4T: Tech Transfer Think Tank
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Policy Levers in Innovation:
A View from "Across the Pond"

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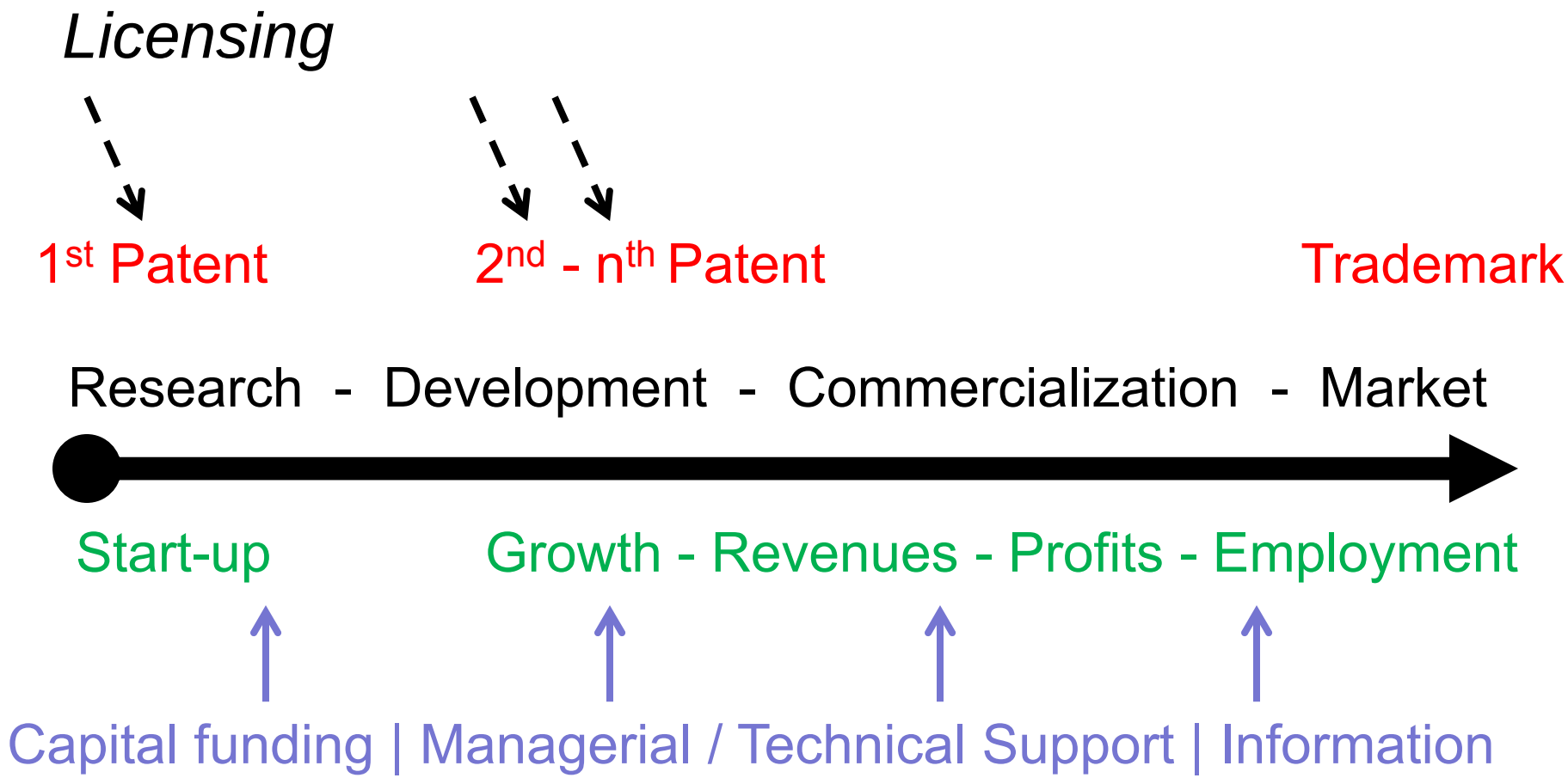
Some economics behind tech transfer

- Specialization
  - Ricardo; Smith – “each to his comparative advantage, then trade to maximize economic efficiency”
- Markets for technology
  - Arora, Fosfuri, Gambardella (2004)
- The role for IP (patents)
  - Create incentives to invest today, with promise of recouping R&D investments in the future, and
  - Provide a platform for trading, and licensing: Creating a market mechanisms allowing for specialization

