

# **The Bayh-Dole Act of 1980 and University-Industry Technology Transfer in the United States**

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# Outline

- US university patenting and technology transfer before and after the Bayh-Dole Act of 1980.
  - US universities have a long history of patenting that extends back to the early 20<sup>th</sup> century.
- The central question: How important has the Bayh-Dole Act been in supporting university-industry collaboration and technology transfer in the United States?
  - *Would growth in these activities have occurred without the Bayh-Dole Act?*

# The Bayh-Dole Act of 1980

- Passed in 1980 to encourage commercial development of federally funded inventions in university and government labs. The Act enabled institutions to obtain patents on inventions and to license these to private parties, including exclusive licenses.
- Bayh-Dole replaced a complex web of Institutional Patent Agreements (IPAs) between individual federal funding agencies and individual universities.
- The Act also constituted a strong Congressional endorsement of university licensing in the face of agency concern over exclusive licensing agreements negotiated under IPAs.

# Characteristics of the university- industry technology transfer process

- Most university faculty inventions require substantial development investment and time to approach even prototype status.
- Patents and “codified” licensing contracts rarely convey the necessary knowhow for commercialization.
- As a result, inventor involvement is essential to transfer, exploitation.
  - Incentives for faculty-inventor involvement are important.
  - The need for inventor involvement helps explain the decentralized structure of US university TLOs.
  - Contributes to the frequency of inventor-founded startups (Lowe, 2002).

# **US higher education system's structure created incentives for technology transfer.**

- Large scale.
- 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 motivates research with “local” benefits, search for links with “local” industry.
- Inter-institutional competition for resources, prestige, faculty.

**US University Licensing &  
Technology Transfer Before  
Bayh-Dole**

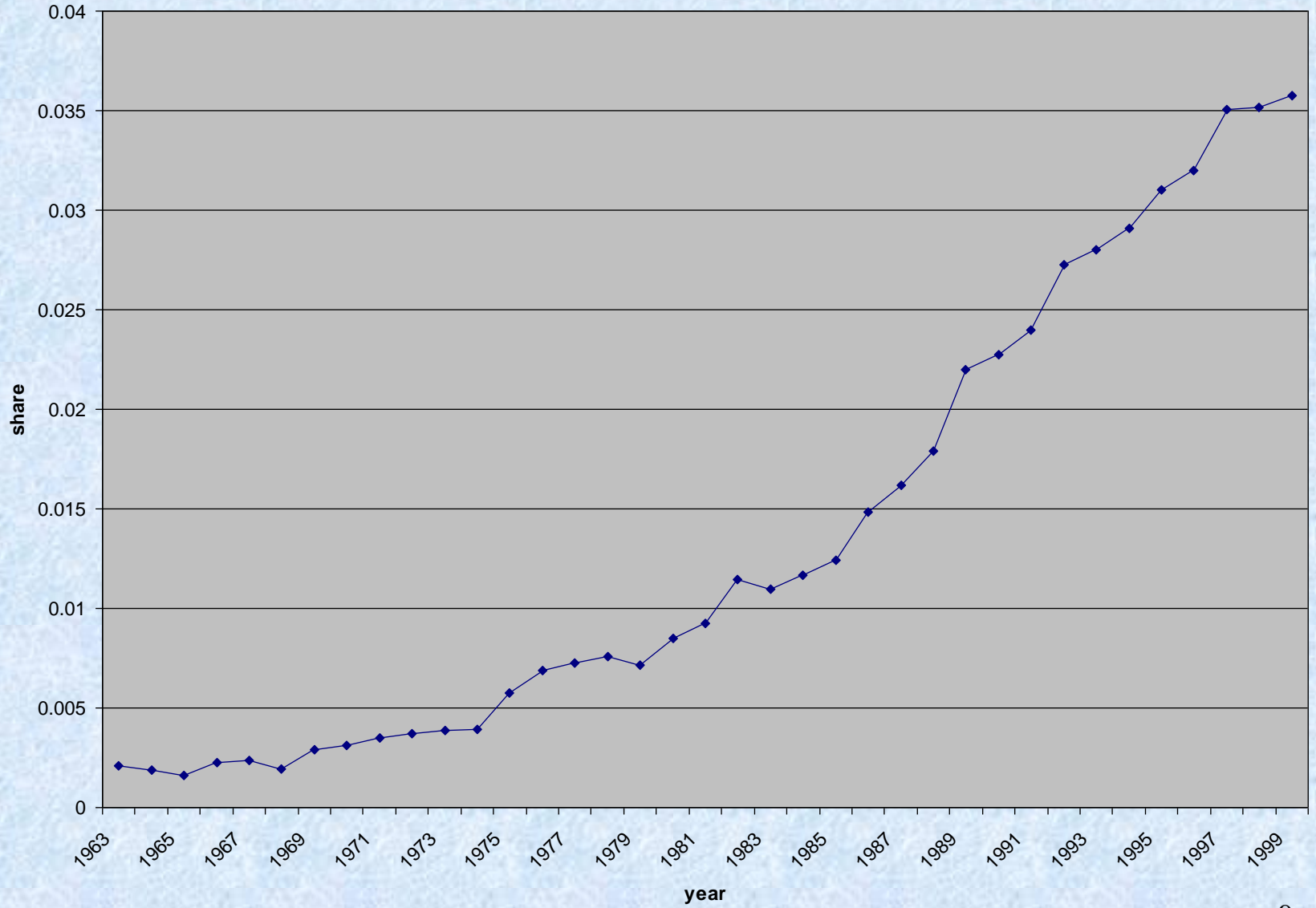
# The 1900-1960 era

- Many U.S. universities were patenting and licensing before 1940.
  - MIT
  - University of Wisconsin
  - University of California
- Growth in federal funding of university research during & after WWII led a number of federal agencies to require patent policies at universities conducting federally sponsored research.
- By the late 1950s, most research universities had adopted formal policies.
  - But at least some of these policies, especially in medical schools, discouraged or prohibited patenting.
  - Many universities avoided direct involvement in management of patenting & licensing.

