What We are Talking About: What is Innovation and Why is It Important?

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Presented to the Accelerating Innovation 2005 Conference: Strengthening the Mid-Atlantic Innovation chain, held at the National Academies of Science

October 19, 2005

Innovation - Definitions

1. *Webster's*— "Introduction of something new; a new idea, method or device; novelty"

2. Council on Competitiveness in *Innovate America* — "This intersection of invention and insight, leading to the creation of social and economic value."

Innovation: Definitions

3. Mine — "A strategy which provides resources to talented people in an atmosphere which promotes creativity and is focused on outcomes ranging from new products to customer satisfaction to new scientific insights to improved processes to improved social programs etc., to create wealth and/or improve the human condition."

Does Innovation Matter in Today's Global Economy?

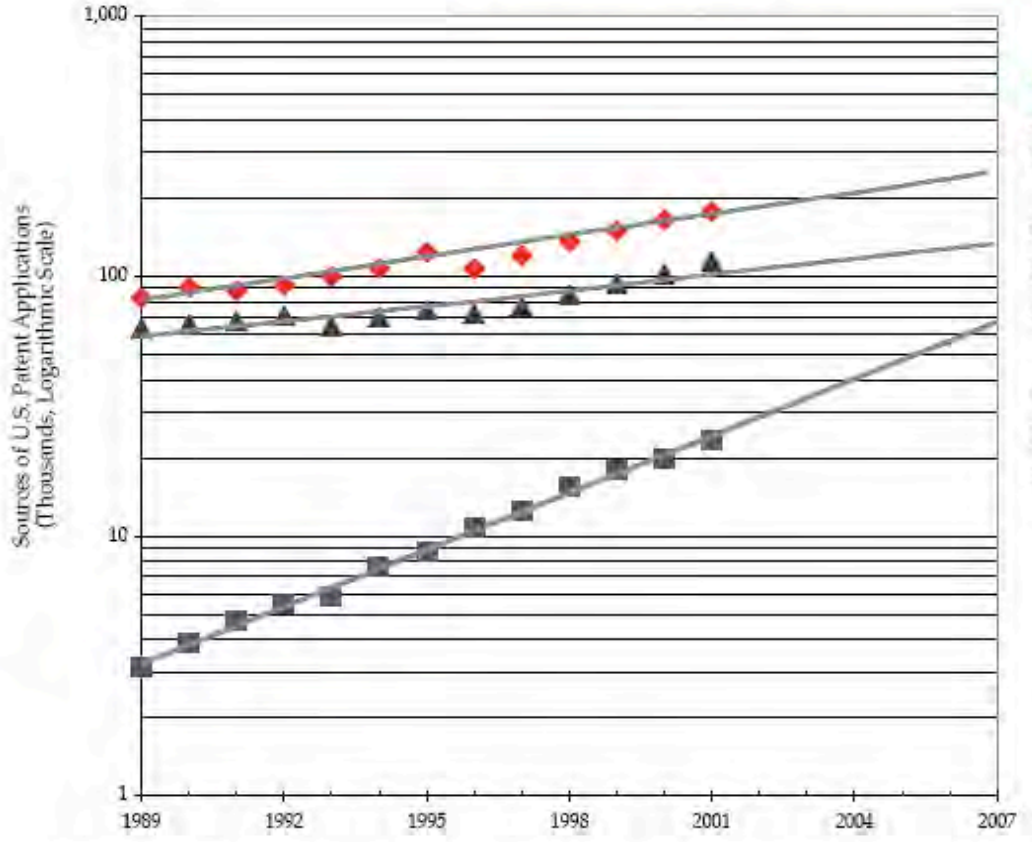
1. The standard of living in the U.S. and Western Europe has been built on innovation and competition.

2. The U.S. position in a "free market" has depended on productivity; ability to take risks; and an instilled belief in upward mobility. It has allowed for higher wages by working smarter and for the creation of new wealth for risk-takers.

Does Innovation Matter in Today's Global Economy?

3. In the current and future global economy, many new, talented players are coming on the scene with new competition via low wages, quality and educated people and creative ways to attract capital.

U.S. Patent Applications: Fastest Growing Economies Gaining on U.S. Rapidly



Other Established Economies: Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom

Fastest Growing Economies: China, Hong Kong, India, Ireland, Israel, Singapore, South Korea, Taiwan

Source: National Science Foundation, *Science and Engineering Indicators 2004*, Appendix Table 6-11.
Compiled by the APS Office of Public Affairs

Ingredients for an Innovative Future

1. Talent — Educated and motivated workforce of diverse skills and interests. A dedication to life-long learning and a cadre of technical professionals to invent the next game-changing technological wave and to exploit the current knowledge base.

2. Investment — Ability to provide resources for long-term development of new, unexplored areas as well as short-term development of improved products, processes and services.

Ingredients for an Innovative Future

3. Infrastructure — Physical environments to support state-of-the-art exploration, and business conditions to encourage risk-taking and collaborative activities (including IP protection, health care and energy certainties, etc).

   note: Adapted from the Council on Competitiveness' *Innovate America Report, 2005*.

