


Industry-funded share of total US academic R&D, 1953 - 2004 (inc. FFRDCs)
share (%)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
year

The Bayh-Dole Act and the "pro-patent era" in university technology transfer

- The Bayh-Dole Act of 1980 is not the only factor:
  - Broader "pro-patent" shift in US IPR policy during late 1970s and 1980s.
    - ***Diamond v. Chakrabarty***: Life forms were deemed patentable by the US Supreme Court in 1980.
    - Creation of the Court of Appeals for the Federal Circuit in 1982, a "pro-patentholder" judicial body.
    - Other federal actions during the 1980s strengthened intellectual property protection in the domestic, international economy.
  - "War on Cancer" spurred public funding of research during the 1970s in molecular biology.
    - Publicly funded basic research yielded biomedical advances with applications in industry.
- Claims for the "transformational effect" of Bayh-Dole (and international emulation of this policy) overlook unusual structure of US university system, long history of collaboration, and the importance of these other policy factors.

University management of patenting & licensing: "Entrepreneurial" or inept?

- For many US universities, licensing revenues are modest.
- University of California system is one of the leading US academic technology licensors:
  - University of California systemwide licensing revenues in 1999-2003:
    - Gross revenues = **US$77M/yr**.
    - Net institutional revenues = **US$16M/yr.**
  - 2003 UC systemwide research sponsored by industry = **US$235M**.
  - Systemwide research budget = ~**US$3 billion**.
  - Gross licensing revenues at UC, Stanford, Columbia, elsewhere are dominated by small # of patents, majority of which cover biomedical inventions.
- Other (non-revenue) motives for university patenting:
  - Faculty pressure.
  - Economic development/technology transfer.
  - Funding of research by industrial collaborators/licensees.
  - "Research freedom."
- Different goals => different policies, performance measures.
- Senior university administrators often are not clear about priorities, fail to communicate priorities to operating staff.

Little experimentation, adaptation in university IP management

- High staff and legal expenses for TTOs; performance depends on learning and experience.
- Cost structure suggests multi-institution collaboration for universities that generate fewer patents.
  - Research Corporation, one pre-1980 example, now does very little licensing.
  - “Face time” with faculty, licensees is needed and => decentralization among universities.
- Is a blend of centralized, decentralized structures feasible?
  - “outsource” patent prosecution, licensing management?
- Different goals => different approaches to organizing, evaluating IPR management.
  - No single “best” model for all institutions.
- Few US universities have explored alternative models for managing patenting & licensing.

Does university patenting impede "open-source" academic research?

- Are universities sacrificing a "core competence" in the pursuit of patents?
- Some US universities have proposed "pro-patent" incentives for faculty.
  - But rewarding faculty for patents is likely to produce lower-quality patents, higher operating costs for technology transfer office.
- Does greater emphasis on one channel of university-industry interaction have a chilling effect on others?
  - Little evidence that faculty patenters publish less.
- Is increased academic patenting (for many reasons beyond Bayh-Dole) impeding science? Evidence is inconclusive.
  - Papers describing research advances that are subsequently patented are cited less intensively (Stern & Murray).
  - But survey evidence suggests that patents do not constrain academic scientists' research (Cohen et al.).
  - Greater volume, complexity of "Materials Transfer Agreements" (MTAs) governing transfers of research tools, materials among academic scientists may affect biomedical research.
- Available indicators are retrospective—difficult to observe changes in behavior in real time.

US industry criticism of university patent policies

- Many corporate critics (HP, Intel, IBM) have long histories of collaborative R&D with universities.
- Emphasis on patenting has created frictions with some firms, rather than facilitating research collaboration, particularly in non-biomedical fields.
  - U.S. firms cite “less restrictive” IPR regime in non-U.S. universities as a factor in expanded research collaboration with these institutions.
  - December 2005 agreement between 12 US research universities and 4 leading IT firms (Cisco, HP, IBM, and Intel):
    - IP resulting from collaborative R&D funded by these firms will “be made available for commercial and academic use by every member of the public free of charge for use in open source software, software related industry standards, software interoperability and other publicly available programs as may be agreed to be the collaborating parties…”
- Biomedical IP also has created tensions:
  - National Institutes of Health efforts to rationalize MTAs have encountered resistance from universities.