Invention and Innovation

- Josef Schumpeter, 1930s
  - Invention and Innovation different phenomena
    - ***Invention*** is the creative spark, but
    - ***Innovation*** is the commercialization process, starting with an *Invention* but conducting the development, making investments in time, resources, money, and successfully marketing the resulting product or service
  - Watt, Boulton and 20 years delay…

Schematic of the innovation process



The Role of the University in Innovation

- I am going to describe the U.S. system
  - *Drunk man and the lightpost*
- Comparative analysis can bring clarity, but
- Our answer must include an understanding of *National Innovation Systems (NIS).*
  - Generally, NIS defined as
    - The institutions (formal and informal) and actors that affect the creation, development, and diffusion of innovation in a society

Reported importance to U.S. Industry R&D: Patents & Licenses from Public Entities

Information source	% rating it as "very" or "moderately" important for industrial R&D
Publications & reports	41.2%
Informal Interaction	35.6
Meetings & conferences	35.1
Consulting	31.8
Contract research	20.9
Recent hires	19.6
Cooperative R&D projects	17.9
Patents	17.5
Licenses	9.5
Personnel exchange	5.8

From Cohen, W. et al (2002) "Links and Impacts: The Influence of Public Research on Industrial R&D," *Management Science,* vol. 48.

Table 4 **Importance to Industrial R&D of Information Sources on Public Research**

Industry	N	Patents	Pubs./ Reps.	Recent Hires	Licenses
2400: Chemicals, nec	73	24.7	35.6	16.4	8.2
2411: Basic chemicals	41	17.1	36.6	17.1	2.4
2413: Plastic resins	28	14.3	35.7	21.4	0.0
2423: Drugs	68	50.0	73.5	30.9	33.8

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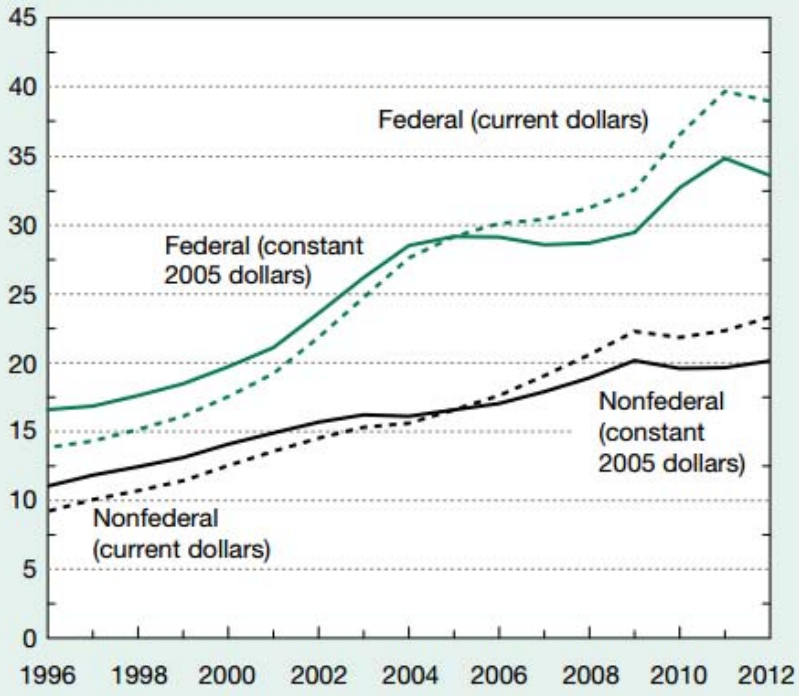
Industry	N	Patents	Pubs./ Reps.	Recent Hires	Licenses
3210: Electronic components	27	18.5	37.0	29.6	11.1
3211: Semiconductors and related equipment	25	20.0	60.0	36.0	12.0
3220: Comm equipment	37	5.4	48.7	27.0	8.1
3230: TV/radio	9	22.2	66.7	33.3	11.1
3311: Medical equipment	74	27.0	40.5	18.9	17.6
3312: Precision instruments	39	23.1	46.2	10.3	12.8

From Cohen, W. et al (2002) "Links and Impacts: The Influence of Public Research on Industrial R&D," *Management Science,* vol. 48.