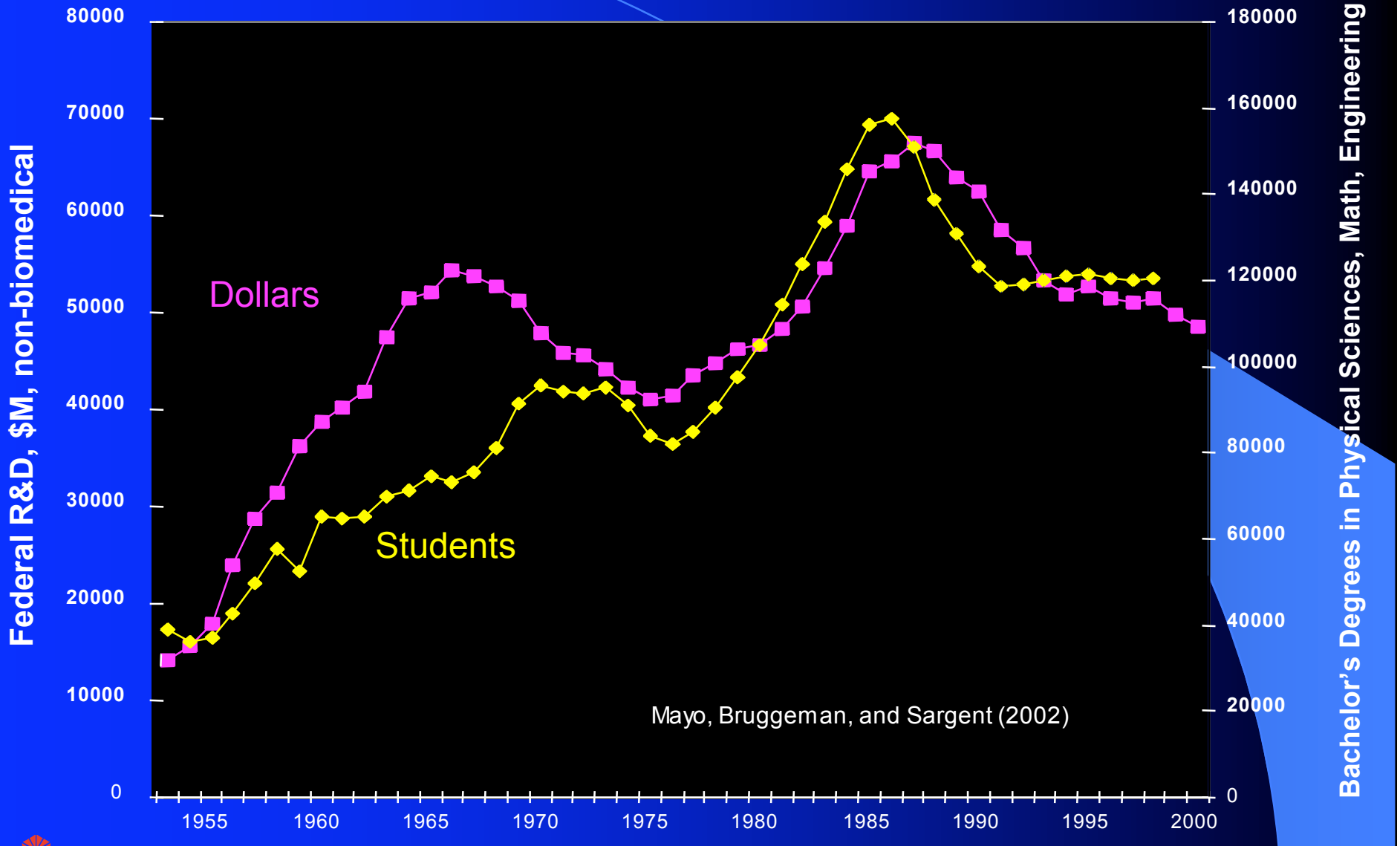
Experts: "Technological Progress" is the Primary Driver of Economic Growth.

Author (Year)	Time Period	% of Economic Growth Due to: Capital	Labor	Tech. Progress
Abramovitz (1956)	1869-1953	22	33	48
Solw (1957)	1909-1949	21	24	51
Kendrick (1961)	1889-1953	21	34	44
Denison (1962)	1909-1929	26	32	33
	1929-1957	15	16	58
Denison (1967)	1950-1962	25	19	47
Kuznets (1971)	1950-1962	25	19	56
	1929-1957	8	14	78
	1889-1929	34	32	34
Jorgenson (1972)	1950-1962	40	8	51
Kendrick (1973)	1948-1966	21	24	56
Denison (1979)	1929-1976	15	26	50
Denison (1985)	1929-1982	19	26	46
Jorgenson (1987)	1948-1979	12	20	69
	Average	21	25	55

U.S Model for Science & Technology

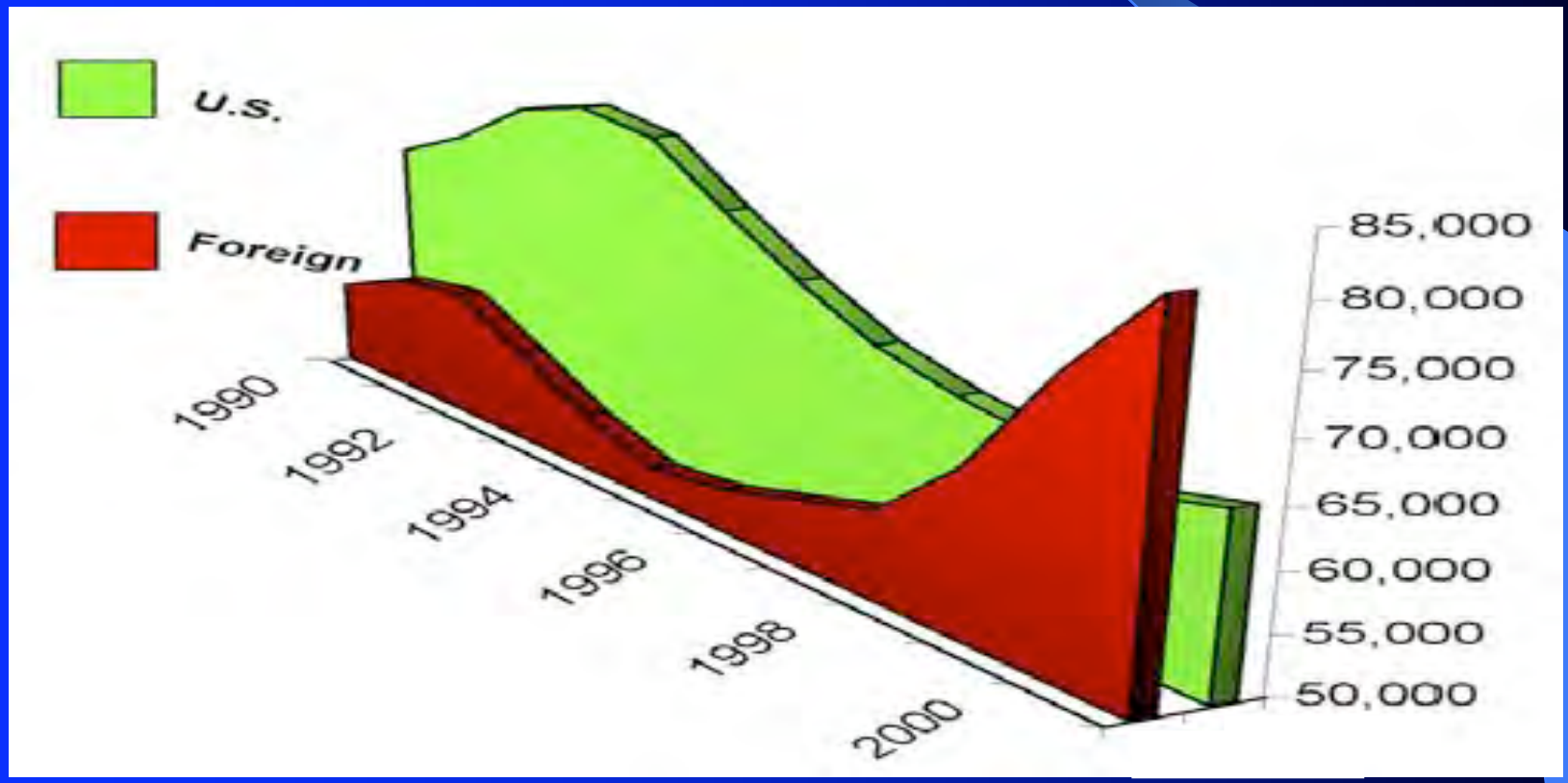
- Concept of Federal Funding for Research & Development
- Graduate Education tied to research in Universities
- Tech transfer to commercial enterprises
- Build-up of U.S. industrial laboratories: DuPont Bell Labs, GE, etc.
- Concept of Government — Industry — University Interactions