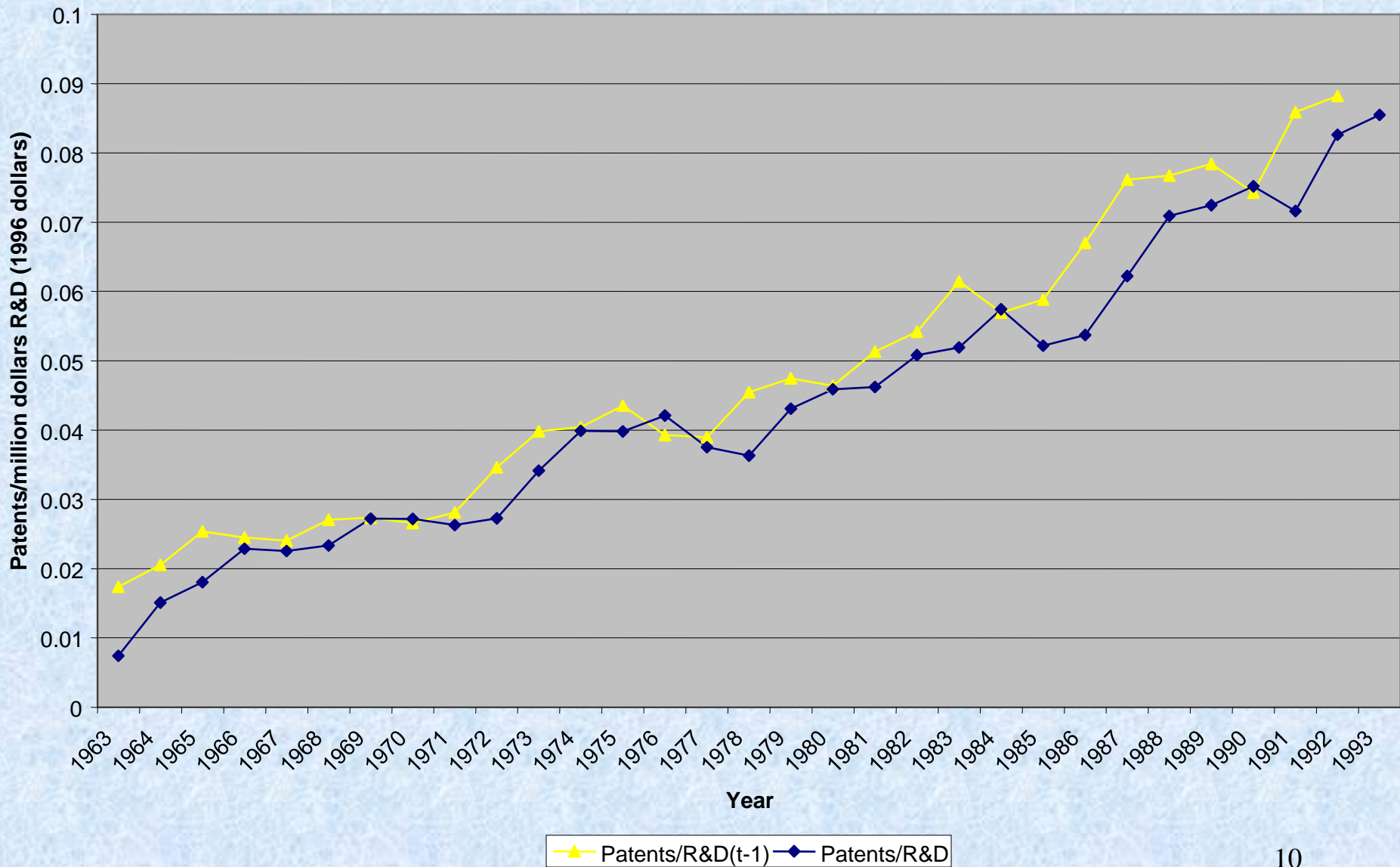
# University patenting grows more rapidly during and after the 1970s

- US universities' share of overall US patenting is stable at roughly 0.2% during 1949-63.
- Universities account for 0.3% of US domestically assigned patents in 1970 and 3.6% in 1999, a 12-fold increase in share that considerably exceeds growth in university share of US R&D performance from 12% in 1970 to 14% in 1999.
- Private universities' share of US university patenting more than triples during 1960-80, growing from 14% in 1960 to 39% in 1970; 45% in 1980; and 39% in 1999.
- University patenting accelerates *before 1980*.

US research univ. patents % of all domestic-assignee US patents, 1963 - 99



# Aggregate Patent/R&D Ratios for Universities, 1953-1993



## **University patenting during & after the 1970s (2)**

- Biomedical technologies' share of US university patents increased from 11% of research university patents in 1971 to 48% in 1997.
- Universities became more active managers of patenting & licensing during the 1970s.