Three primary bases

- Investments in basic R&D
  - Government – and increasingly Industry – funding
- Technology transfer offices in universities
  - Patenting, and licensing
- Successful commercialization
  - Licensing, new company start-ups / spin-outs, university-industry collaboration

Figure 5-1
Federal and nonfederal academic S&E R&D expenditures: FYs 1996–2012

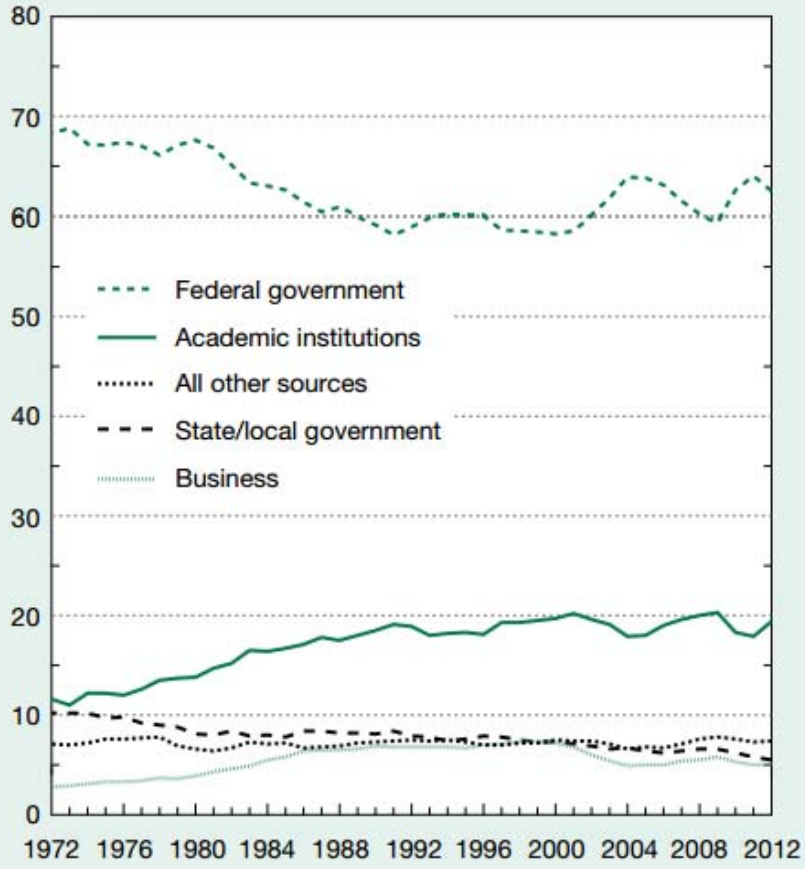


NOTES: Data include expenditures for S&E R&D. Gross domestic product implicit price deflators were used to convert current dollars to constant 2005 dollars.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey. See appendix table 5-2.

Science and Engineering Indicators 2014

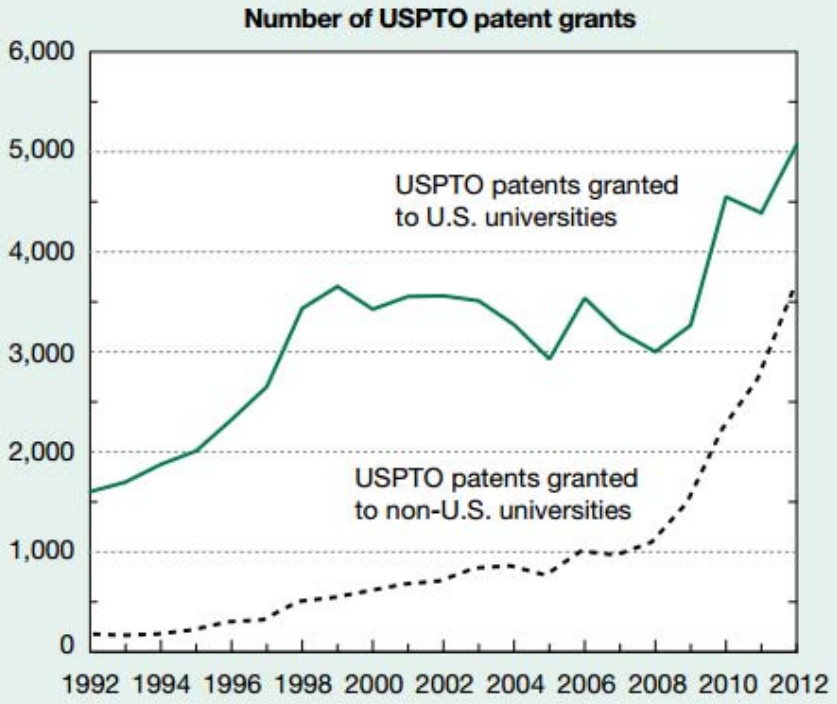
Figure 5-2
Academic S&E R&D expenditures, by source of funding: FYs 1972–2012