Science Enrollments & Federal $ Show High Correlation

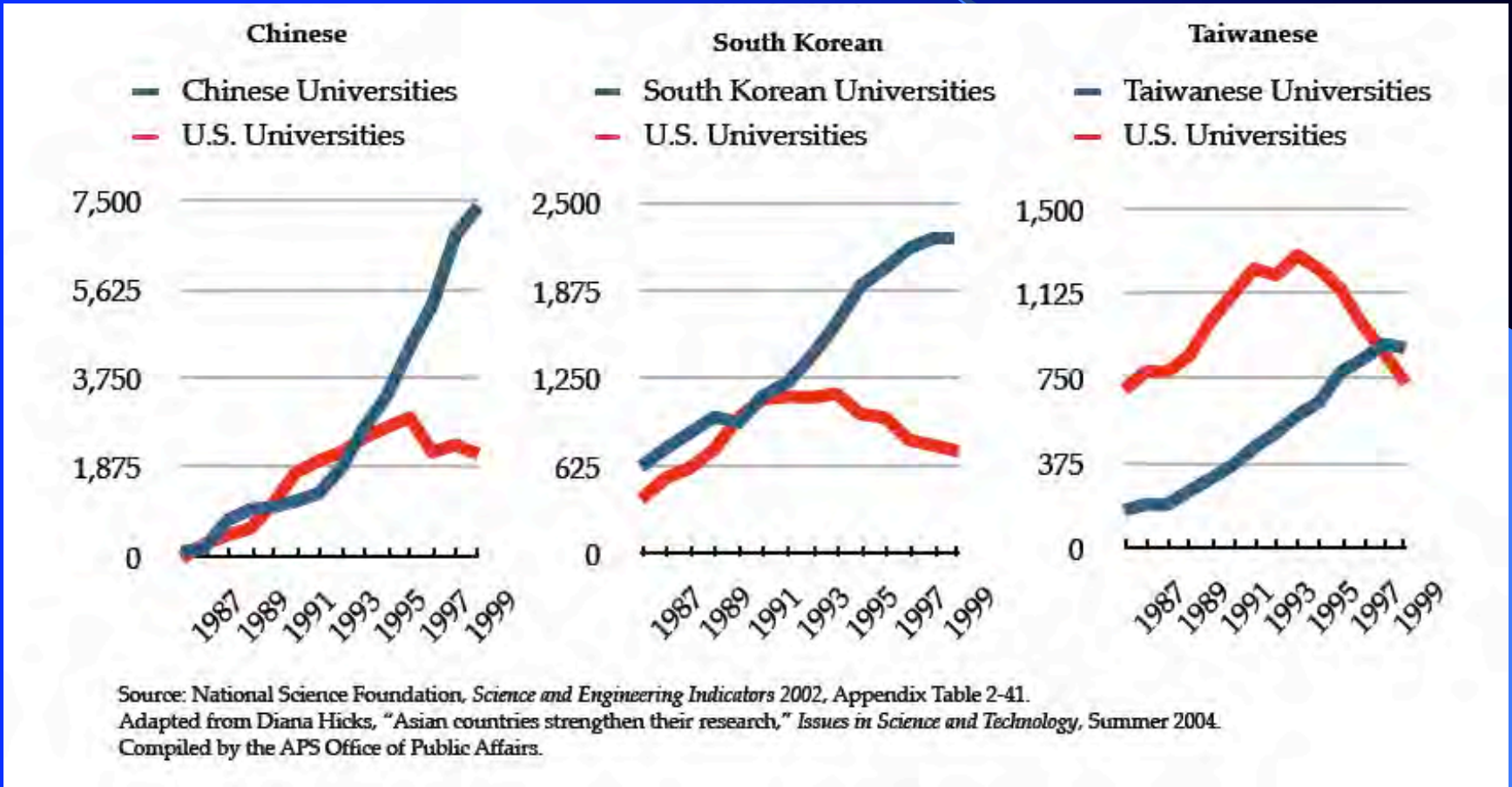


Foreign-born Students Awarded Majority of U.S. Scientific Graduate & PhD Degrees —

U.S. Innovation System Depends Upon Availability *and* Presence of Such Individuals — But will They Stay?