**The Effects of Bayh-Dole on US  
University Technology  
Licensing after 1980**

# Post-1980 trends: Increased aggregate university patenting and greater entry by universities into patenting

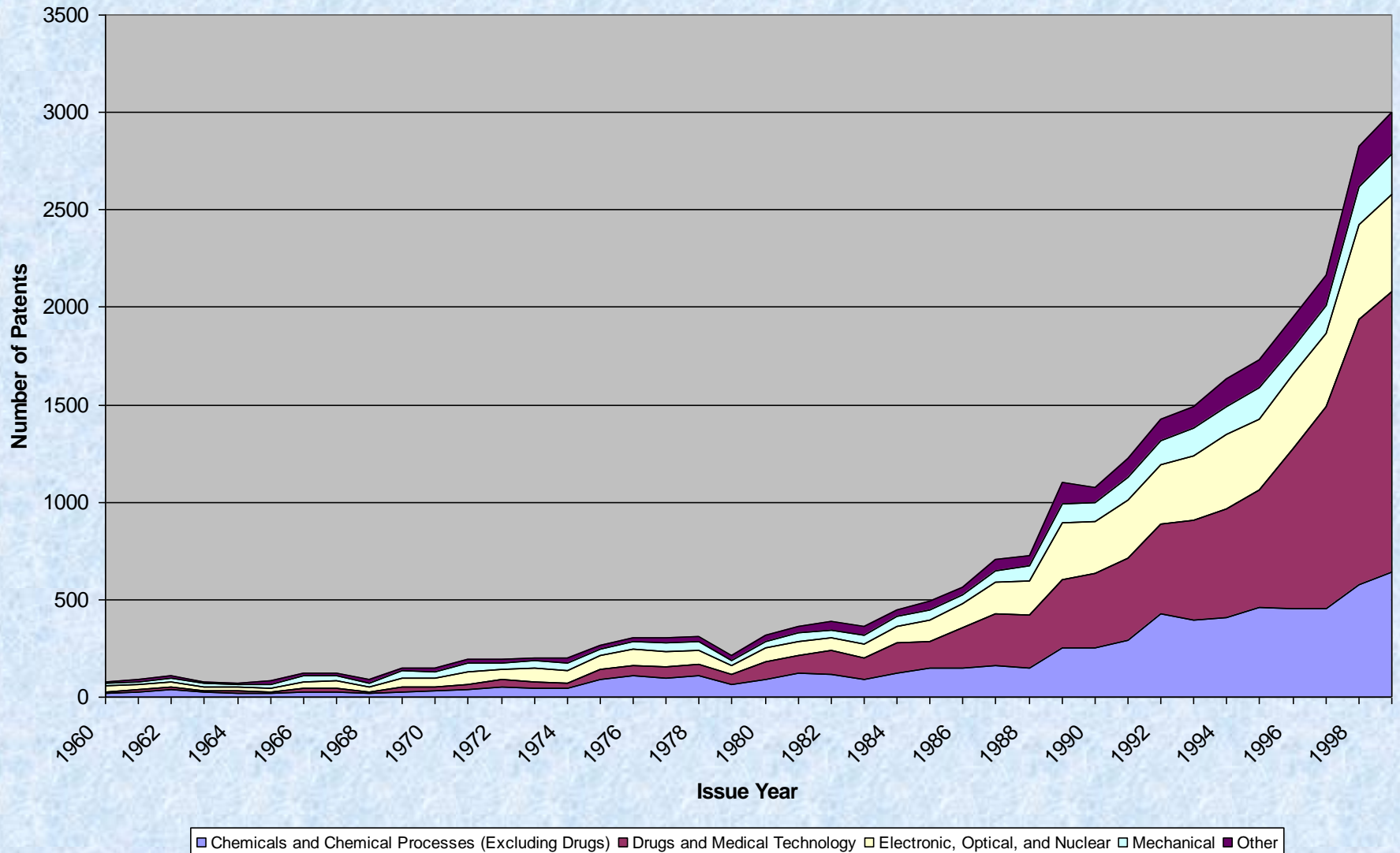
## Growth

- Growth in overall university patenting continues after 1980 (Research university share of all US patents grows from 0.7% in 1979 to 3.6% by 1999).
- Biomedical share of university patenting grows.

## Entry

- “High-intensity” academic patenters (more than 10 patents assigned during 1970-80) account for 87% of academic patents in 1975, 64% in 1992.
- “Medium-intensity” academic patenters ( $\leq$  10 patents during 1970-80) account for 15% of academic patents in 1975, 30% in 1992.
- “Entrant” academic patenters (no patents during 1970-80) account for 0% of patents in 1975, 6% in 1992.

## Technology Field of Carnegie University Patents, 1960-1999



# But these trends reflect more than just Bayh-Dole: Other developments in U.S. policy during the 1970s and 1980s

- *Diamond v. Chakrabarty*: Life forms are deemed patentable by the US Supreme Court in 1980.
- Creation of the Court of Appeals for the Federal Circuit in 1982. The Court becomes a strong “pro-patentholder” judicial body.
- Other federal actions strengthen intellectual property protection in domestic, international economy during the 1980s.
- “War on Cancer” spurs research in molecular biology.

## **“Before & after” Bayh-Dole at the University of California and Stanford**

- Growth in annual invention disclosures at both universities accelerated before 1980.
- Biomedical portion of overall disclosures also increased before 1980.
- At both institutions, biomedical inventions’ share of patenting and licensing income began to grow before 1980.

# Licensing income at Columbia, UC, and Stanford

- Gross licensing income (constant \$\$) grew significantly during 1970-1995 at Stanford, UC (1985-1995 at Columbia).
  - 50-fold growth at UC, FY1970-95.
  - 200-fold growth at Stanford, FY 1970-95.
  - 60-fold growth at Columbia, FY 1985-95.
- Top 5 licenses generate a large proportion of gross income at all 3 universities.
- Biomedical licenses account for a large proportion of top 5 earners at all 3 universities.
- By 1995, the license portfolios of the “entrant” and the two “incumbents” closely resemble one another.