Universities' response to criticism

- Some universities are trying to develop "integrated" approaches to managing relationships with industry.
  - UCB: "Trial policy" that gives industry funders rights of 1st refusal for industry-funded work. How easily can such policies be implemented, given fungibility of university research funding?
  - UCB and Stanford: OTT Director now has broader responsibility for overall relations with industry, management of industry-sponsored research relationships.
- One option: Downplay "royalty-maximizing" strategies are being downplayed in order to develop a broader collaborative relationship with industry.
  - MIT: 2003 - 2005 licensing income ~US$28M/year; industry-funded research in 2003 =16% of Institute research (4x Stanford).
- More than 25 years after the passage of the Bayh-Dole Act, "entrepreneurial" US universities have been slow to develop more flexible, adaptive policies.
  - Will UCB, Stanford initiatives be emulated by other US universities?

Why have “entrepreneurial universities” not responded more effectively?

- Patent-centered strategies differ from historic technology transfer policies that emphasized collaboration, education.
- Many universities have limited experience, internal expertise in patent, licensing management.
  - Personnel are difficult to hire, train, retain.
  - Faculty (especially nonengineering, nonbiomedical researchers) may not understand role of patenting in technology transfer.
  - Tension between common institution-wide policies and field-specific flexibility.
- Failure to recognize that MIT, Stanford, other leading research universities have unusual research capabilities.
  - “Home-run” patents are rare, unpredictable.
  - Lower-tier research universities may harbor unrealistic views of financial returns or the scale of flows of patentable research advances.
  - Universities without medical schools face particular challenges.
  - But even Stanford, UC Berkeley have encountered considerable criticism from industry.

Conclusions

- Universities house entrepreneurs (in both the economic and research spheres), but universities are not themselves entrepreneurs, nor can or should they emulate entrepreneurial, profit-seeking firms.
- Since 1980, industry has developed diverse approaches to managing IP within the innovation process.
  - Reflects industry-specific, technology-specific differences.
    - Open-source.
    - Standards promotion through licensing.
- But most US universities have emphasized patents in technology transfer policies since 1980.
  - University patent policies have created frictions with industry in some fields.
  - Direct financial returns from patent licensing are dwarfed by industry-supported research.

Conclusions (2)

- US universities have been slow to develop more flexible IP management policies.
- Very little experimentation with alternative, lower-cost structures for managing IP.
- Universities promoting patenting have overlooked their core capability in “open-source” innovation.
  - “Open-source” research model is difficult to reproduce within firms, and provides an attraction for industry funding of academic research.
  - Important source of benefit for industry and economic development.
  - “Open-source” model may be most compatible with training of students, perhaps the most important economic contribution of universities.
- *European and Asian universities should learn from, rather than imitate, US universities’ post-1980 experience.*

Corporate criticisms of US universities

- American Universities have become extremely aggressive in their attempts to raise funding from large corporations…..Large US based corporations have become so disheartened and disgusted with the situation they are now working with foreign universities, especially the elite institutions in France, Russia and China, which are more than willing to offer extremely favorable intellectual property terms." (Dr. R. Stanley Williams, HP, September 17, 2002).

- "If there was one point on which virtually every private firm that we spoke to was in agreement, it was that universities take inconsistent positions on fair terms of access to research tools depending on whether they are importing tools or exporting them. Over and over again, firms, complained to us that universities "wear the mortarboard" when they seek access to tools developed by others, yet they impose the same sorts of restrictions when they enter into agreements to give firms access to their own tools." (Director's Working Group on Research Tools, 1998).

- "Companies describe the expectations of the universities as unrealistic, particularly in light of the fact that most IP does not have a high value and that the expense involved of taking an invention and making it into a successful commercial product falls to the firm. Universities, according to the firms interviewed, do not understand the business process well enough and demand ownership and income from IP generated in the university disproportionate to the contribution. The other striking and uniform position of industry is to try to work directly with research personnel in the university and to bypass the technology transfer office. They find working with researchers relatively easy and can often use the research staff to exert leverage on the university and intervene with the university administration to negotiate and generate an agreement satisfactory to the company." (Hertzfeld, Link, & Vonortas, Research Policy, 2006, p. 835).