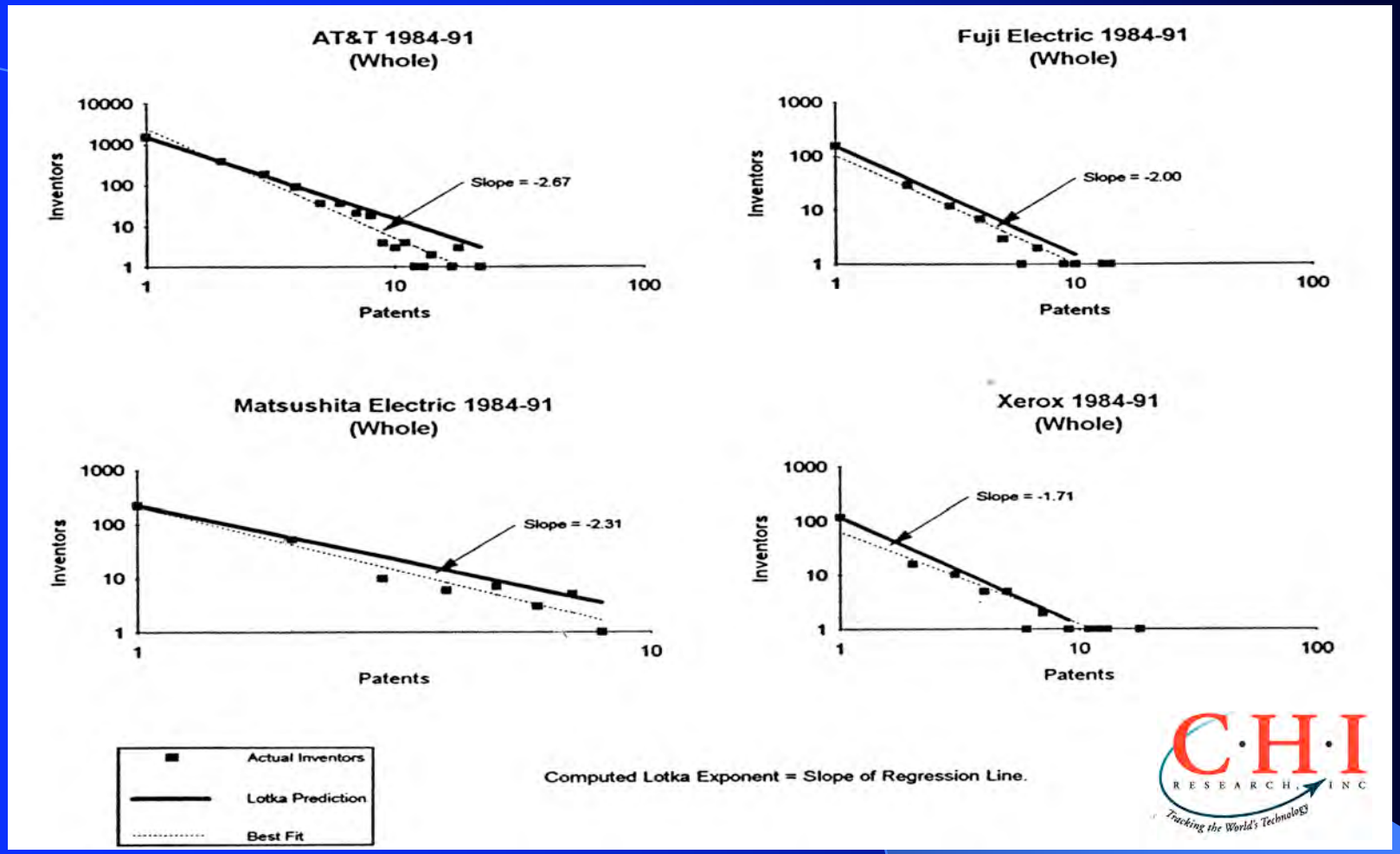


Surprise: Asian PhD. Students are Staying Home (1986-99)



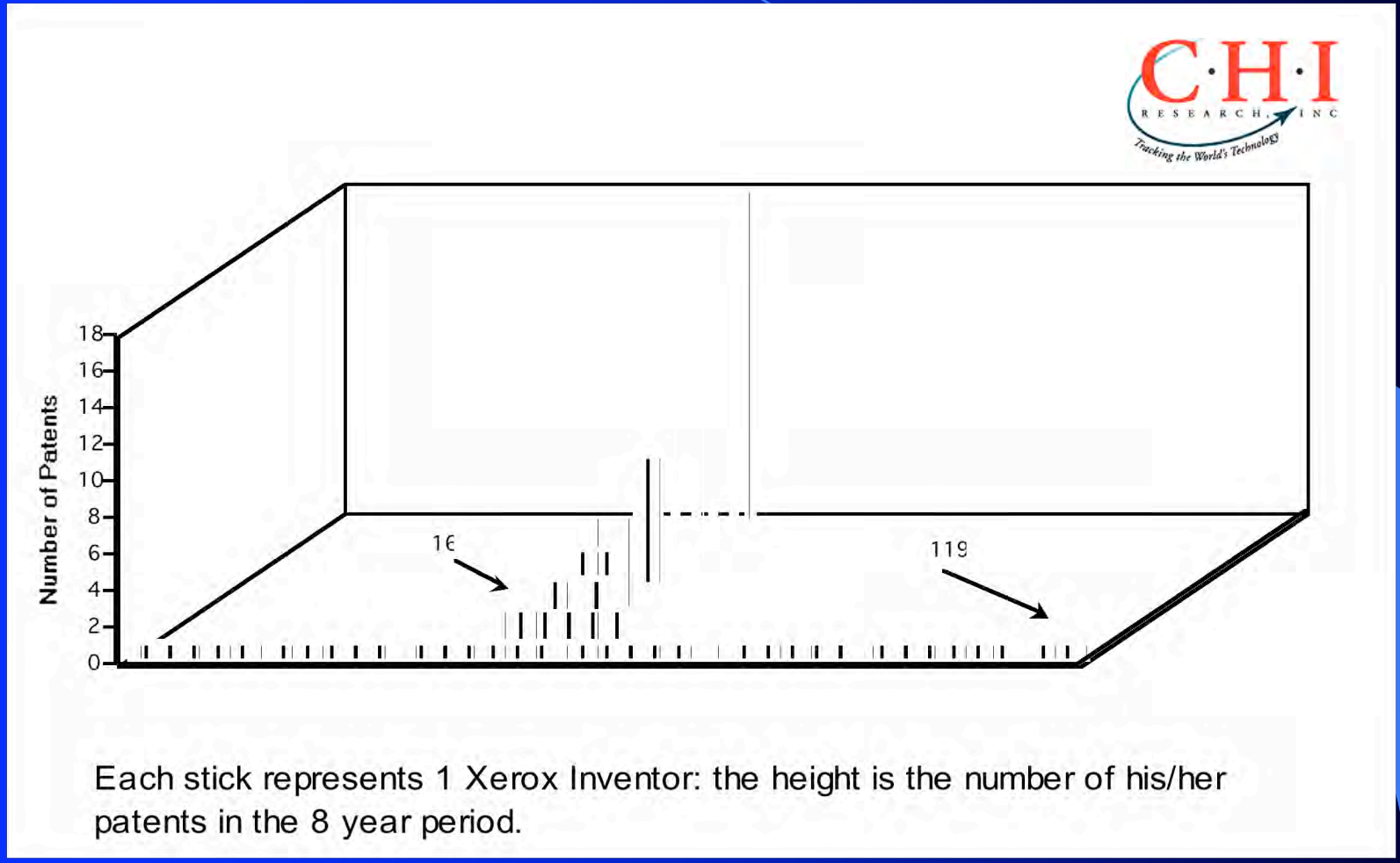
Source: National Science Foundation, *Science and Engineering Indicators 2002*, Appendix Table 2-41.
Adapted from Diana Hicks, "Asian countries strengthen their research," *Issues in Science and Technology*, Summer 2004.
Compiled by the APS Office of Public Affairs.