**Selected Data on University of California, Stanford University, and Columbia  
University Licensing Income, FY1970-95**

UC	FY1970	FY1975	FY1980	FY1985	FY1990	FY1995
Gross income (1992 dollars: 000s)	1140.4	1470.7	2113.9	3914.3	13240.4	58556.0
Gross income from top 5 earners (1992 dollars: 000s)	899.9	1074.8	1083.0	1855.0	7229.8	38665.6
share of gross income from top 5 earners (%)	79	73	51	47	55	66
share of income of top 5 earners associated with biomedical inventions (%)	34	19	54	40	91	100
share of income of top 5 earners associated with agricultural inventions (%)	57	70	46	60	09	0
Stanford		FY76				
Gross income (1992 dollars: 000s)	180.4	842.6	1084.4	4890.9	14757.5	35833.1
Gross income from top 5 earners (1992 dollars: 000s)		579.3	937.7	3360.9	11202.7	30285.4
share of gross income from top 5 earners (%)		69	86	69	76	85
share of income of top 5 earners associated with biomedical inventions (%)		87	40	64	84	97
Columbia						
Gross income (1992 dollars: 000s)				542.0	6903.5	31790.3
Gross income from top 5 earners (1992 dollars: 000s)				535.6	6366.7	29935.8
share of gross income from top 5 earners (%)				99	92	94
share of income of top 5 earners associated with biomedical inventions (%)				81	87	91

# Summary: The effects of Bayh-Dole in the United States

- Much of the growth in patenting & licensing would have occurred without Bayh-Dole:
  - Growth in biomedical research funding and discoveries.
  - Broader strengthening of federal intellectual property rights.
  - Longstanding incentives for university administrators and faculty to operate as entrepreneurs, seeking links with industry.
- Growth in other forms of research collaboration is less apparent—industry share of university R&D doesn't grow significantly after 1980.
- Patenting and licensing is concentrated in biomedical technologies.

## Effects of Bayh-Dole (2)

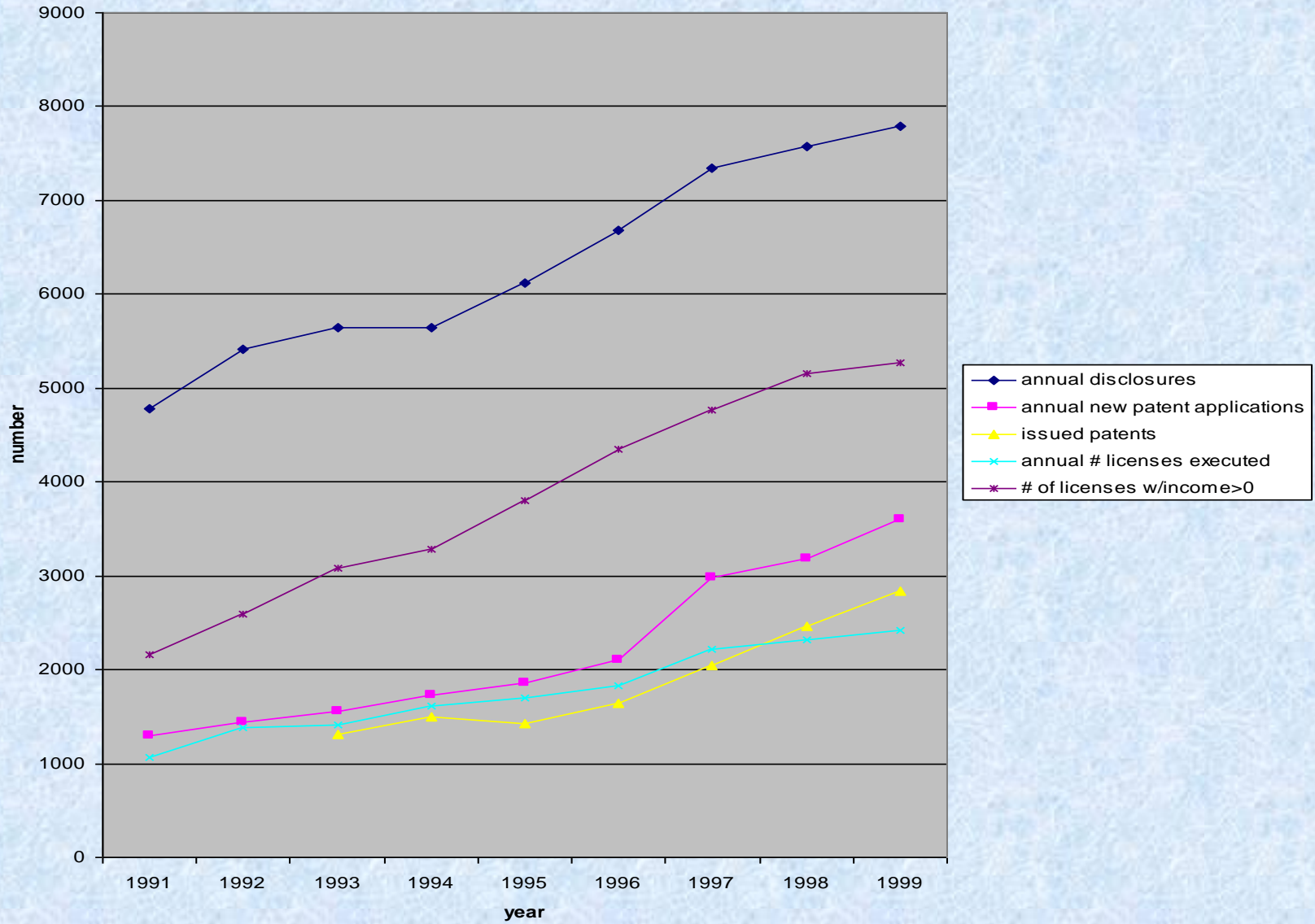
- Financial returns for many universities from licensing are concentrated among a small number of inventions.
- For many universities, these financial returns are modest or negative.
- Learning to manage these activities requires considerable time and expense.
  - Staff and legal expenses for patenting and licensing offices are high.