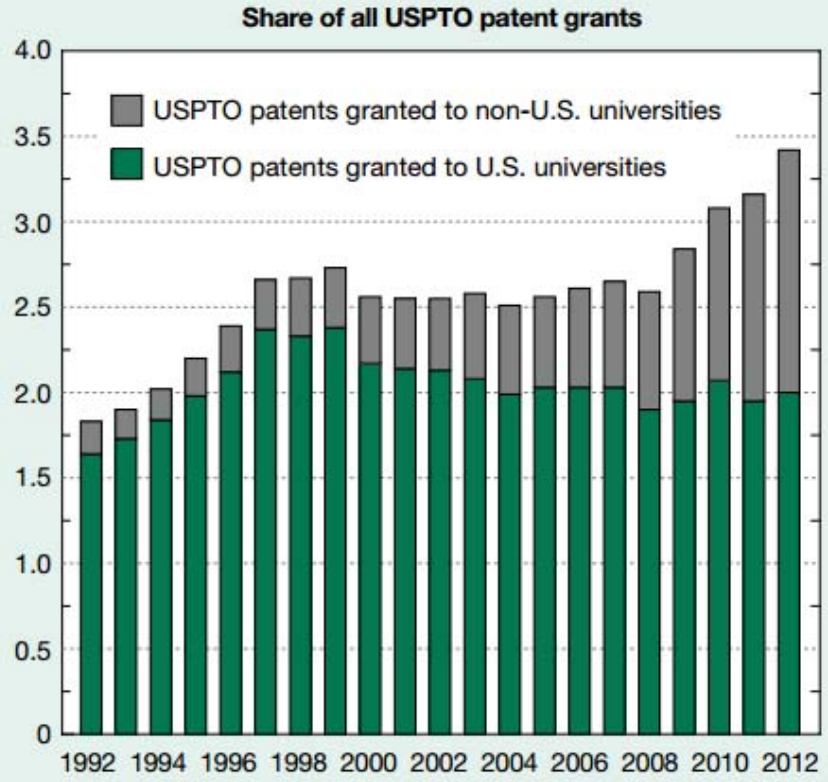


SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey.

Science and Engineering Indicators 2014

Figure 5-34
USPTO patents granted to U.S. and non-U.S. academic institutions: 1992–2012



