Early Careers for Biomedical Scientists: Doubling (and Troubling) Outcomes

Paula Stephan
pstephan@gsu.edu
Georgia State University
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Overview

- Throughout 1990s concern expressed regarding workforce outcomes for early career biomedical scientists
- In late 1990s, NIH budget began an expansion that resulted in a doubling of the budget over a 5-year period
- Here we examine the effects of this doubling on careers of young life scientists

Overview continued

- Begin by discussing why the young are of special interest
- Continue by summarizing the early career situation for biomedical scientists in the 1990s.
- Update the situation, for 2003 and 2005.
- Examine NIH funding patterns during and after the doubling
- Conclude with a summary and discussion of what the future may hold

Acknowledgements/Caveats

- Portion of presentation uses data from Survey of Doctorate Recipients. Use of data does not imply NSF endorsement of research methods or conclusions.
- SDR data are for PhDs who received their doctoral training in U.S.; includes MD/PhDs; fails to count those who received PhD training outside the U.S.
- Views expressed are not those of NIH
- Acknowledge support from the Science and Engineering Workforce Project funded by Alfred P. Sloan Foundation.

Why Focus on the Young?

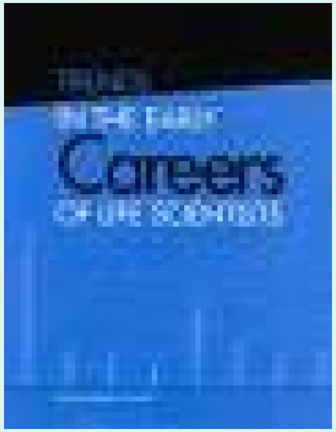
- Relationship of age to productivity
- Cohort effects: initial labor market conditions when one gets a PhD have impact throughout career
- Young have been drawn to study biomedical sciences because of a love of science…highly motivated
- Efficiency concerns—is this a rational policy?
- Signals created by poor prospects affect future flows into PhD programs

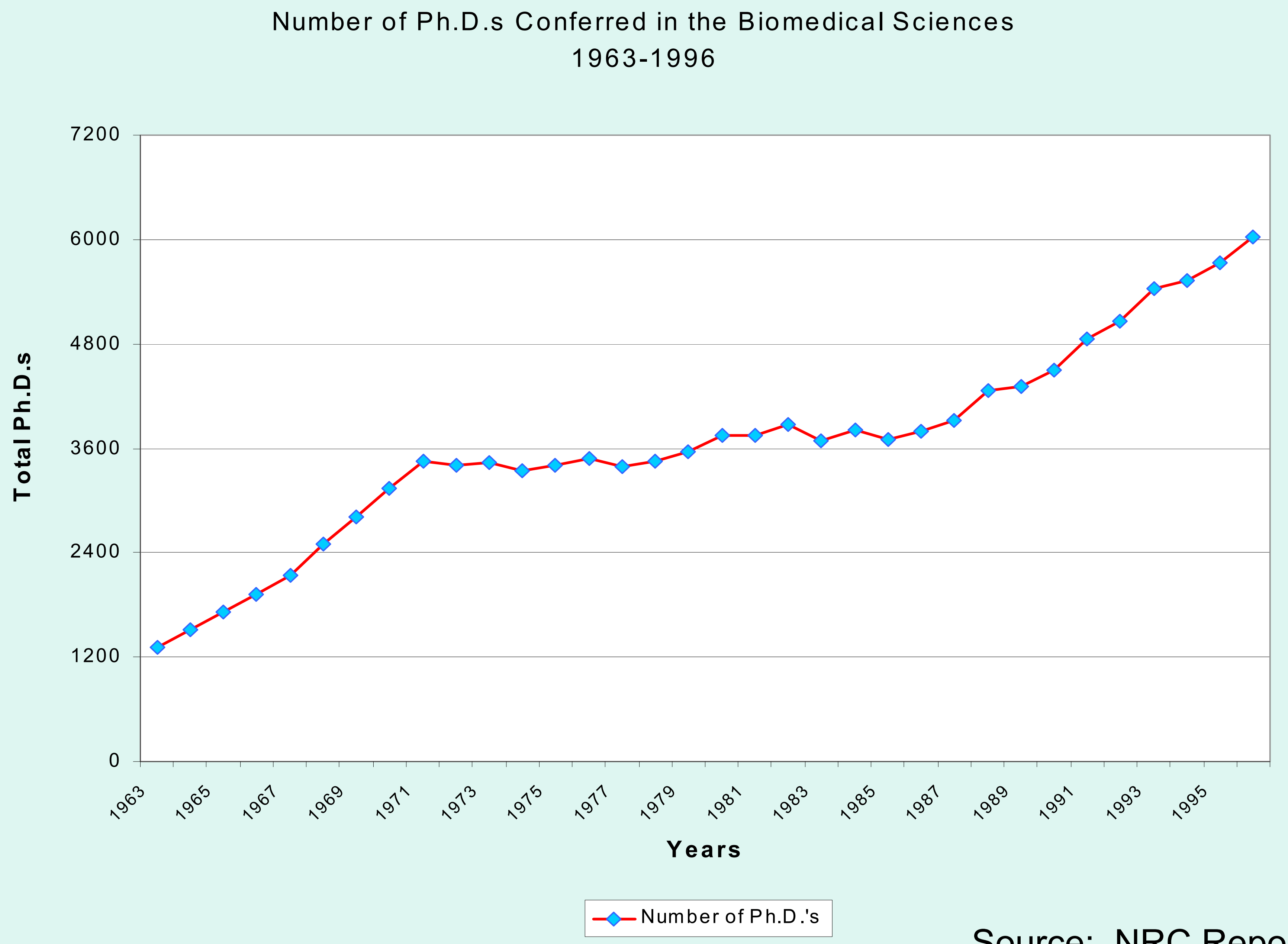
Situation in 1990s

- In 1996 NRC established a committee to study trends in the early careers of life scientists.
- Rationale for study was that production of PhDs had been growing but job market outcomes had not. Manifested by such indicators as
  - Increase in time to degree
  - Increase in number holding postdoc position and length of postdoc position
  - Decrease in probability of holding a tenure track position
  - Decline in NIH support for young investigators