## Effects of Bayh-Dole (3)

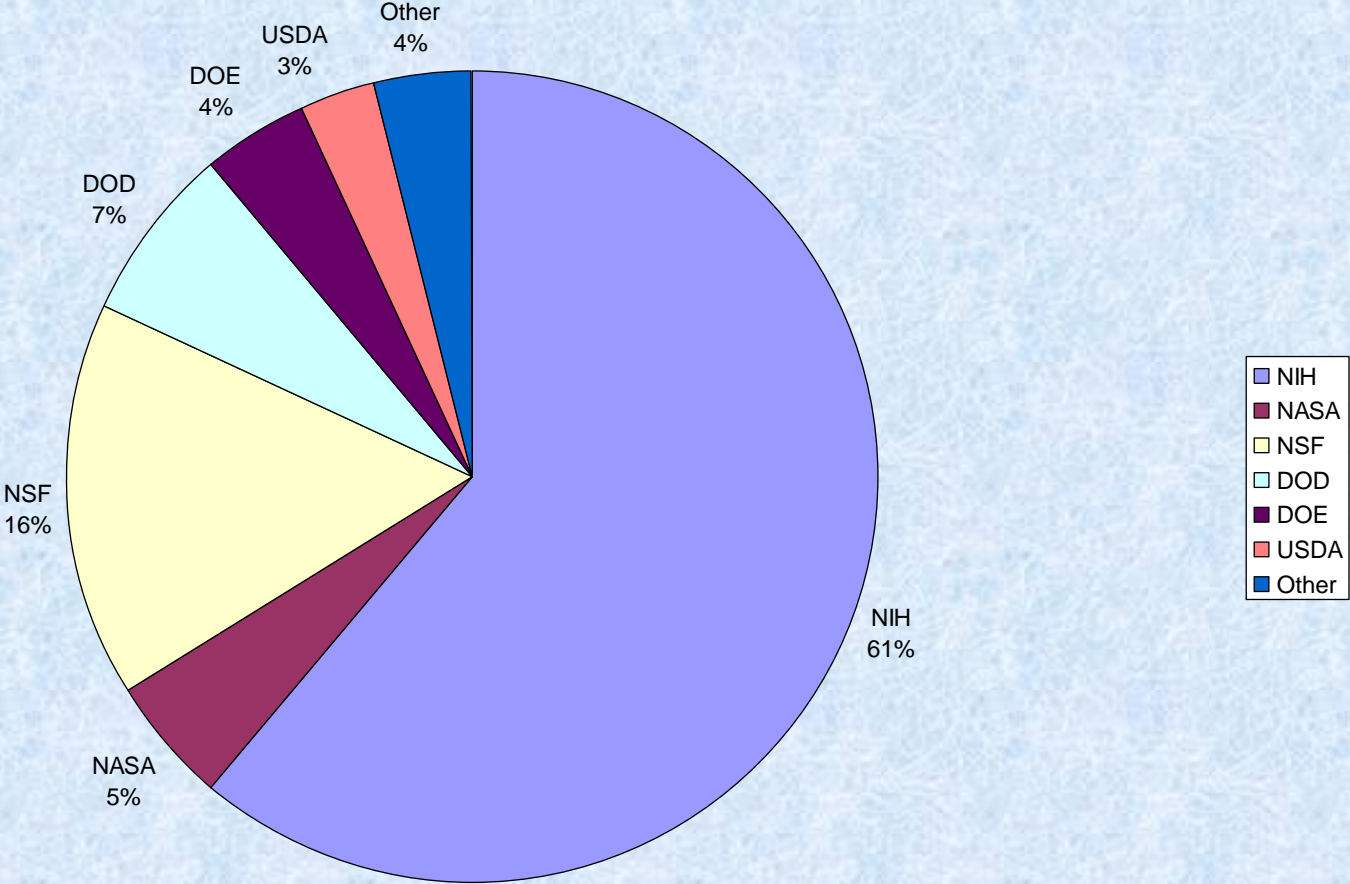
- Increased university patenting & licensing in some fields is changing universities and industrial firms into competitors from collaborators.
- Research collaboration and technology transfer include many channels in addition to patenting and licensing.
- Are patents and licenses necessary to support transfer and commercialization of university inventions? Evidence is mixed.
- Technology transfer and commercialization also rely on other institutions outside of the U.S. university, such as venture capital and equity markets.

# Appendix

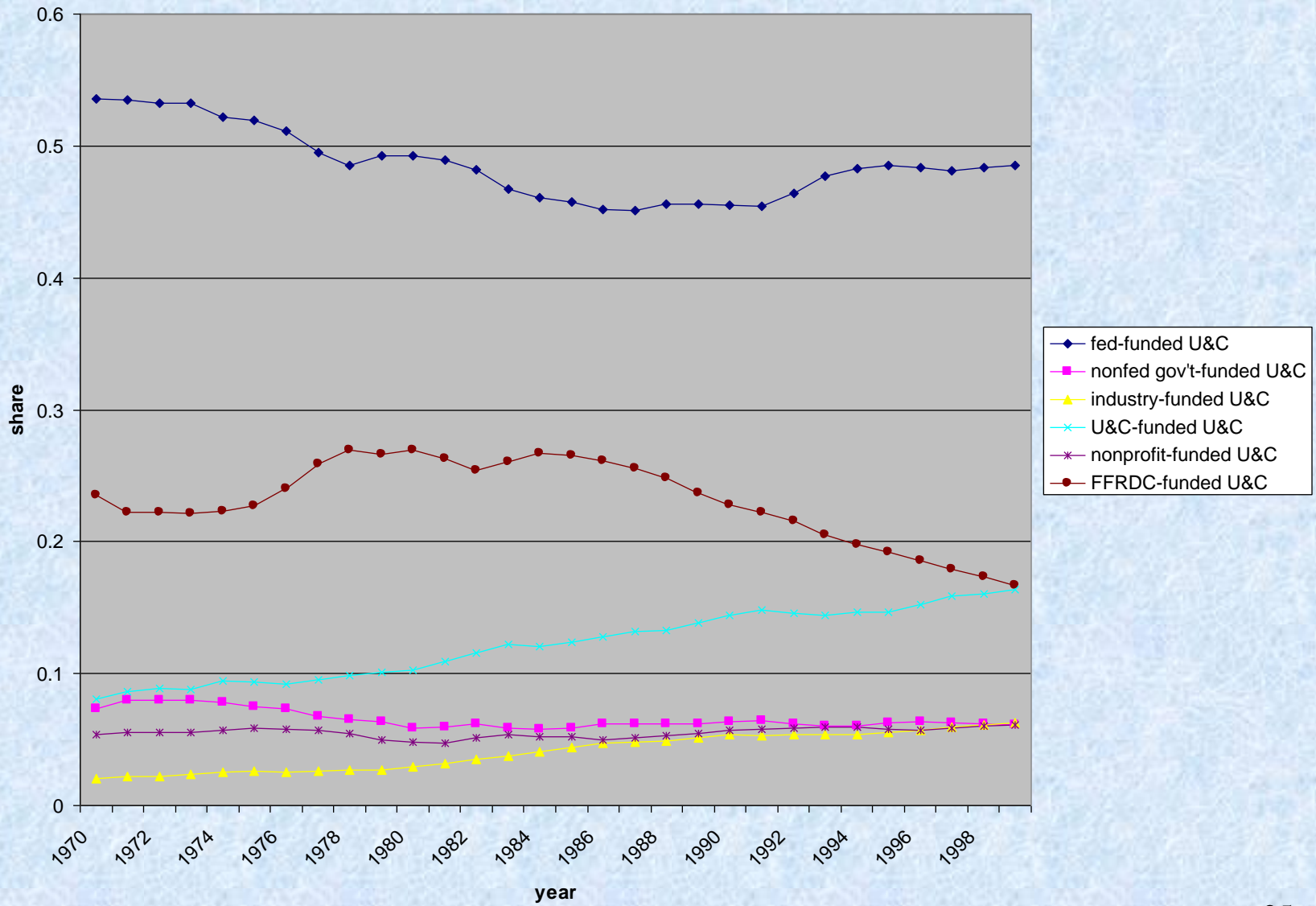
Trends in disclosures, patents, and licenses, AUTM "recurrent respondents," FY1990 - 98