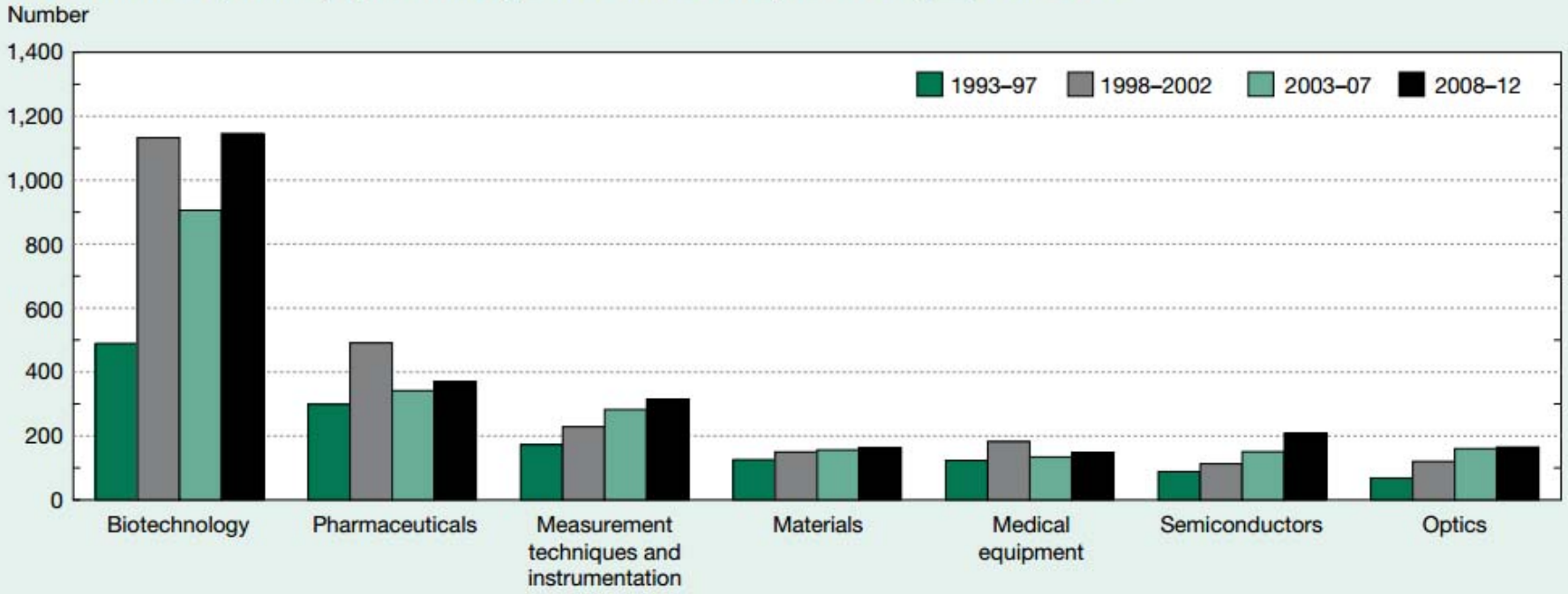


USPTO = U.S. Patent and Trademark Office.

SOURCE: The Patent Board,™ special tabulations (2013) of Proprietary Patent database. See appendix table 5-62.

Science and Engineering Indicators 2014

Figure 5-36
U.S. academic patents, by technology area: Selected 5-year averages, 1993–2012



NOTES: Data include institutions affiliated with academic institutions (e.g., university and alumni organizations, foundations, and university associations). Universities vary in how patents are assigned (e.g., to boards of regents, individual campuses, or entities with or without affiliation with the university). The Patent Board™ technology areas constitute an application-oriented classification system that maps the thousands of International Patent Classes (IPCs) at the main group level into 1 of 35 technology areas. If a patent has more than one IPC, only the primary IPC is considered in mapping.