NRC Committee

- Chaired by Shirley Tilghman, Currently President of Princeton

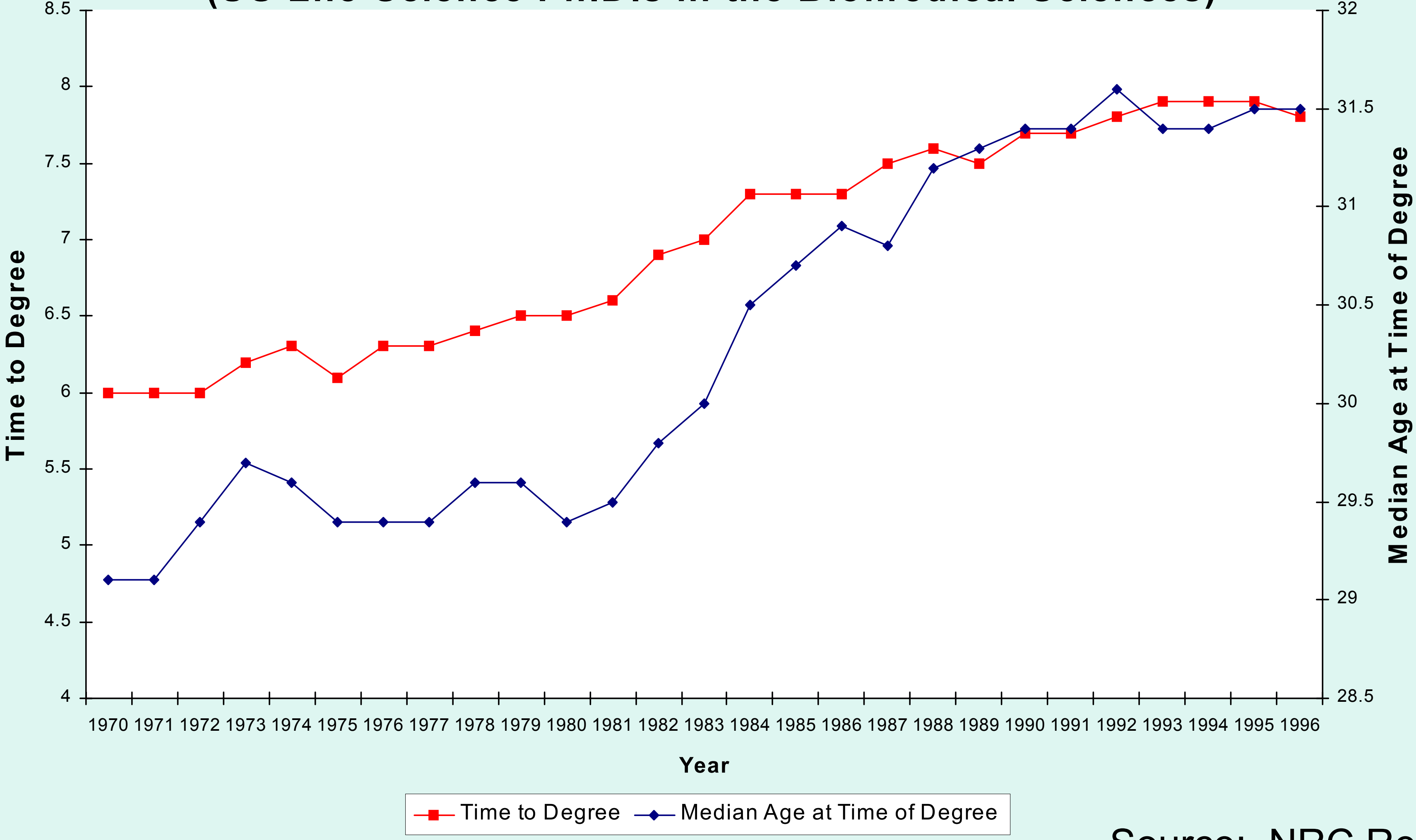




Source: NRC Report

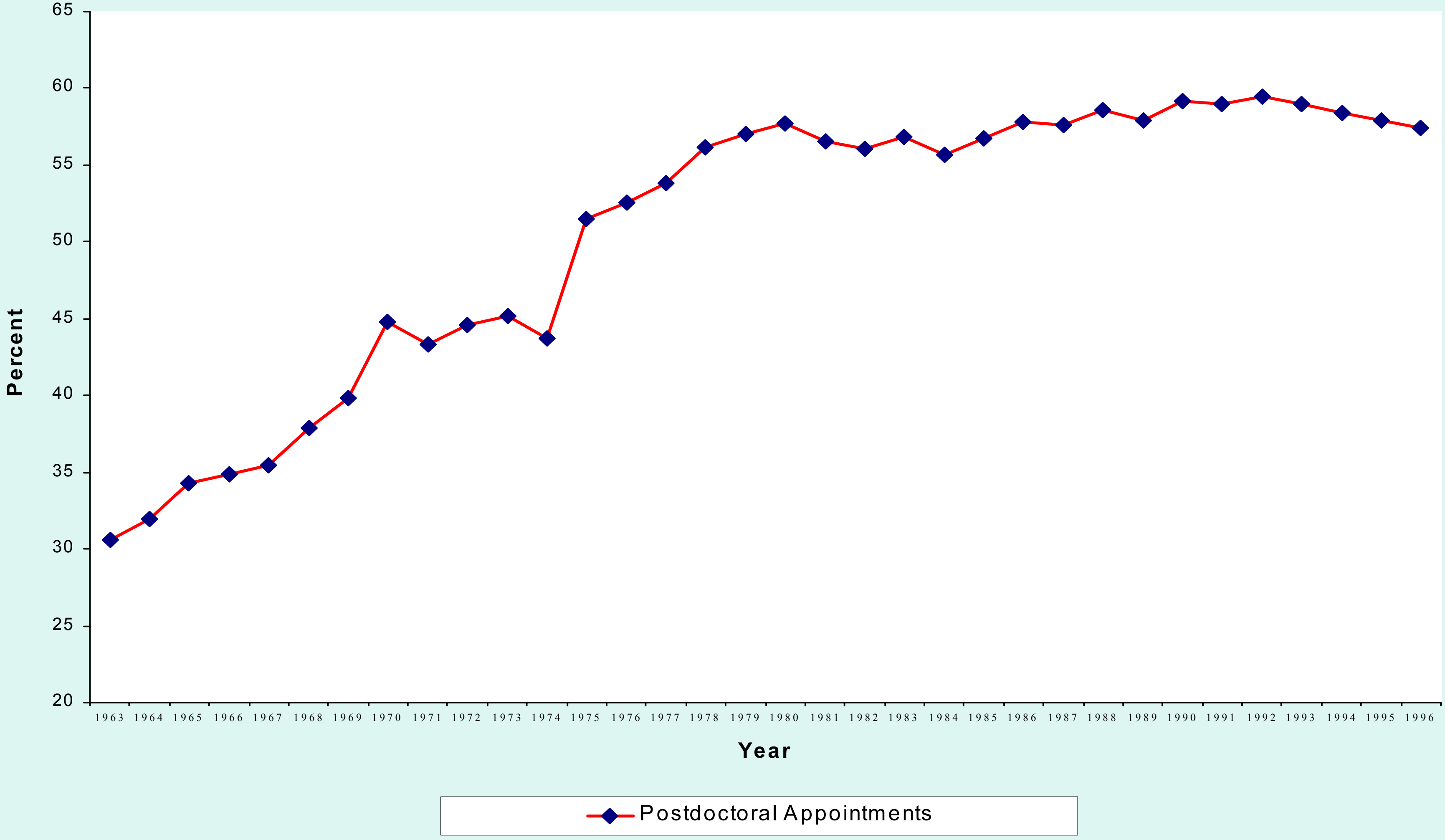
Median Time to Degree and Age at Degree

(US Life-Science Ph.D.s in the Biomedical Sciences)



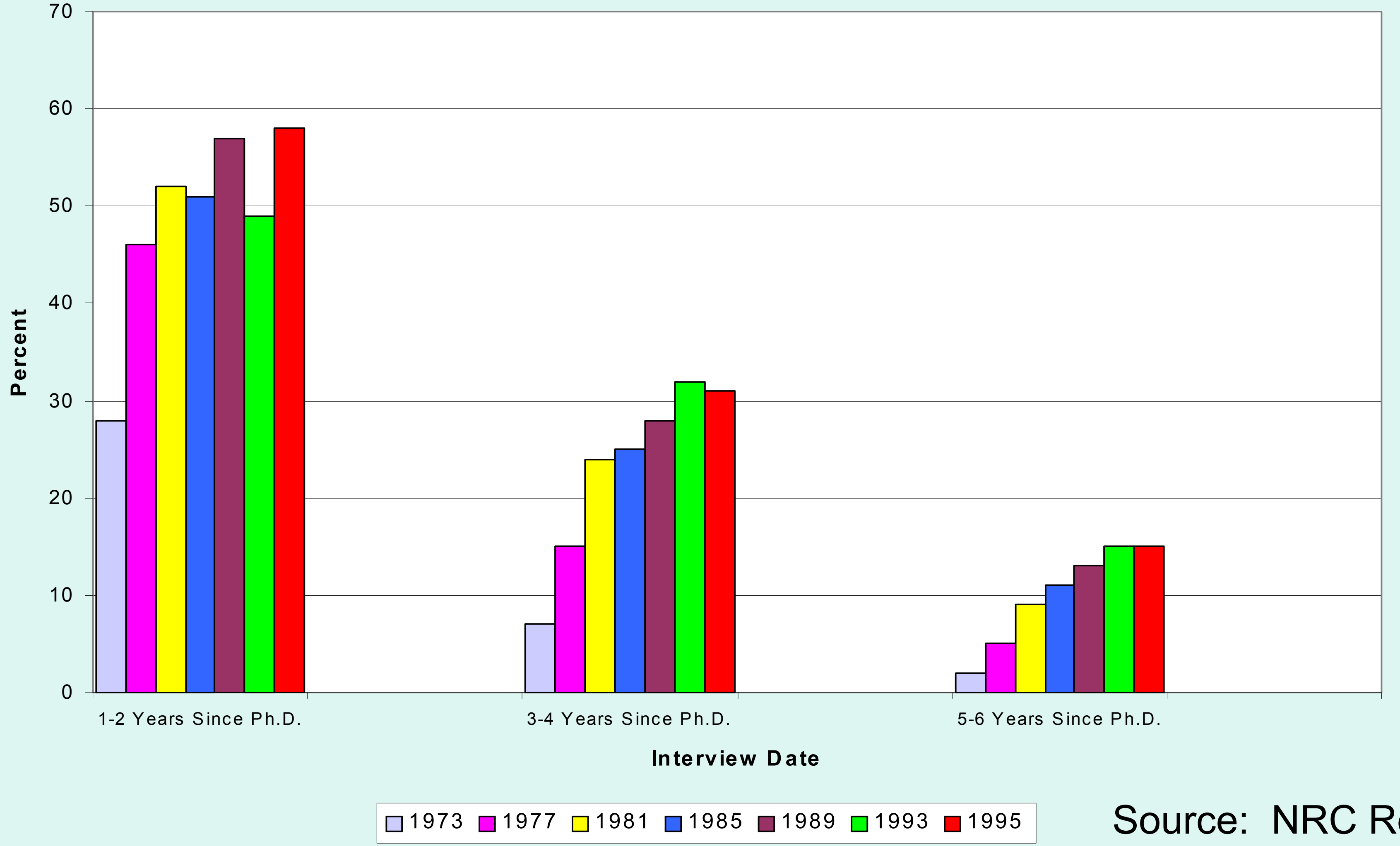
Source: NRC Report

Percent of US Life-Science Ph.D.s in the Biomedical Sciences Planning Post Doctoral Training Upon Graduation



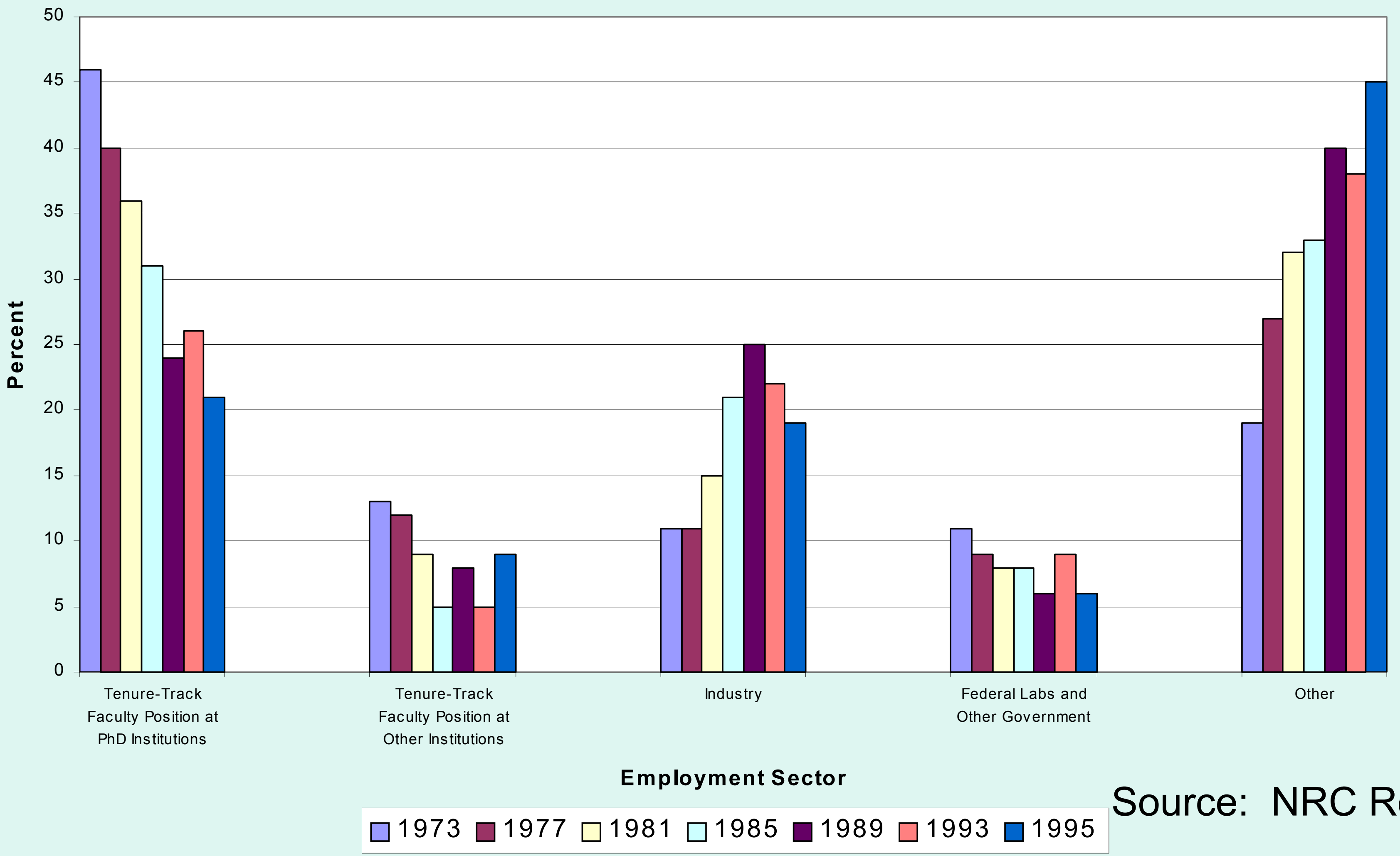
Source: NRC Report

Fraction of Biomedical Life Science Doctorates in Postdoctoral Appointments in Academe, Industry, and Government (1973-1995)