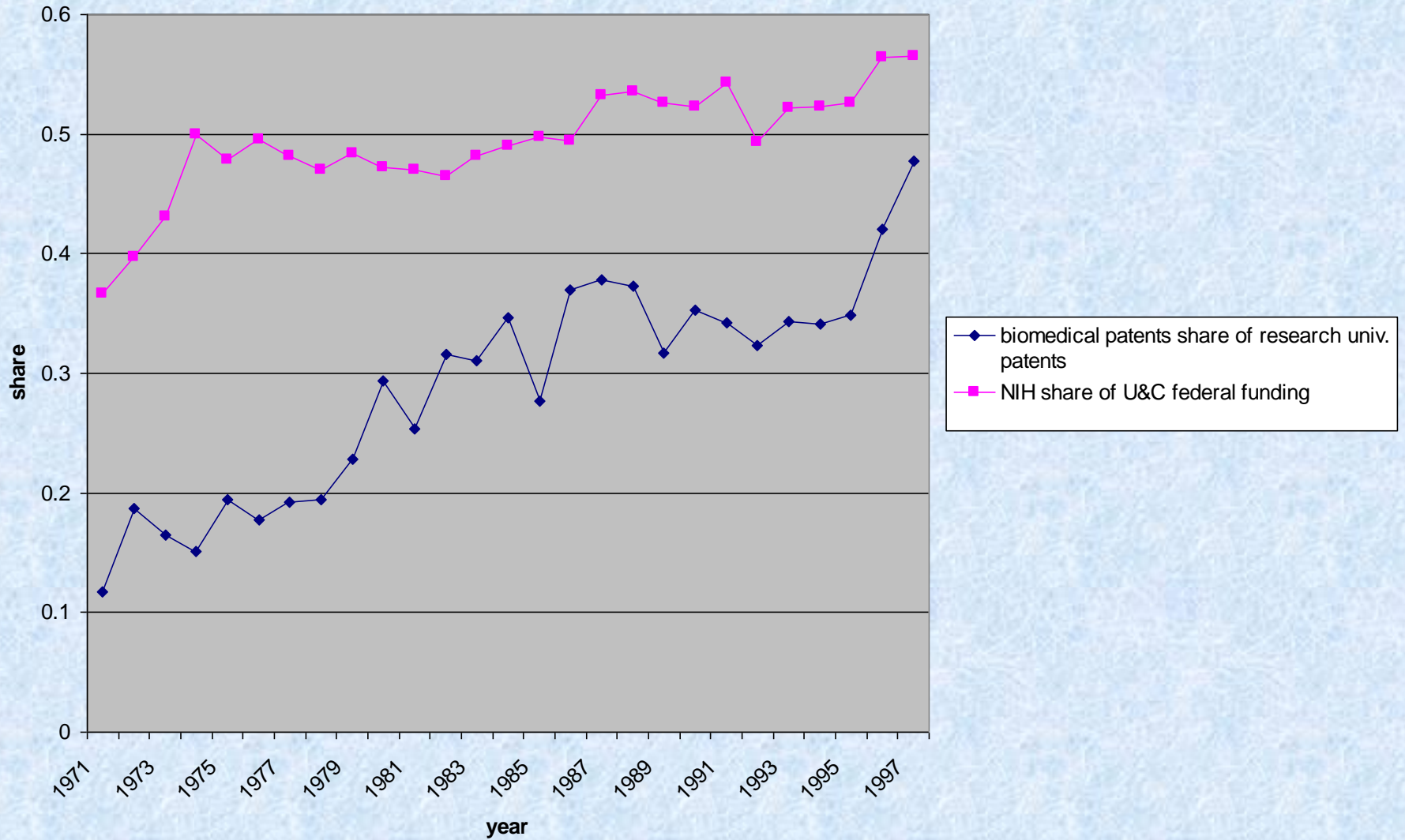
Federal funding of U&C R&D, FY 2001



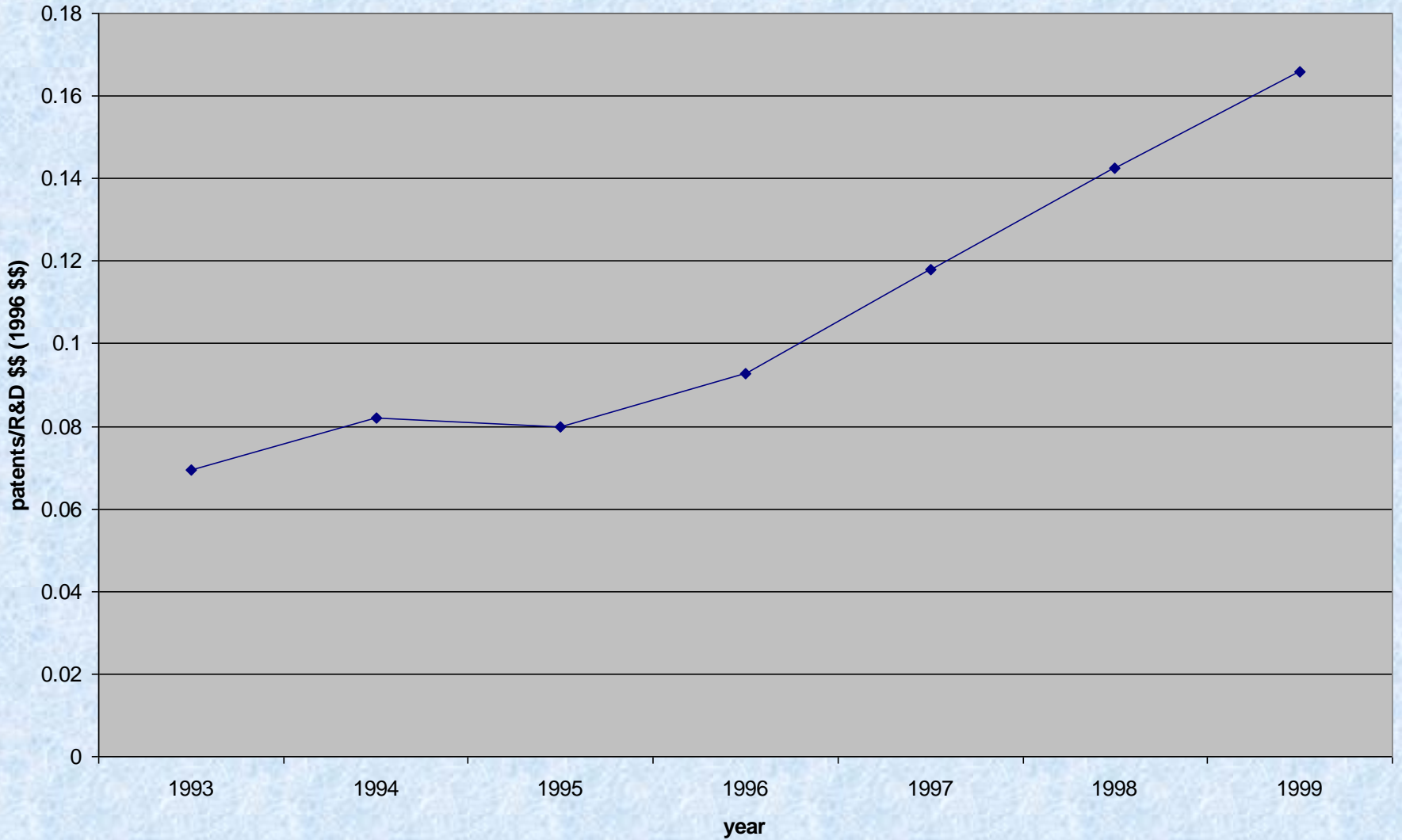