High Concentration also occurs in patenting: Whole Patent Count Plots — Semiconductors



From presentation by Francis Narin, CEO of CHI 2003

A Few Key Inventors Drive an Entire Lab: Xerox Semiconductor Inventors 1981 - 1987



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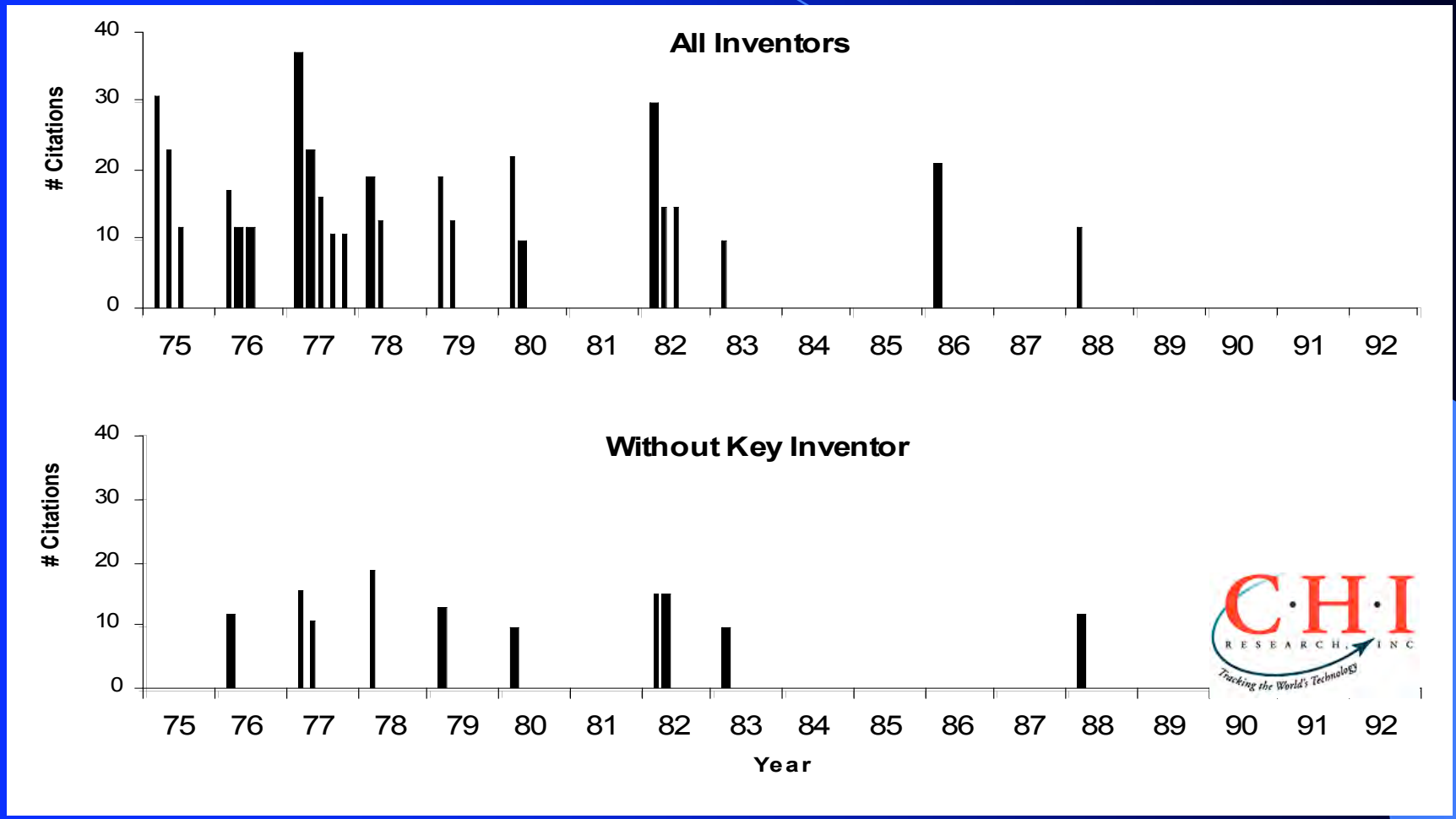
The Role of a Key Inventor in an Acquisition that Failed — Each Line is a Highly Cited Patent



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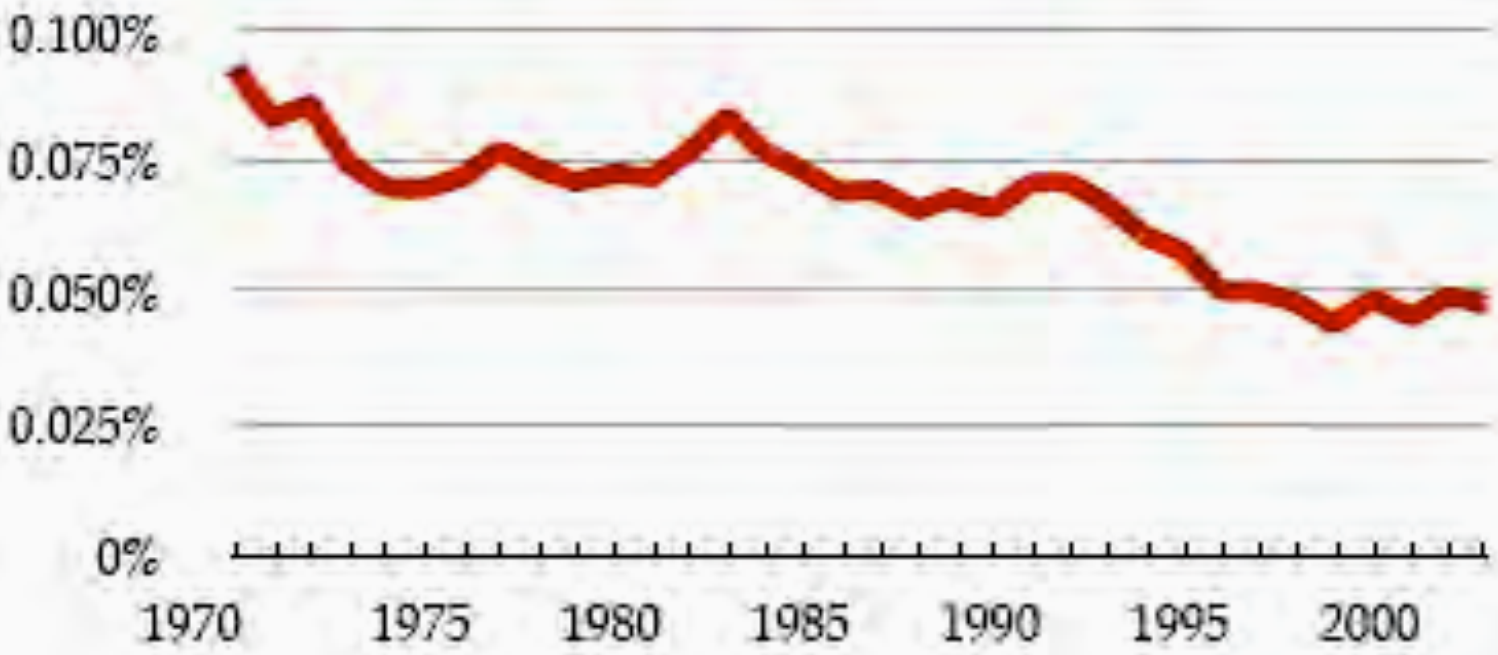
FEDERAL INVESTMENT IN PHYSICAL SCIENCES IN SIGNIFICANT DECLINE