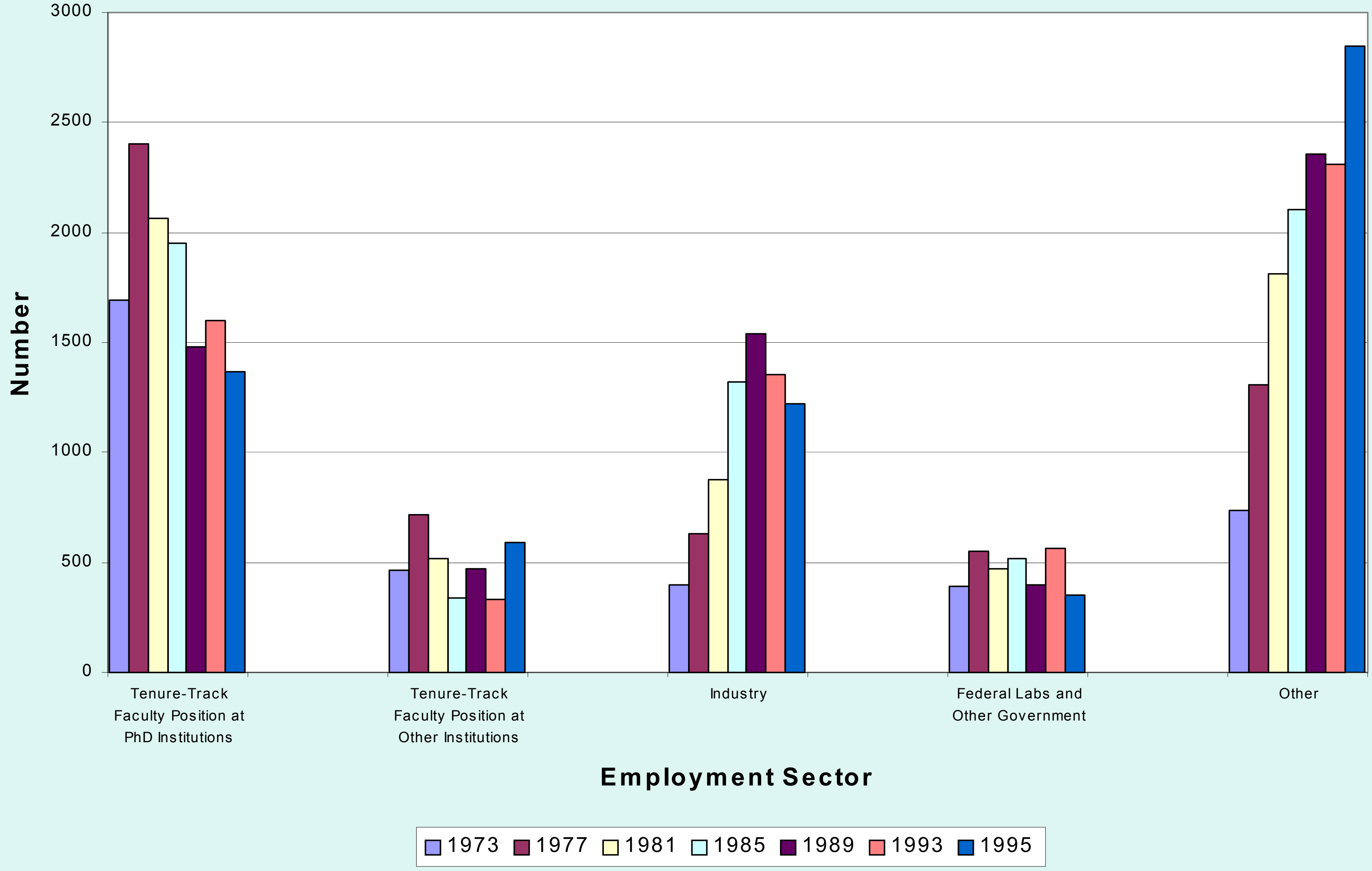
Source: NRC Report

Percent of Biomedical Life Science Ph.D.s in Selected Sectors (5-6 Years Since Degree)



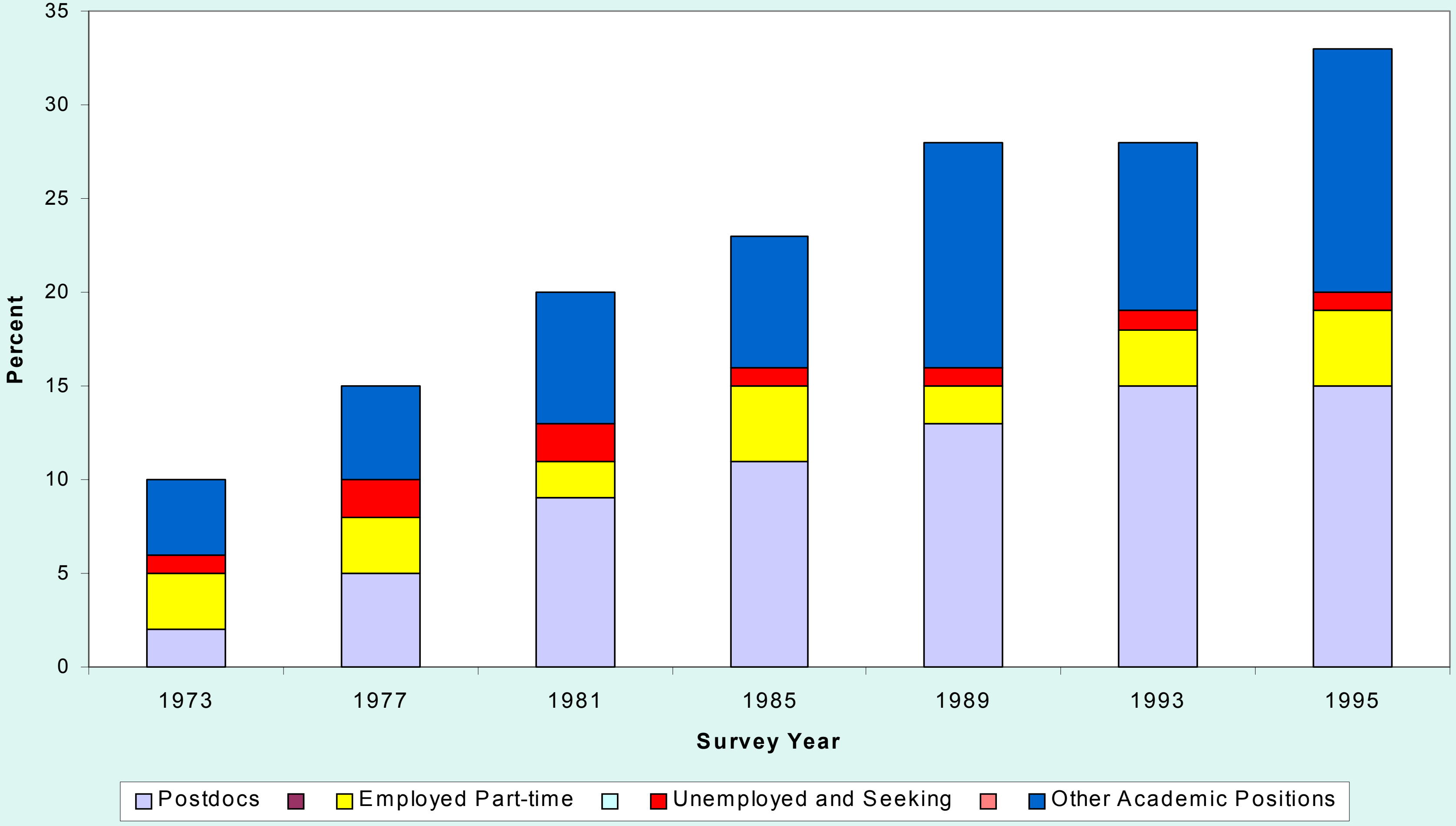
Source: NRC Report

Number of Biomedical Life Science Ph.D.s in Selected Sectors (5-6 Years Since Degree)

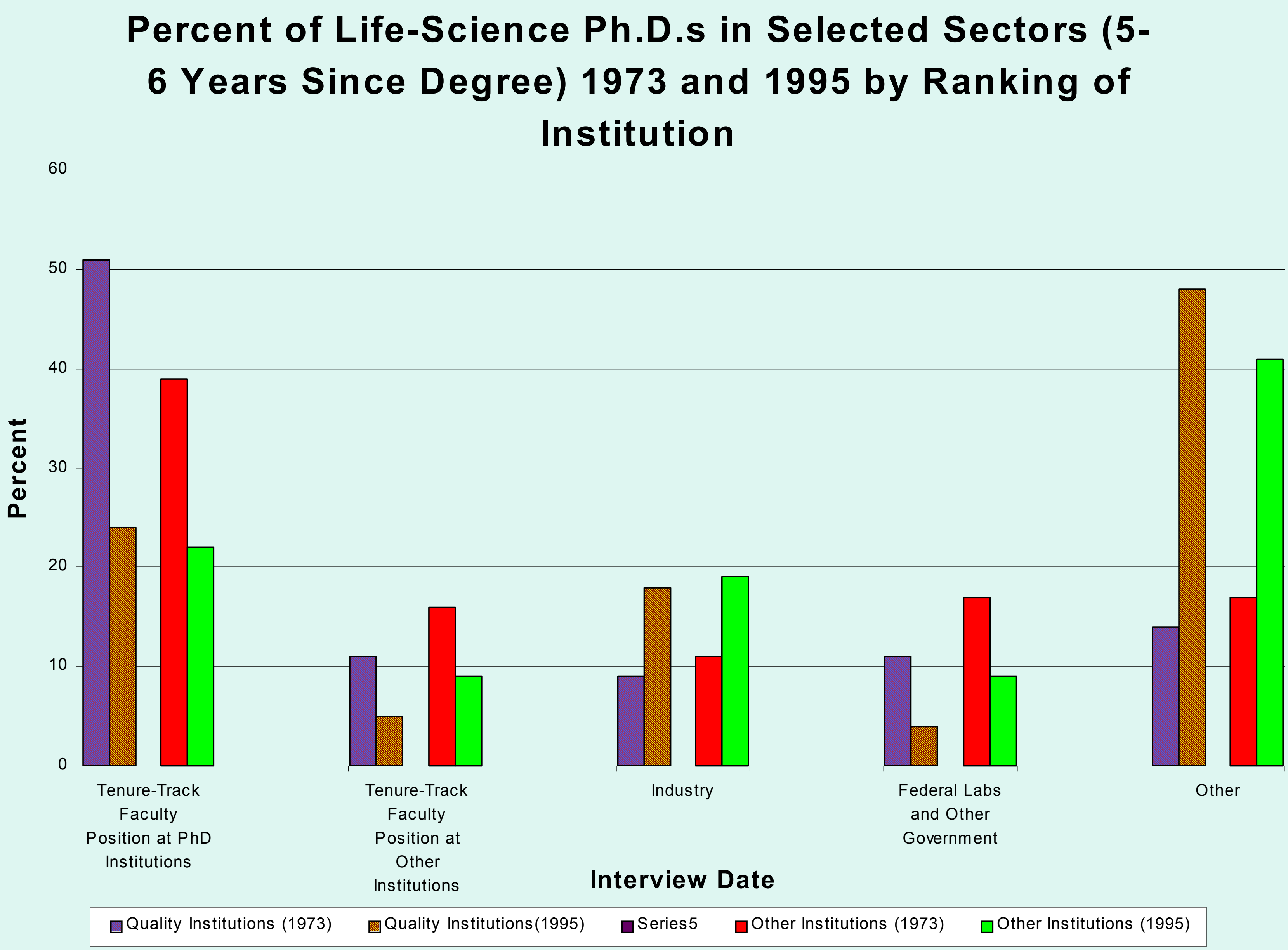


Source: NRC Report

Percent of Biomedical Life Science Ph.D.s in Part-time, Temporary Positions or Unemployed (5-6 Years Since Receipt of Ph.D.)



Data: NRC Report



Data: NRC Report

NIH Support For those 35 and Younger

- 1993 about 380 awards
- 1994 about 410 awards
- 1995 about 350 awards
- 1996 about 340 awards
- 1997 about 330 awards
- 1998 about 330 awards
- Average age at first independent award in 1980: 37; average age in 1990 39.5. Continued to rise during 1990s.