sources of funding for U&C R&D, 1970-99



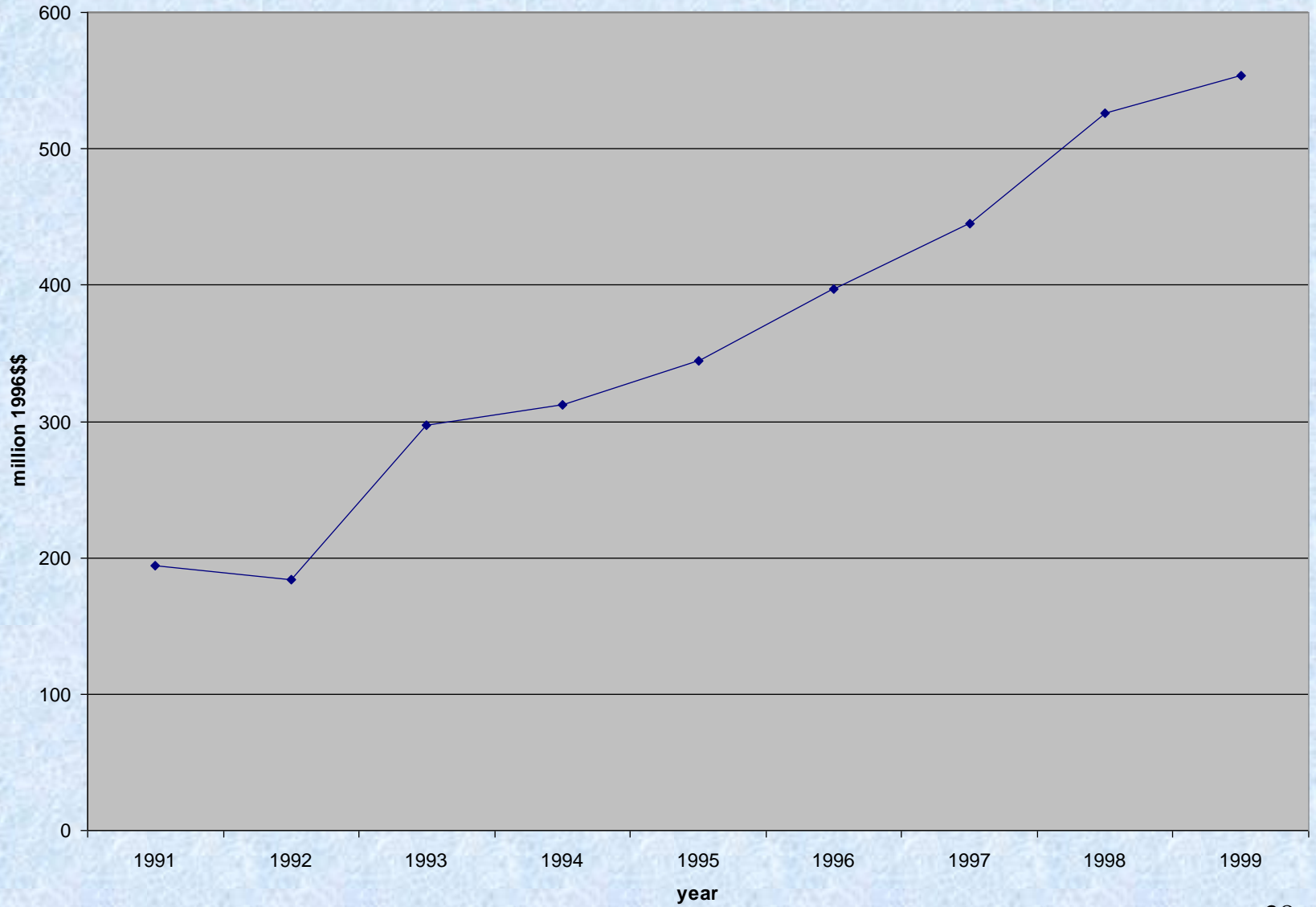
Biomedical patents and NIH funding, 1971-97