Ratio of U.S. Federal Government Funding for Physical Sciences Research to U.S. Gross Domestic Product: 1970-2003



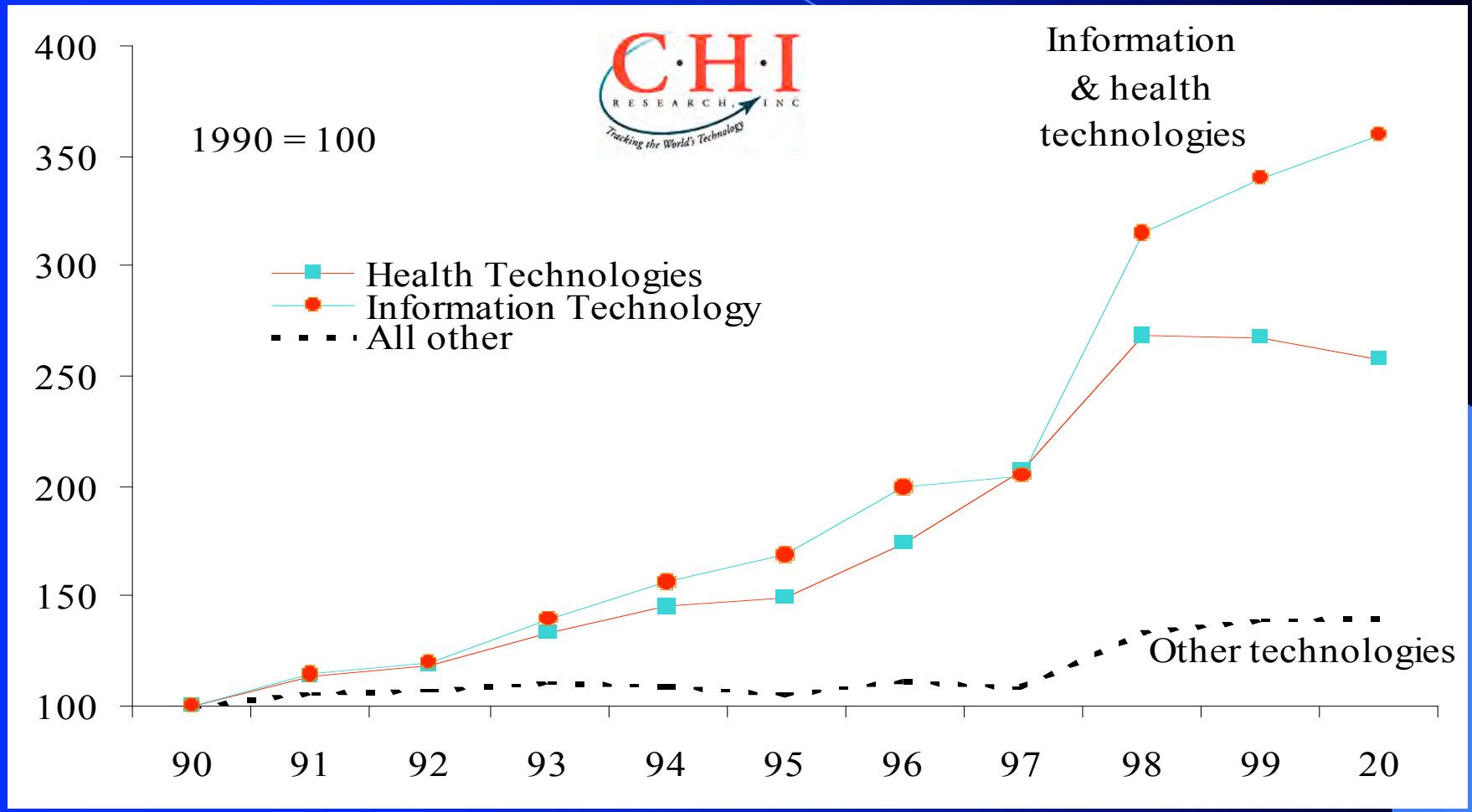
Source: American Association for the Advancement of Science www.aaas.org/spp/rd/guidisc.htm
Compiled by the AFS Office of Public Affairs

73 percent of the science papers cited by U.S. industry patents were public science