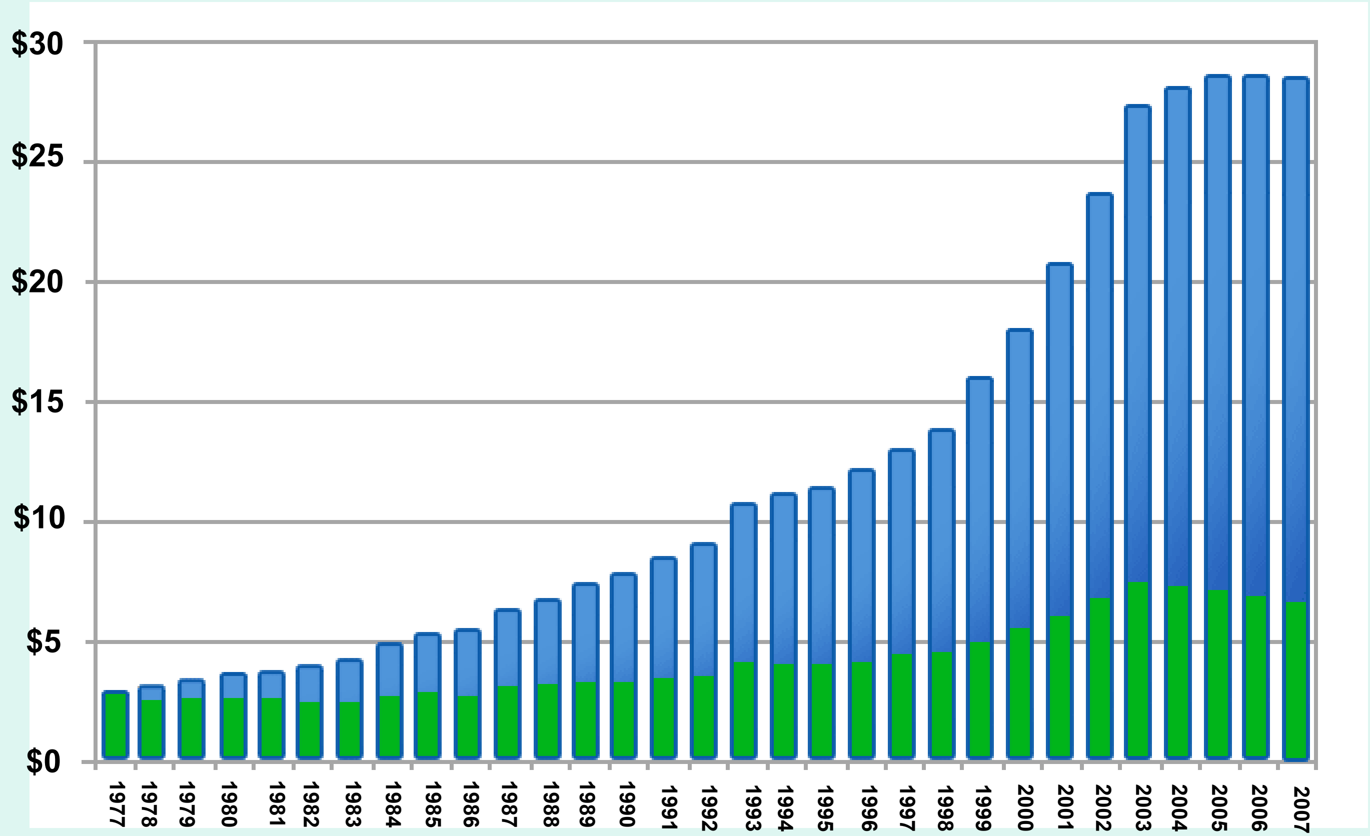
Summary of Recommendations of NRC Committee

- Restraint of the Rate of Growth of the Number of Graduate Students in the Life Sciences
- Dissemination of Accurate Information on the Career Prospects of Young Life Scientists
- Improvement of the Educational Experience of Graduate Students
- Enhancement of Opportunities for Independence of Postdoctoral Fellows
- Alternative Paths to Careers in the Life Sciences

Post Report Situation

- NIH budget doubled
- Number of PhDs residing in U.S. who trained in U.S. aged 35 or younger increased; postdocs trained outside the U.S. also increased.
- Hiring patterns of U.S. trained changed somewhat, with a lag
- See this by looking at NSF data and at AAMC Faculty Roster Data

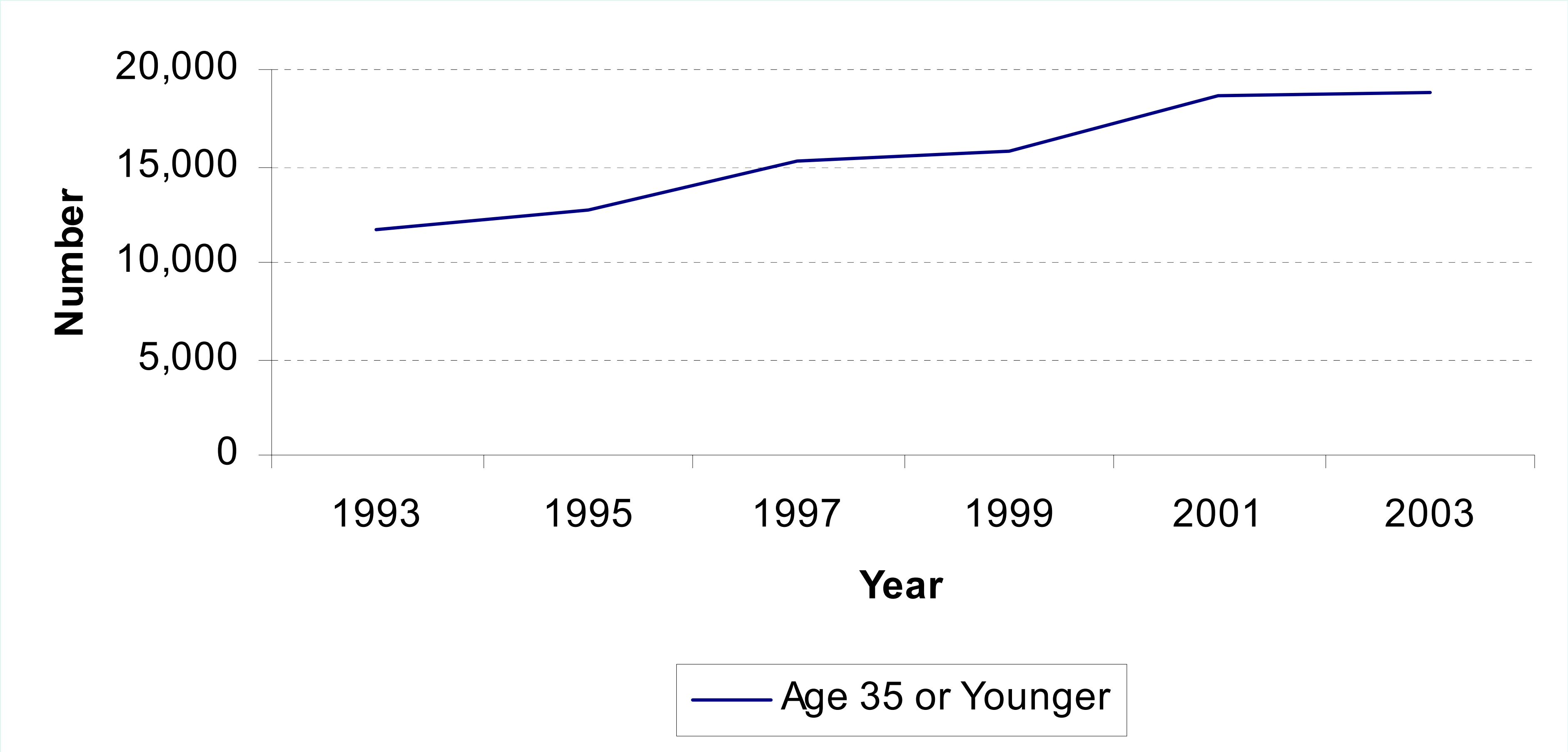
(Dollars in Billions)



Current Dollars Constant Dollars

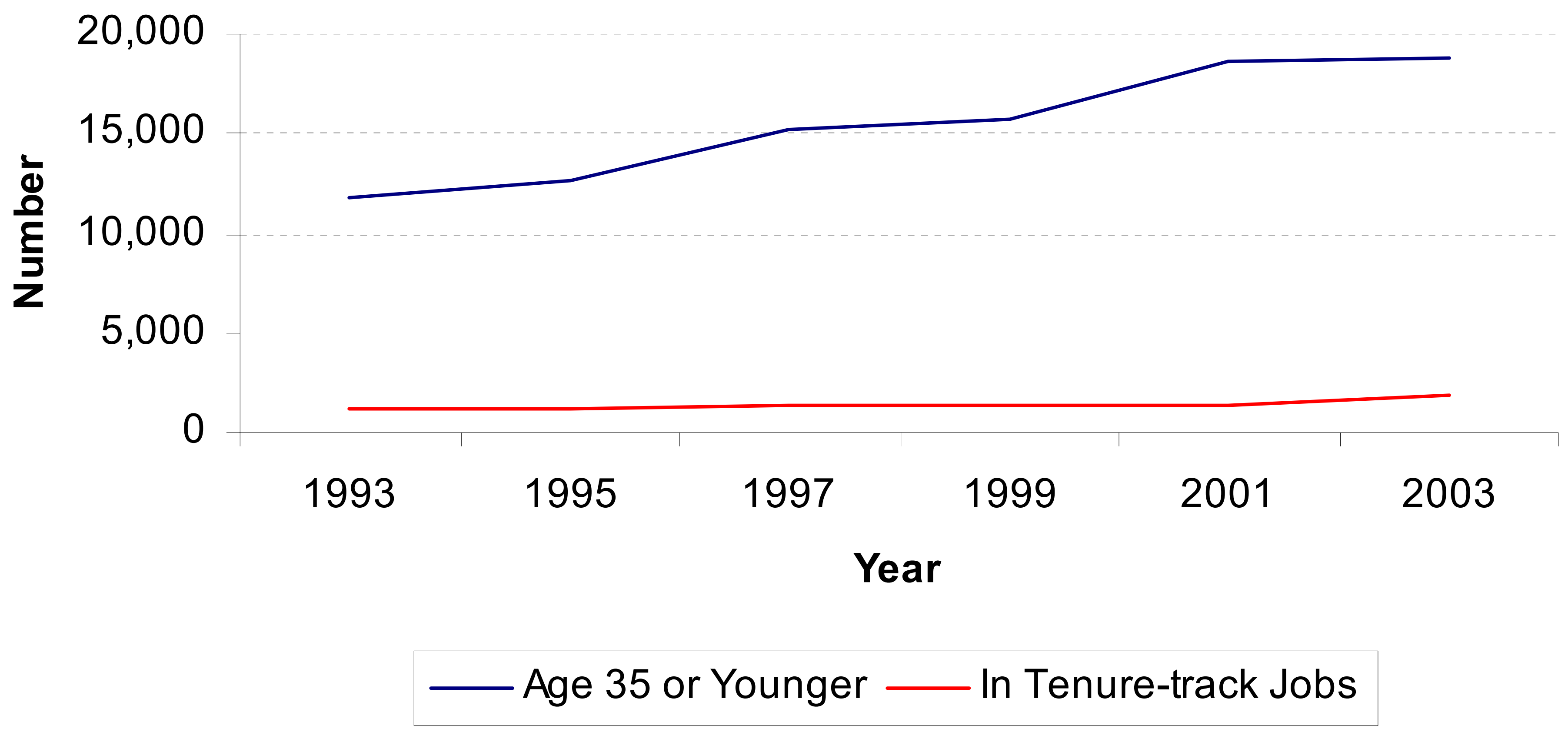
OER: NIH Budget over time

Biomedical PhDs Trained in U.S. Age 35 or Younger



Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.