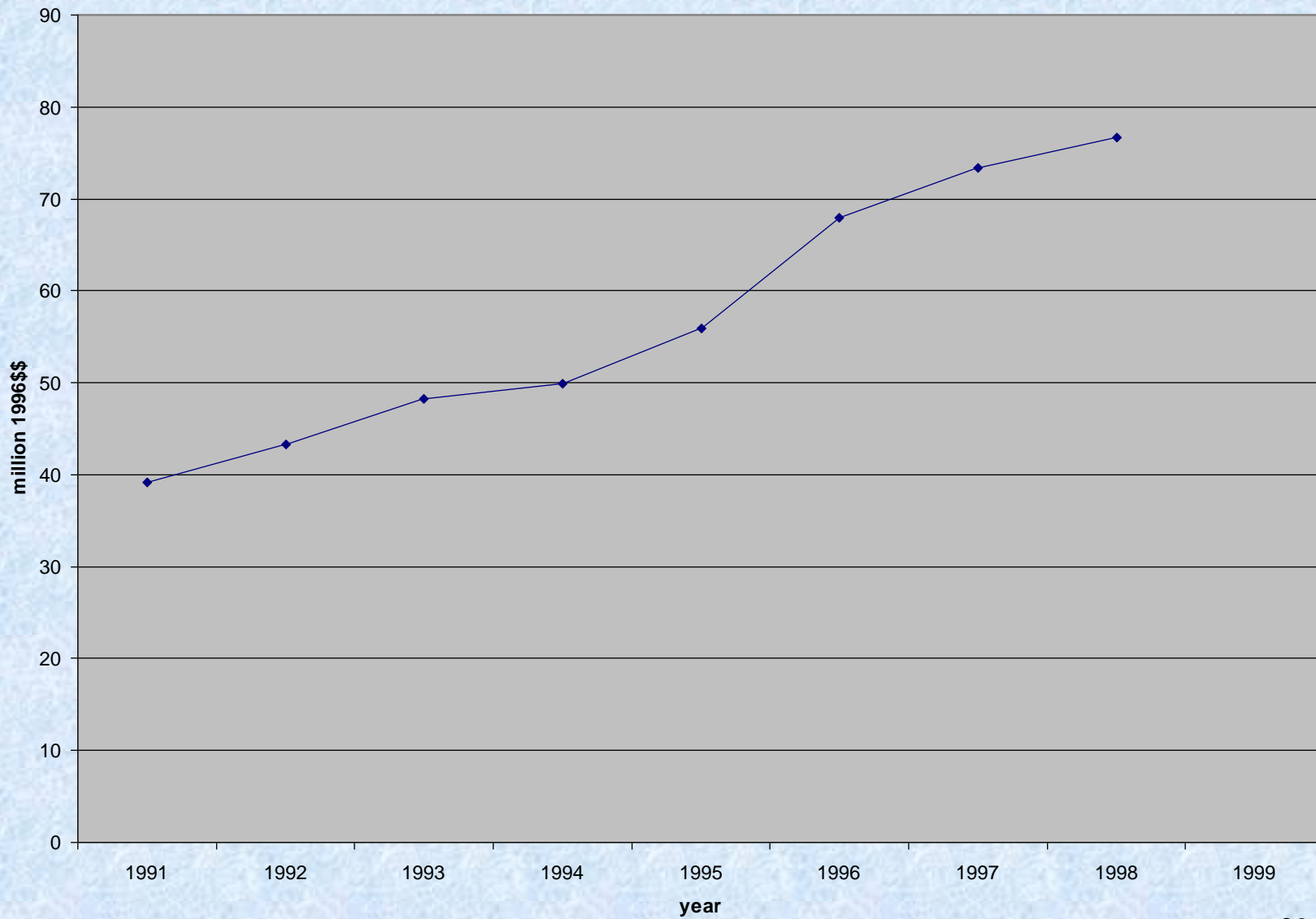
Patents/R&D expenditures, all AUTM respondents, FY 1993-99



Gross licensing income, FY 1990-98, AUTM survey "recurrent respondents" (n=82)



gross legal fees, FY 1990-98, AUTM "recurrent respondents" ( n=73)



**Institutional funds % of R&D at Doctorate-granting universities, FY 1985-98**