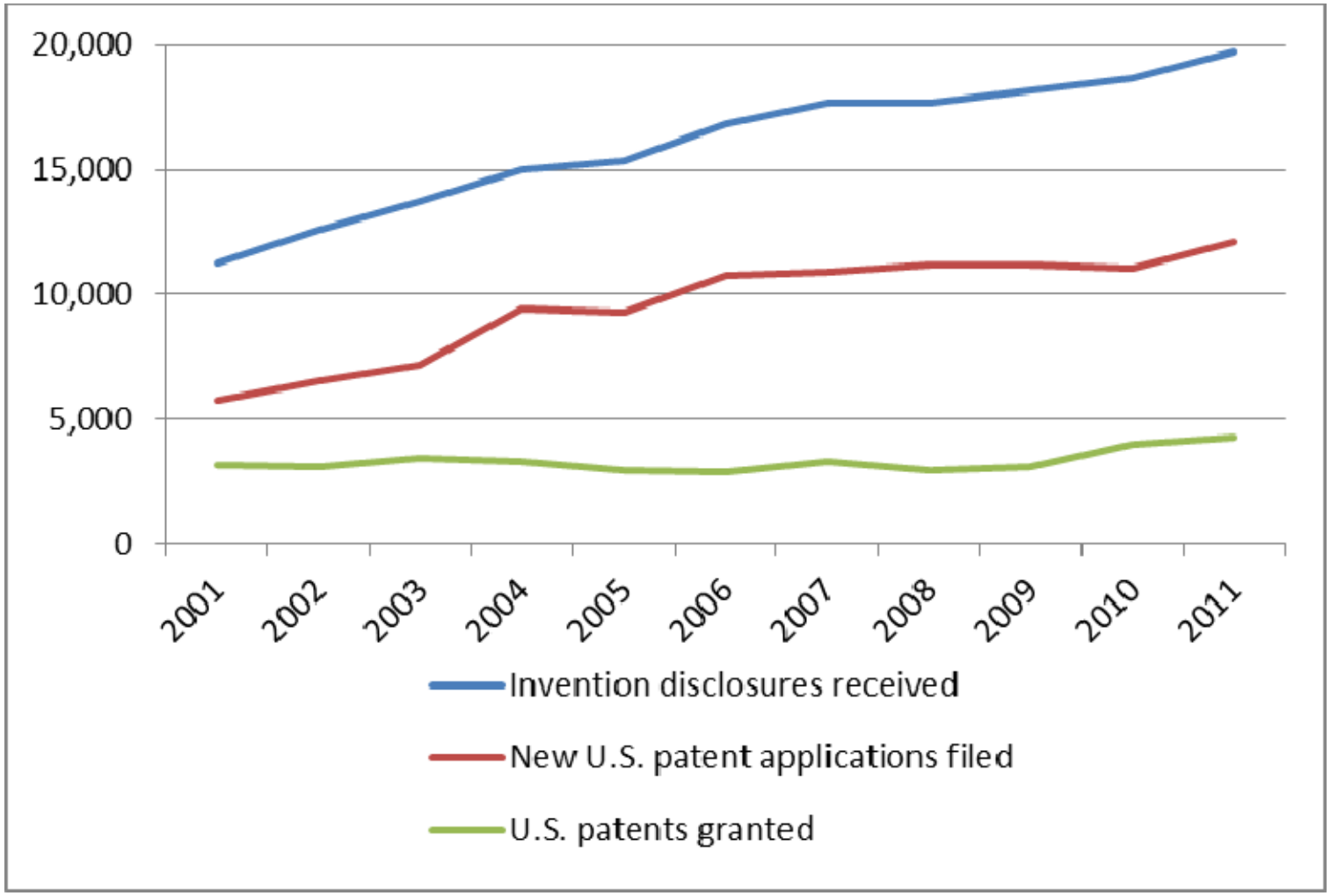
SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, and The Patent Board,™ special tabulations (2013) from U.S. Patent and Trademark Office (USPTO), Patent Grant Bibliographic Data. See appendix table 5-63.