Biomedical PhDs Trained in U.S. Age 35 or Younger

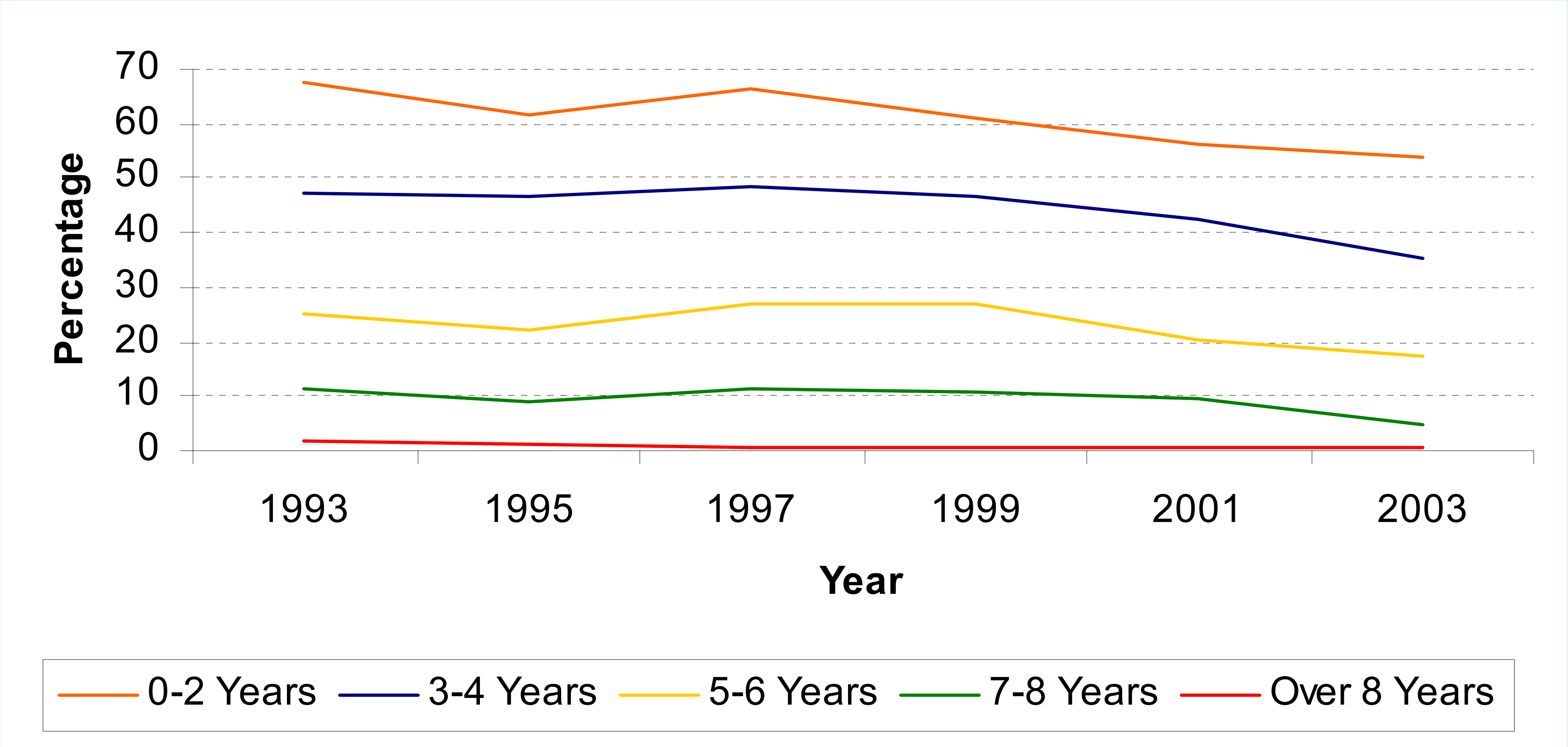


Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.

Conclude

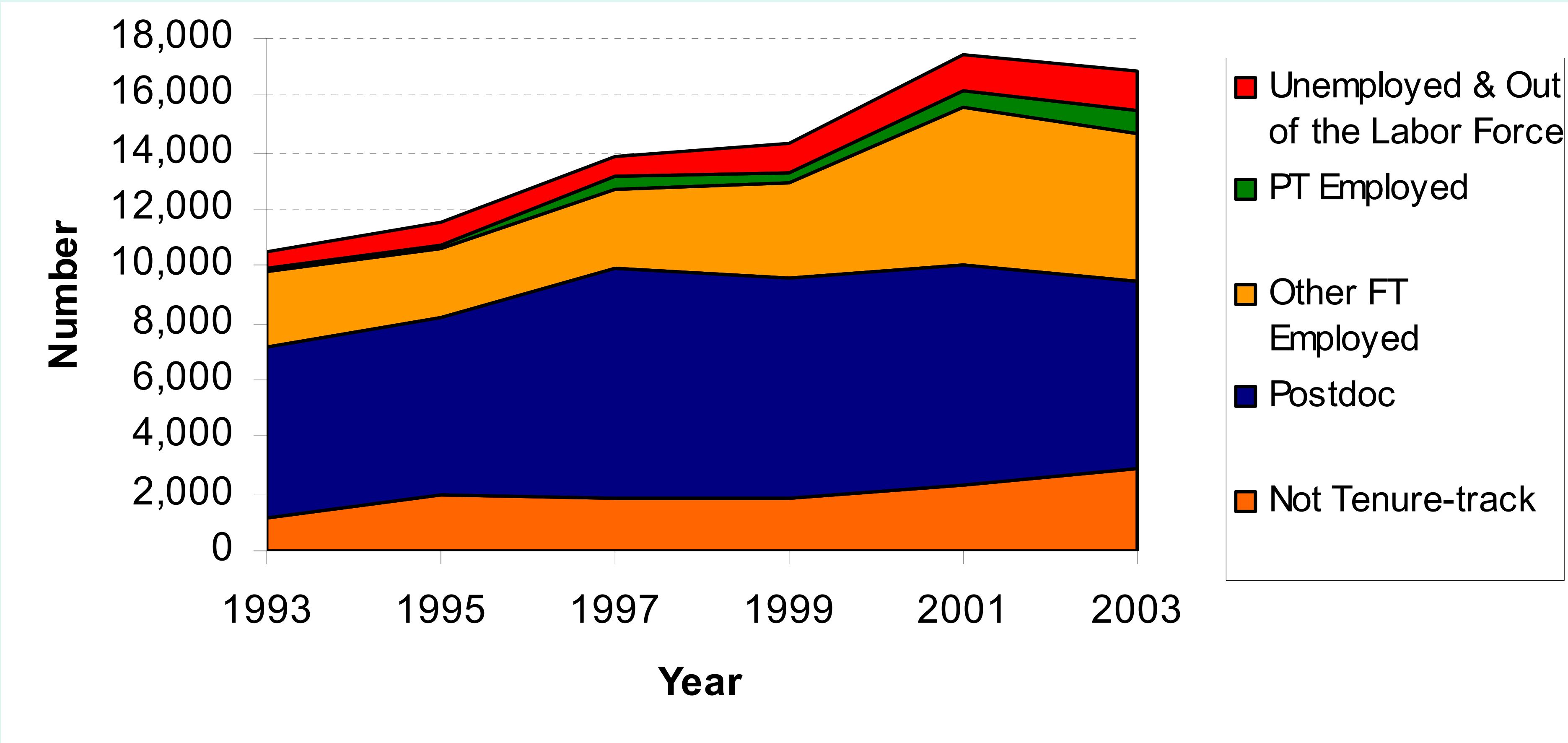
- *Number of tenure track positions occupied by those trained in the U.S. 35 and younger held constant at best until 2001; then grew somewhat towards end of NIH doubling.*
- *Probability that a young person trained in biomedical life sciences in U.S. holds a tenure track position is about the same in 2003 as it was in 1993 and improved between 2001 and 2003: 10.3 % to 10.4% (or from 6.9% in 2001).*
- Next slides show that
  - postdoc situation also improved;
  - non-tenure track positions grew during the period

Proportion of Biomedical PhDs Trained in U.S. in Postdoc Positions By Time Since Degree



Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.

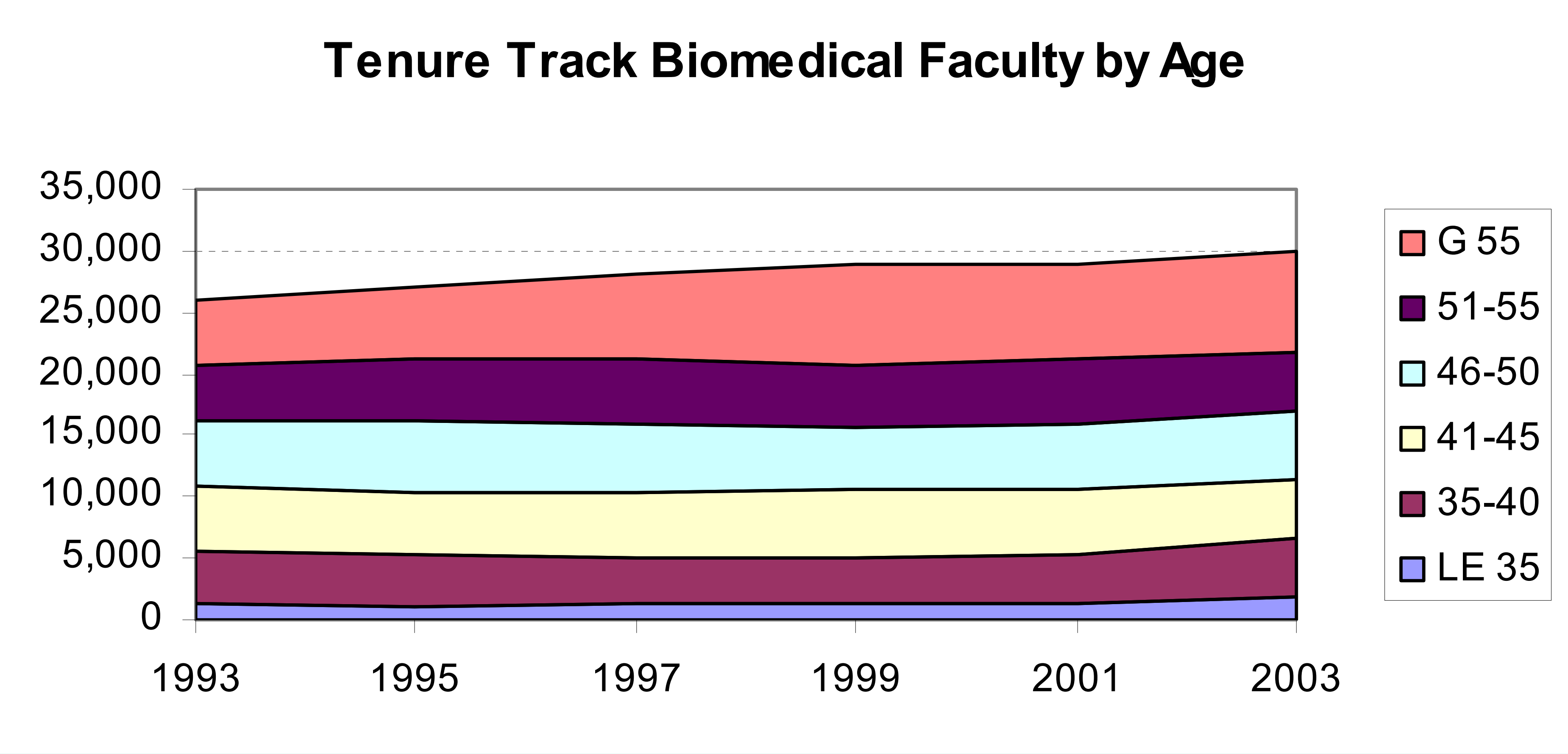
Labor Force Status of Biomedical PhDs Trained in U.S. Age 35 or Younger in Other than Tenure-Track Positions



