University research and industrial innovation: The “Bayh-Dole model”

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

- Relevance to growth & development.
- The “Bayh-Dole model” and its emulation.
- The effects of Bayh-Dole on US university patenting & technology transfer.
- Conclusions & implications for developing economies.
Relevance of this topic to growth & development

• Increased “science-dependence” of industrial innovation may => greater role for academic research in innovation.
• More prominent role for university research within developing economies in future economic “catchup”?
• Bayh-Dole is one element of the “strong-IPR” policy regime prevalent in US since the 1980s.
• US experience with Bayh-Dole has attracted attention from industrial & developing-economy policymakers.
• Will widespread emulation of Bayh-Dole create a scientific “anticommons” or limit access to knowledge by developed, developing economies?
The Bayh-Dole Act of 1980: Content

• Rationalized and simplified federal policy toward assignment of patent rights, licensing for results of federally funded research.
  – Political statement as important as statutory provisions.

• BD Act reduced federal agencies’ influence over university licensing policies.
  – Under BD, federal agencies retain significant rights:
    • Royalty-free, nonexclusive license to the patent
    • “March in” rights to mandate licensing of a patented invention (not invoked thus far)
    • Power to deny patent rights to a contractor/inventor “in exceptional circumstances” (invoked once).

• Organization of patent, licensing management left to individual universities.
  – In spite of the “light” regulation of these activities, little variety in structure is apparent.
“Emulation” of the Bayh-Dole Act

• Discussions or policy changes affecting “technology transfer” activities of national universities have taken place in Japan; Italy; Germany; Denmark; France; Canada; developing nations such as Brazil.
  – Bayh-Dole widely cited by proponents of such initiatives as a policy model.

• But “emulation” fails to address key issues:
  – How important has the Bayh-Dole Act been in supporting university-industry collaboration and technology transfer in the United States?
  – Will emulation of the Bayh-Dole Act accelerate collaboration and technology transfer in other nations’ university systems?
How do universities influence industrial innovation?

- 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 influence on industry innovation.*
  - But these surveys focus on relatively large firms.
Structural characteristics of US higher education created incentives for industry collaboration before 1980

- Large scale of national “system.”
- No centralized (e.g., federal) control of administrative policies.
- Heterogeneous institutional structure (public; private; secular; religious; large; small) and quality.
- Dependence by many institutions on “local” sources of financial & political support.
- Inter-institutional competition for resources, prestige, faculty.
- University-industry collaboration, university patenting were widespread before 1980.
Developments during the 1970s influenced passage of Bayh-Dole

- Growth in university patenting:
  - US university patenting increased from 0.2% of annual US issued patents in 1970 to 0.5% by 1980.
  - Biomedical technologies’ share of US university patents increased from 17% in 1971 to more than 30% in 1980.
  - Private universities’ share of US university patenting more than tripled during 1960-80, growing from 14% in 1960 to 45% in 1980.

- Effort by HEW (parent of National Institutes of Health) in late 1970s to limit use of exclusive licensing agreements by NIH funding recipients led US universities to press Congress to revise federal policy.

- Bayh-Dole is an effect of growth in US university patenting during the 70s, as well as one of several causes of increased academic patenting during the 80s.
The Bayh-Dole Act of 1980: Effects

- University share of all US patents grew from 0.5% in 1980 to 1.9% by 1999.
  - US universities account for as much as 11% of “biotechnology” patents by 2000.

- Entry into patenting by universities with limited pre-1980 experience.
  - Universities receiving 10 or fewer patents during the 1970s increase share of university patenting from 15% in 1980 to 36% in 1992.
  - Entrant universities receive “lower-quality” patents initially, close “quality gap” with experienced institutional patenters by 1990s.

- Industry-funded share of total university research in U.S. grows from roughly 3.9% in 1980 to 6.9% in 1995, 7.4% in 1999, declines to 7% in 2003.
  - Well below 1953 industry-funded share of nearly 9%.
US university patents % of all domestic-assignee US patents, 1963 - 99
Post-1980 patent trends reflect more than Bayh-Dole

- The broader “pro-patent” shift in US policy during late 1970s and 1980s.
  - Other federal actions strengthened intellectual property protection in the domestic, international economy during the 1980s.

- “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.
University management of IPR

• For many US universities, financial returns are modest or negative.
  – High operating expenses for patenting and licensing offices.
  – University of California systemwide net institutional revenues in 1999-2003 = \text{US}$16M/yr., small share of overall UC research budget of nearly \text{US}$3B/yr.
    • Industry sponsored US$235M of research at UC in FY 2003.
• Emphasis on patenting has created frictions with some firms with long history of collaboration, particularly in non-biomedical fields.
  – U.S. firms (e.g., HP) cite “less restrictive” IPR regime in non-U.S. universities in expanding foreign research collaboration.
    • December 2005 initiative supported by IBM, Cisco, HP, Intel and 12 US universities seeks to make IP from “selected research collaborations” available free of charge for commercial and academic use.
• Stanford, UC Berkeley have restructured technology transfer offices to include responsibility for industry-sponsored research.
Does university patenting affect academic research?

• Does greater emphasis on one channel of university-industry interaction have a chilling effect on others?
  – Little evidence that faculty patenters publish less.
  – Does friction over patents impede U-I collaboration in some fields?

• 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).
  – Some evidence that industry now is slower to cite university patents in industry patents (Fabrizio).
  – But survey evidence suggests that patents do not constrain academic scientists’ research (Cohen et al.).
  – Greater volume, complexity of “Materials Transfer Agreements” may affect biomedical research.

• All indicators are retrospective—difficult to observe changes in behavior in real time.
Conclusion

• Bayh-Dole did not create a “new era” in US university patenting, licensing, industry collaboration.
  – Long history of such collaboration reflects structural characteristics of US higher education “system.”

• Much of the increased US university patenting of the 1980s & 1990s would have occurred in the absence of Bayh-Dole.
  – NIH, molecular biology “revolution”, other IPR policy shifts as important as Bayh-Dole.

• Bayh-Dole was in part a response to increased university patenting.
  – Its “endogeneity” may limit effects, feasibility of emulation of Bayh-Dole by other governments.
Conclusion (2)

• More than a “Bayh-Dole policy” is needed to stimulate closer interaction between universities and industry.
  – Structure of public research funding (competition).
  – Structure of university system (competition, autonomy).
  – Importance of institutions external to the university (labor markets, financing for new firms).

• Importance of patents for university-industry technology & knowledge transfer varies across and within industries.
  – Neither necessary nor sufficient in some research fields.
  – Necessary but not sufficient in others.
  – US universities have been slow to adapt policies to accommodate such field-specific differences.
Implications for developing economies

- Preliminary evidence does not suggest that increased patenting by US universities has restricted dissemination of knowledge.
- US, Japanese, Taiwanese, S. Korean university systems’ most important contributions during economic “catchup” were in training, rather than frontier research.
  - True for 21st – century catchup?
  - Unequal access by citizens to developing-economy universities arguably a more serious concern than technology transfer (2002 World Bank study).
- Institutional diversity, autonomy are essential factors in industry collaboration and technology transfer in US universities before & after 1980.
  - Competition among universities, within industry a stimulus to collaboration.
  - Post-1945 public funding of US academic research also important.
- Is a “BD model” relevant or desirable for developing economies?
  - By itself, BD-style legislation is not sufficient to encourage U-I research collaboration and technology transfer.
  - Licensing income contributes little to academic operating budgets.
  - Broader restructuring of university systems is needed to encourage collaboration with local industry that spans multiple channels of interaction.