— NSF-sponsored study, March 1997

Federal support of basic research drives creation of scientific papers …

Growth in U.S. Inventor Patenting



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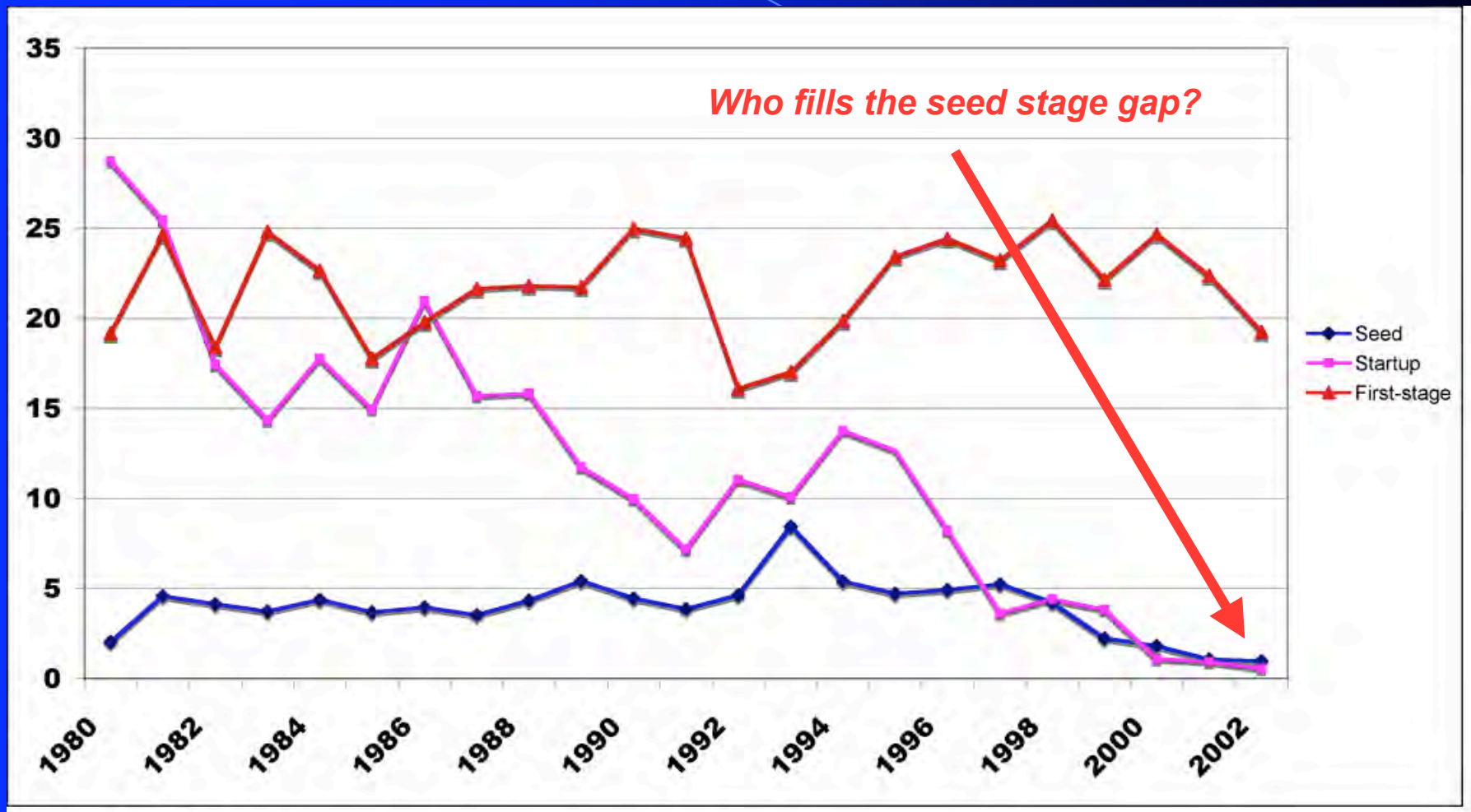
Infrastructure Needs

- Health Care
- Capital Availability
- Incentives for University / Industry / Government Collaboration efforts
- Complete Education System (K-12 plus graduate)
- Immigration Reform for highly talented contributors

The Collapse of U.S. Seed and First-Stage Venture Capital Funding – dwindling high risk investments …