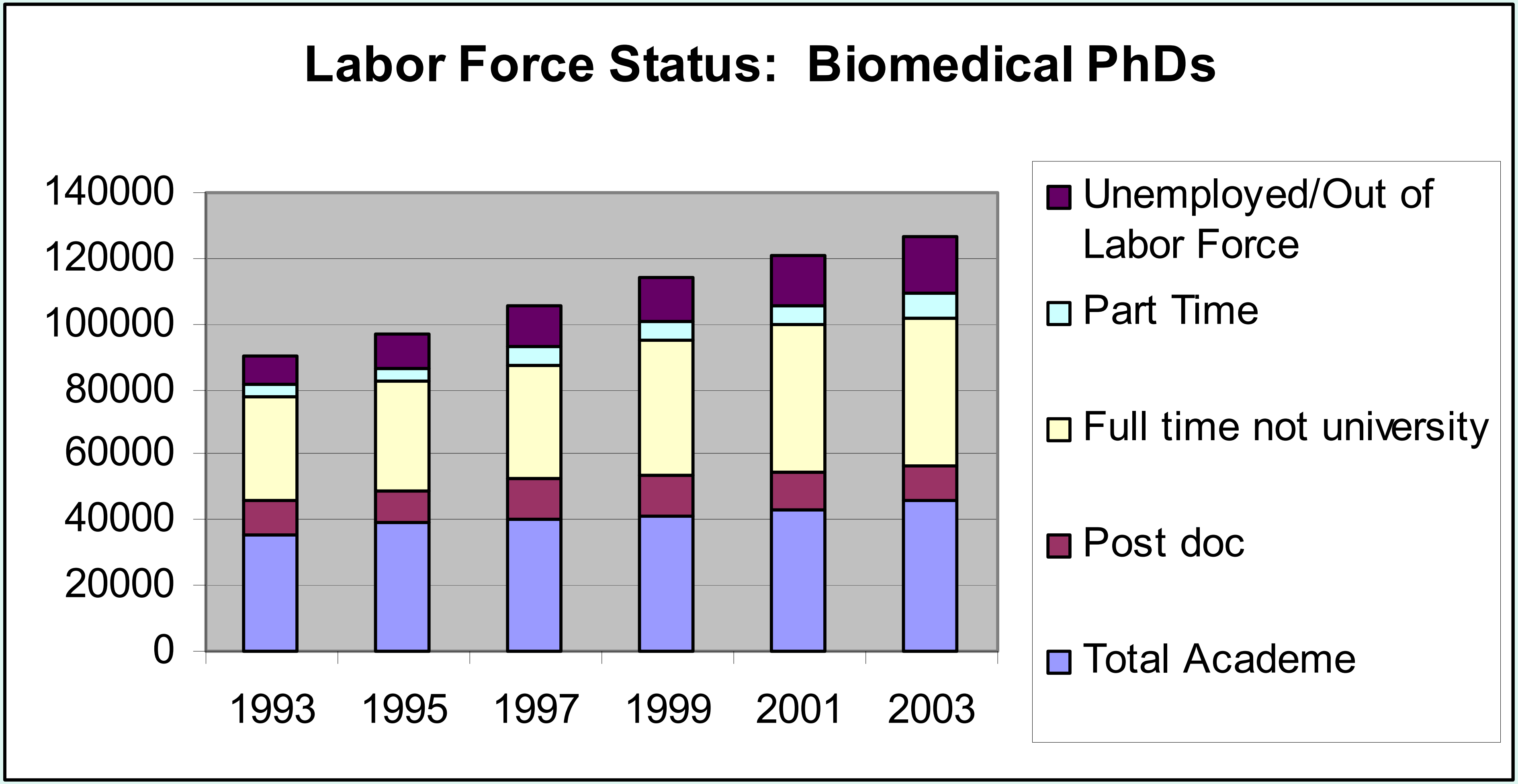
Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.

Labor Market Outcomes in the Biomedical Sciences Across Age Groups

- Tenure track by age
- Full-time employment by sector
- Tenure-track status in academe
- Labor force status

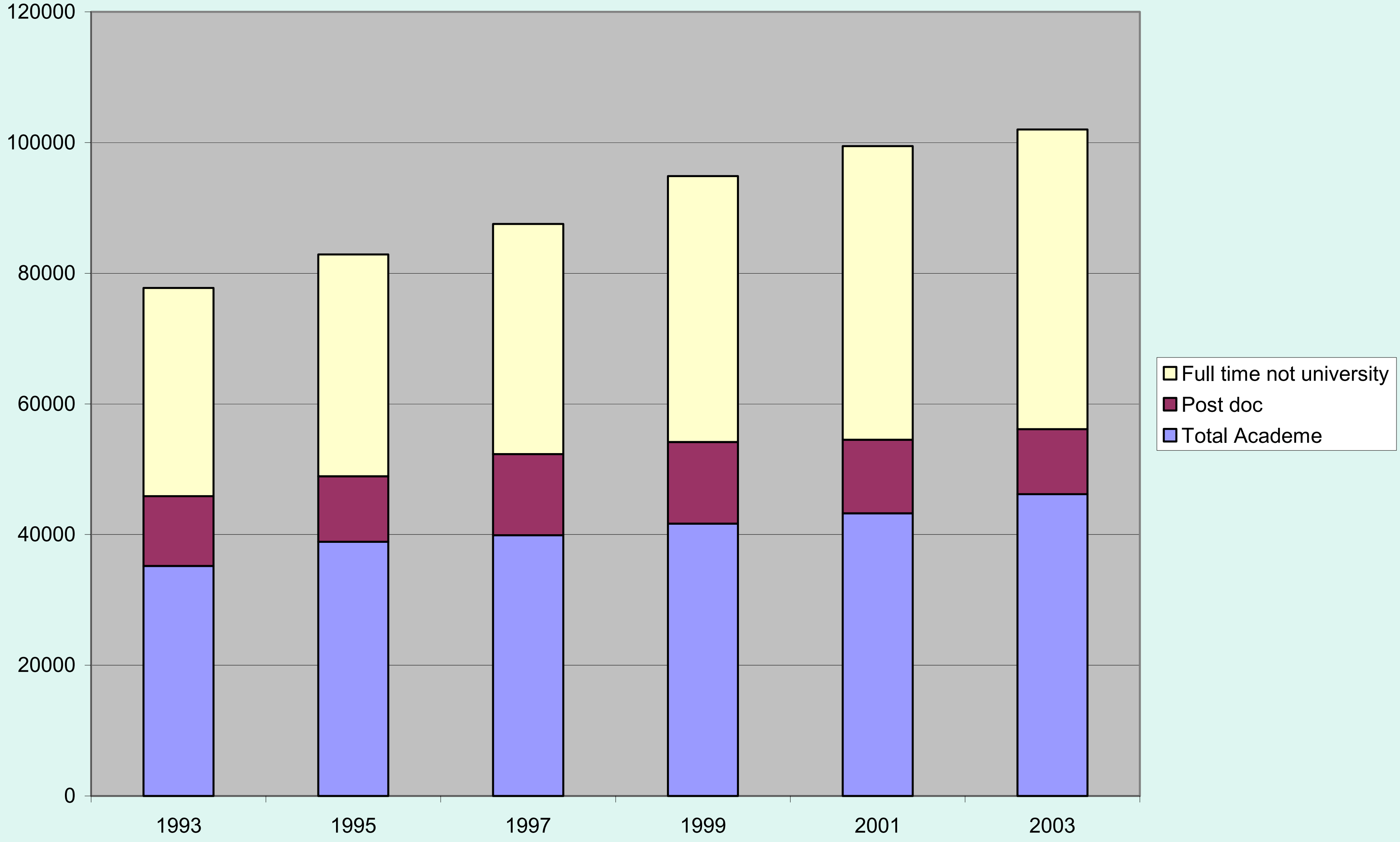


Tenure track status is for those trained in U.S. Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.



Labor force Status for those trained in the U.S. Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.

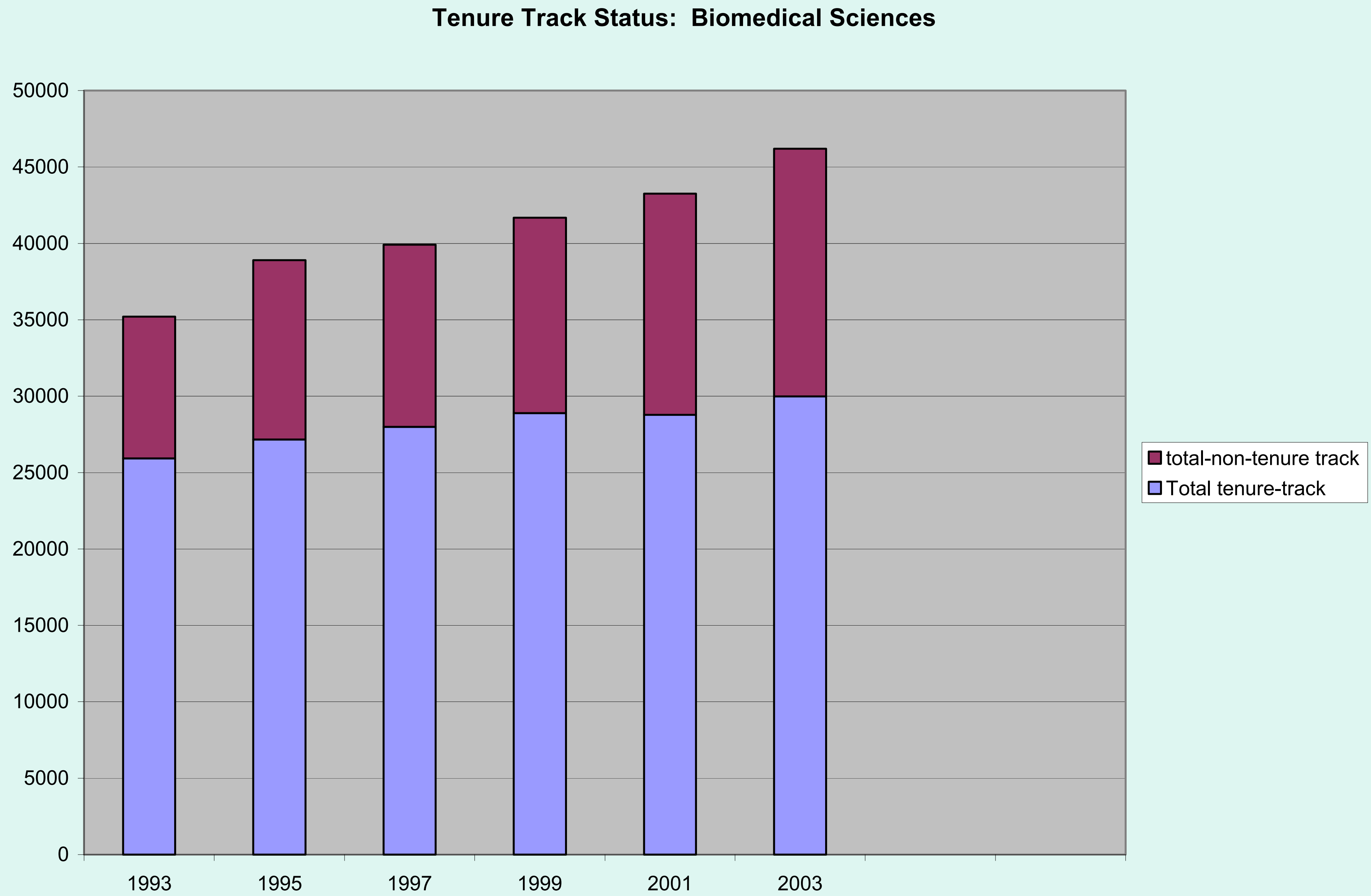
Full Time Positions by Sector: Biomedical Sciences



Slide shows positions for those trained in the U.S. Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.