Science and Engineering Indicators 2014

Patenting U.S. federally-funded research

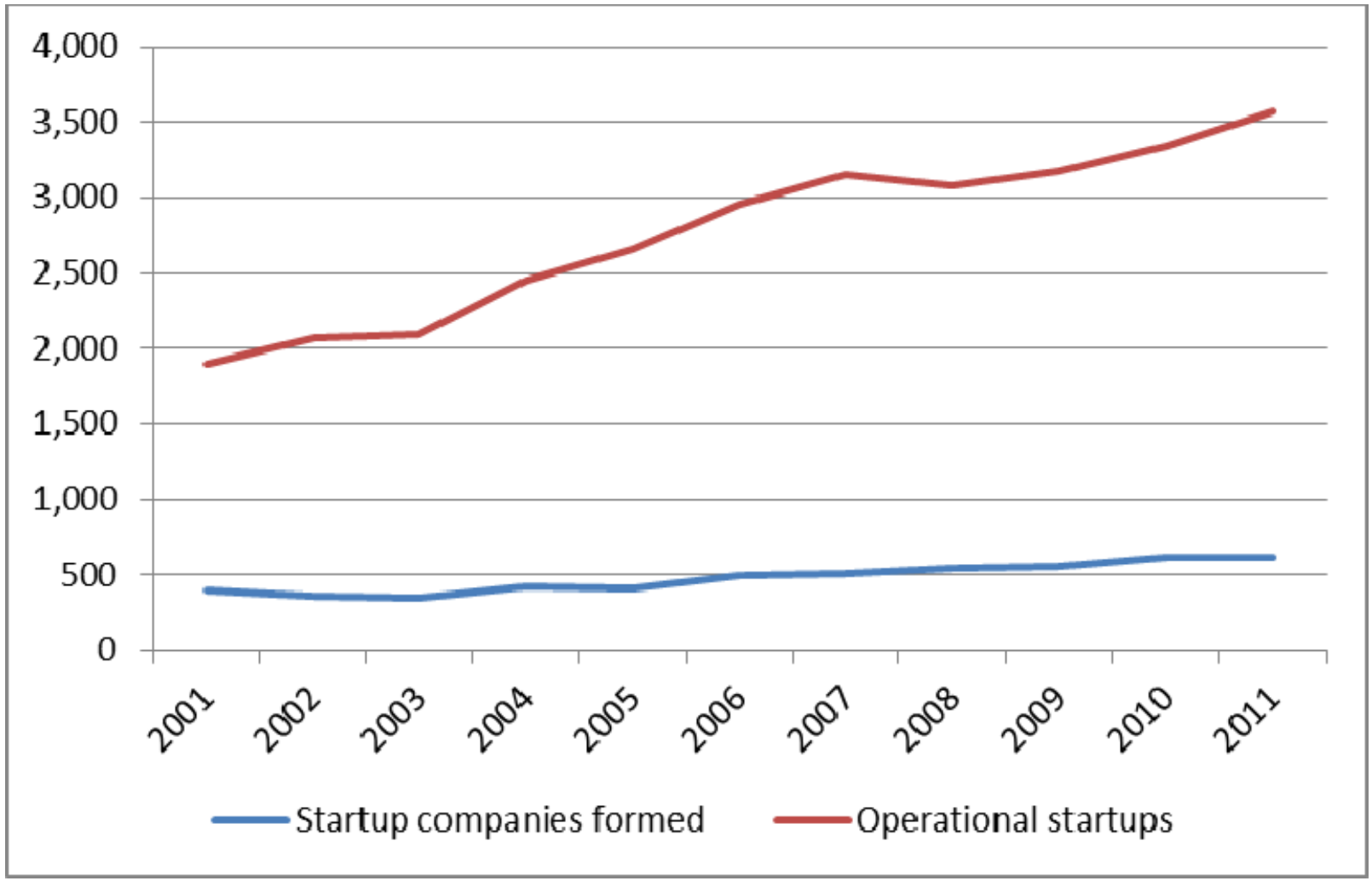
- Prior to 1980, university patenting rate was low
  - But, important inventions found their way into the patenting system, such as Cohen-Boyer PCR, 1970s
- Bayh-Dole Act (1980)
  - Loosened regulations on university patenting
  - Subsequent growth in university tech transfer offices (TTOs), university patenting, and university licensing
- Patenting rules in the U.S.
  - Generally, new emerging technologies are patentable
    - Biotechnology (1980); Software (1986)
  - Patent fee discounts: 50% small entity; 75% universities

Academic patenting, AUTM, 2001-2011



SOURCE: Association of University Technology Managers (AUTM), AUTM Licensing Survey (various years).
NAS Science and Engineering Indicators 2014

University Startup Companies, 2001-2011



SOURCE: Association of University Technology Managers (AUTM), AUTM Licensing Survey (various years).
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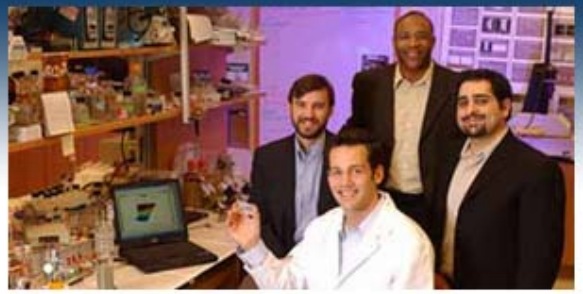

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Since 1986, ATDC companies attracted MORE THAN $2 billion IN OUTSIDE CAPITAL

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ATDC by the numbers

In 2013, ATDC companies created a combined total of MORE THAN $1 billion IN REVENUE

In 2013, ATDC companies attracted MORE THAN $50 million IN OUTSIDE CAPITAL

Summary

- In the U.S., the university is an integral part of our National Innovation System
  - It generates *Invention*, and takes an active role in *Innovation*
- How do the three bases work?
  - Investments in basic R&D
    - Prime the pump – fuel the engine
  - Technology transfer offices in universities
    - Selection in TTO to patent, based on likely successes
  - Successful commercialization
    - Further selection from industry, based on likely commercial success
- Outcomes: Efficient specialization, and royalties flow back to the university to invest in more R&D
  - And public receives a steady stream of innovation, improving lives

Thank you

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