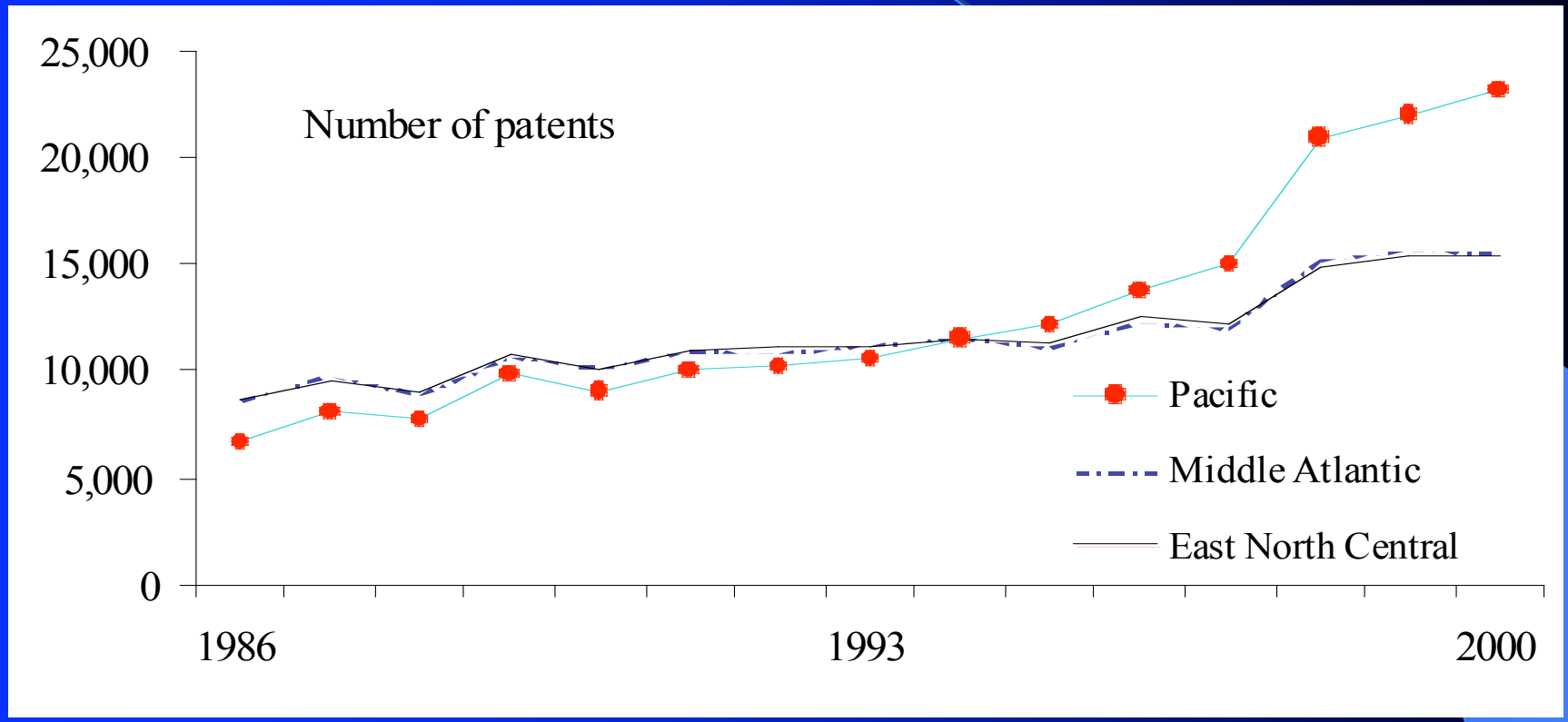


source: National Science Foundation, *Science & Engineering Indicators 2004*

Technology is Dynamic

- Technology changes Location,
- Technology changes Focus,
- Both Occur Rapidly, and Massively

Patenting From the Pacific Region Overtakes the Largest East Coast Regions

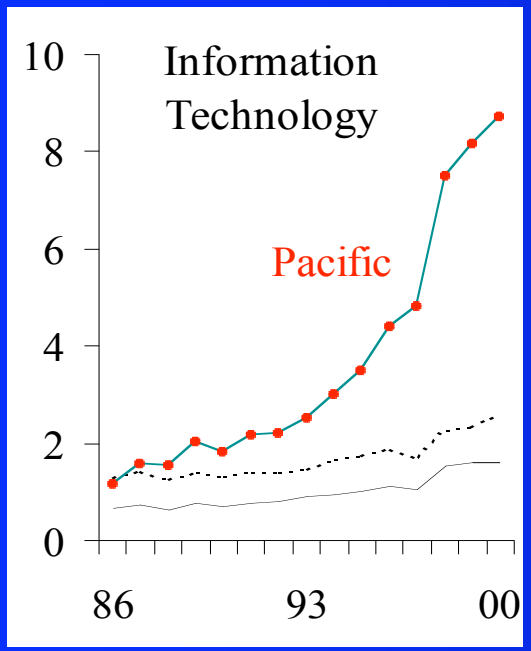


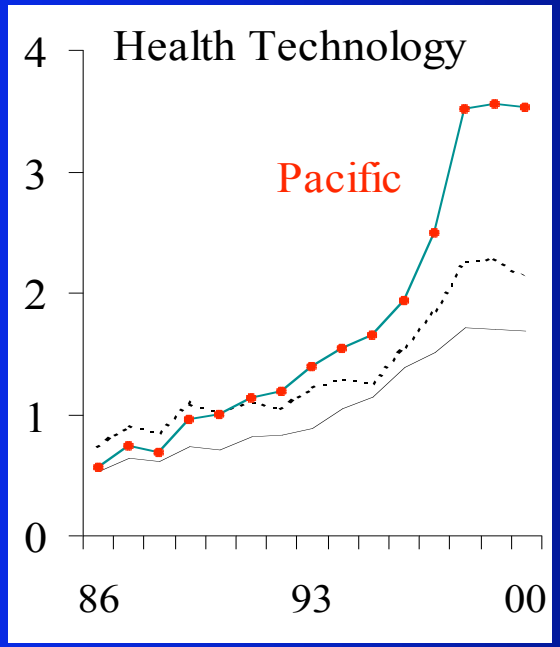
East North Central = Illinois, Indiana, Michigan, Ohio, Wisconsin
Middle Atlantic = New Jersey, New York, Pennsylvania
Pacific = California, Nevada, Oregon, Washington, Hawaii, Alaska

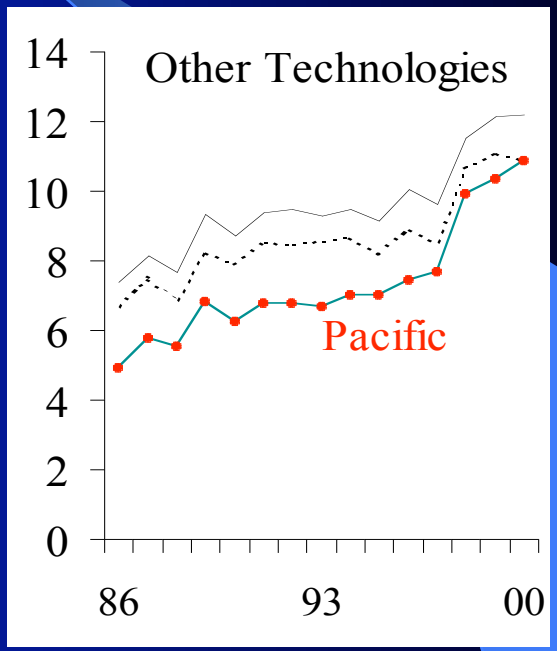
C·H·I RESEARCH, INC
Tracking the World's Technology

Information & Health Technologies Give the U.S. Pacific Region Its Lead

Number of patents/1000







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Current Proposals That Must be Heard

- Council on Competitiveness' *Innovation America 2005*
- Robert Atkinson, *The Past and Future of America's Economy (2005)* [Waves of innovation drive cycles of growth and change]
- *PCAST Report 2005*
- National Academies (2005), *Rising Above the Gathering Storm*

Some History of Science and Technology Leadership

- Europe at the beginnings of the 20th Century
  - Rutherford and the British Scientists
  - The Curies and the French scientific community
  - Einstein and the German community
- Effect of World War I
  U.S. nationalization of German chemical companies
  Technology build up in the U.S. corporate laboratories
- Solvay Conferences

Solvay Conference on Physics in 1933

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- Solvay Conferences
- Rise of Nazi Germany and U.S. immigrants
- World War II and U.S. technical response

Solvay Conference of 1961

The Rise of U.S. Technical Dominance

- Science/technology efforts of World War II – National Laboratories, etc.
- Devastation of Europe
- Post-war refugees to U.S.
- G.I. Bill
- Growth of U.S. Companies – Examples:
  - IBM
  - GE
  - AT&T
  - Hewlett-Packard
  - Computer Companies
- Build-up of U.S. Universities
  - NSF, NIH, etc.
  - Influx of foreign graduate students

Solvay Conference of 1991

XXth Solvay Conference on Physics.
Topic : Quantum Optics.

Wednesday November 6 until Saturday November 9, 1991.