Summary

- Growth in non-academic sector jobs has outpaced growth in academic sector jobs during the period for those trained in the United States.
- Growth in those unemployed or out of the labor force
- Decline in percent in post doc positions from 13.3% to 9.7%



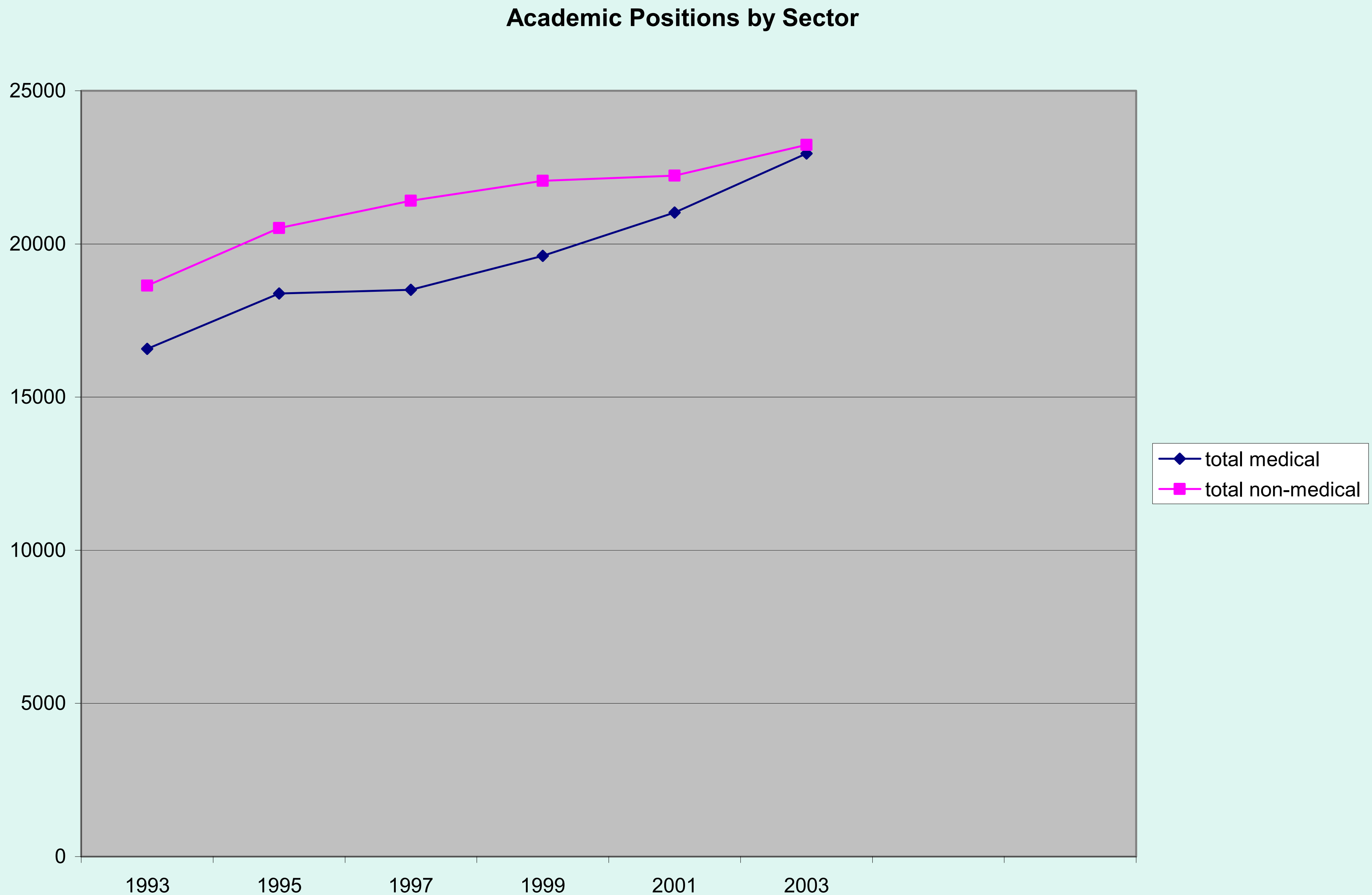
Slide shows tenure tract status for those trained in the United States. Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.

Summary

- Growth in academic positions for those trained in the United States during past 10 years of about 33%
- Growth is noticeable during NIH-doubling period
- Growth has been heavily concentrated in the non-tenure track positions
  - Non-tenure track has grown by over 70%
  - Tenure-track has grown by 20%

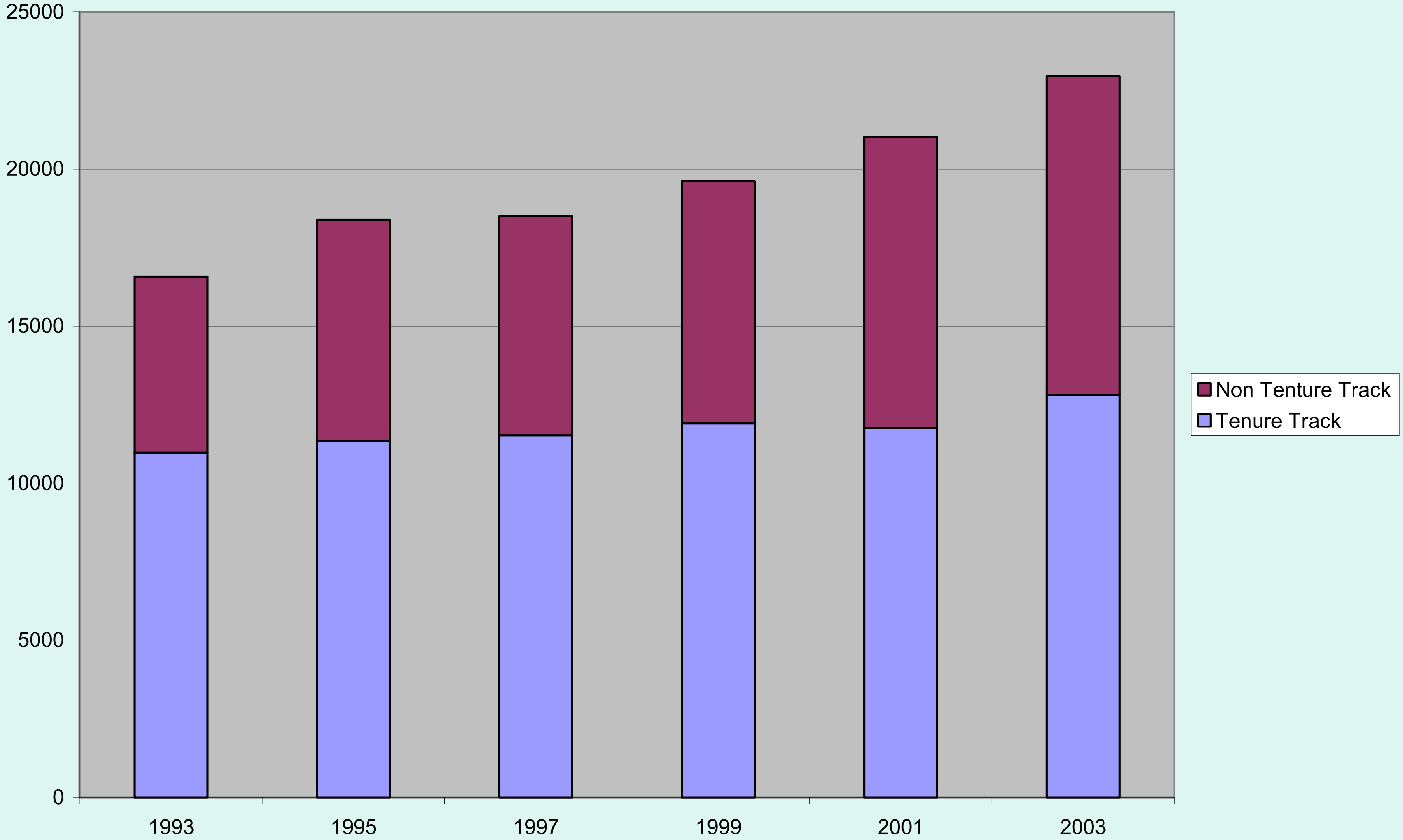
Medical Colleges vs. Non-medical Colleges

- Next slides show that
  - Growth has been in medical colleges
  - Especially among non-tenure track positions



Slide shows positions held by those trained in the United States. Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.

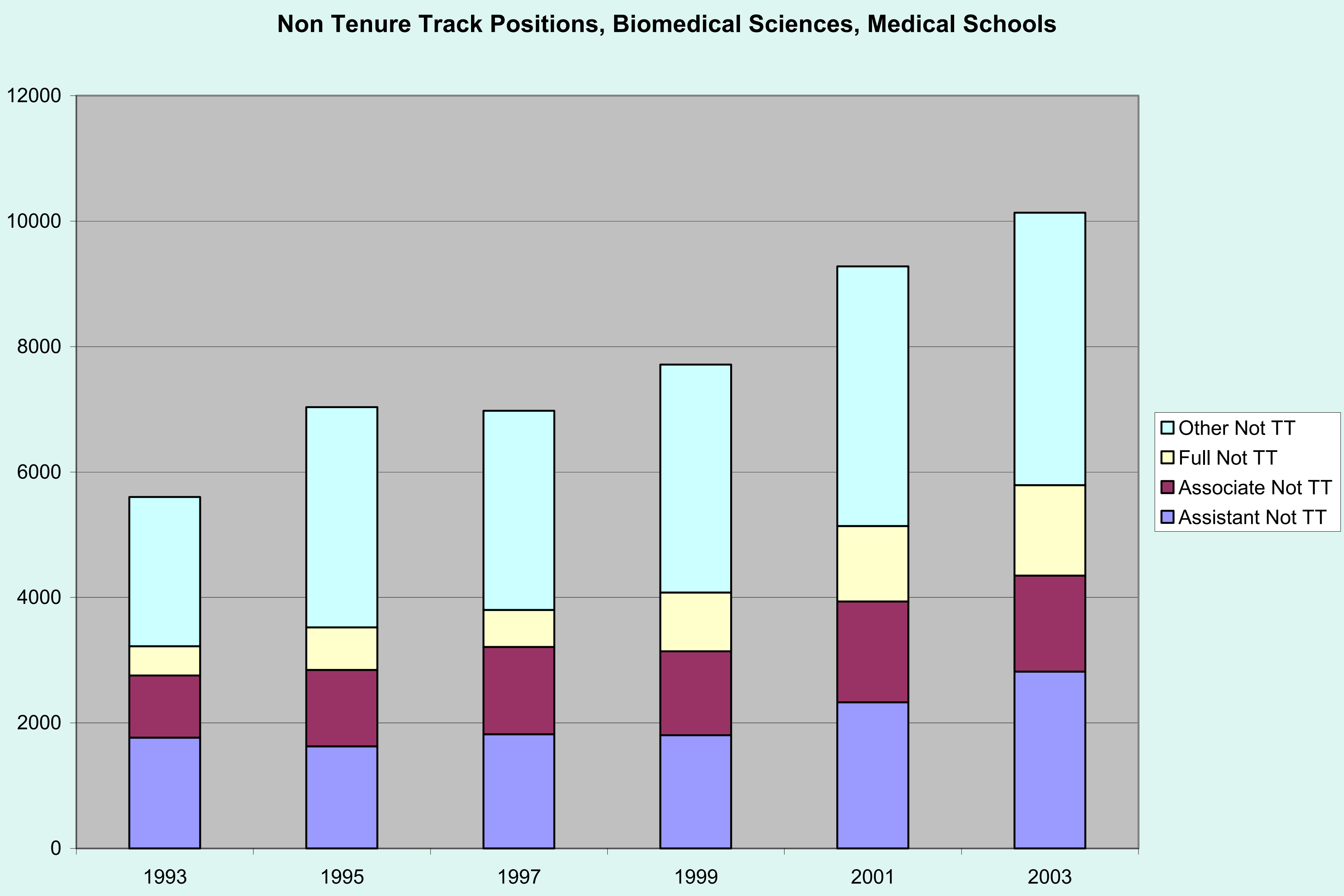
Medical Faulcy Positions by Tenure Track, Biomedical Sciences



Slide is for those trained in the U.S. Source: Survey of Doctorate Recipients, NSF. The use of NSF data does not imply NSF endorsement of the research methods or conclusions contained in this report.

Summary

- See growth in hiring of individuals trained in the U.S. among medical colleges during the decade relative to non-medical colleges
- Change in mix of tenure and tenure track
  - 33% of medical faculty were in non-tenure track positions in 1993;
  - 45% were in non-tenure track positions in 2003.
- Considerable growth in hiring at medical colleges during the NIH doubling period



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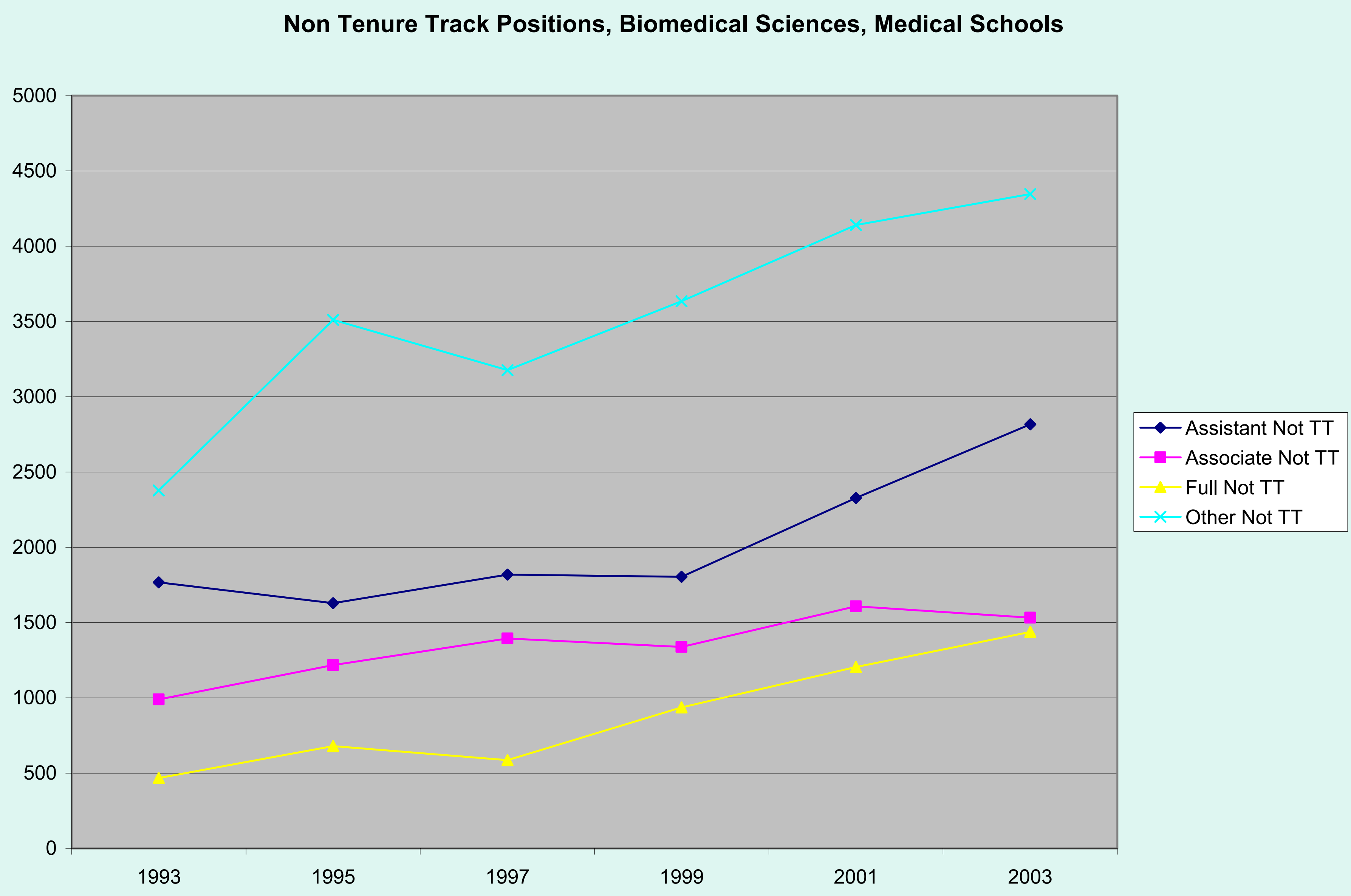

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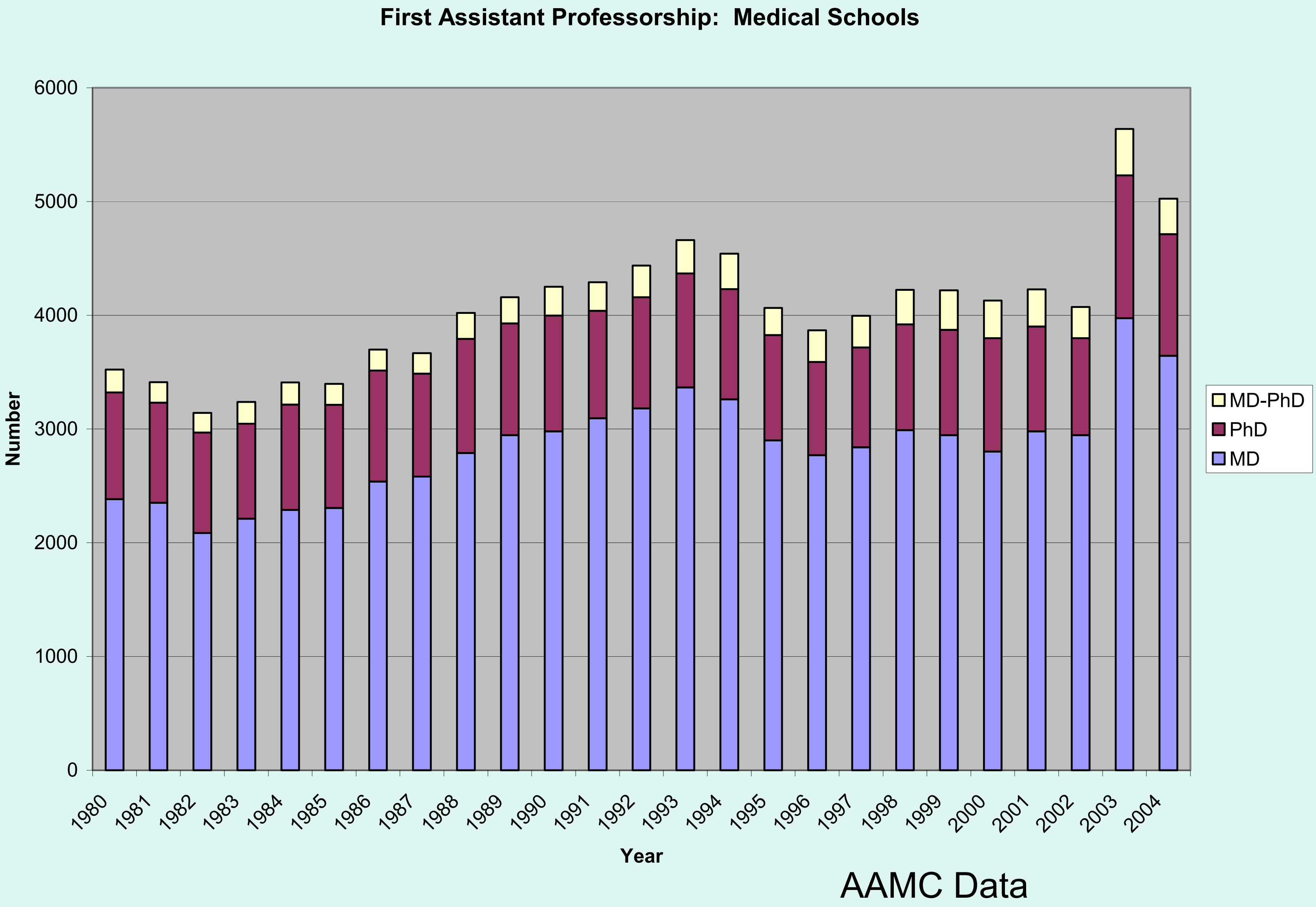
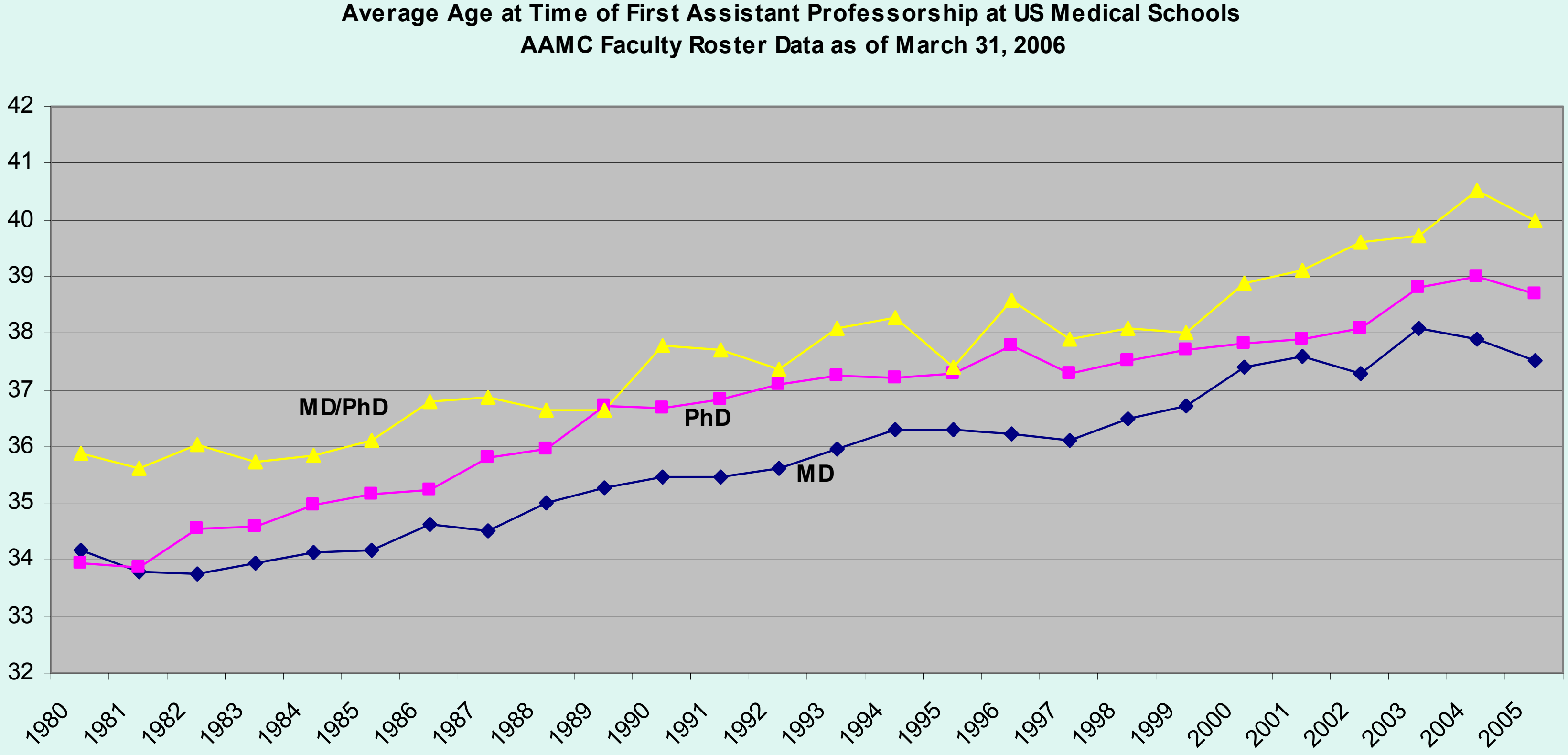
Other Data Indicators

- AAMC Faculty Roster Data
- Bricks and Mortar


First Assistant Professorship: Medical Schools
6000
5000
4000
3000
2000
1000
0
Number
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year
MD-PhD
PhD
MD
AAMC Data



Average Age at Time of First Assistant Professorship at US Medical Schools
AAMC Faculty Roster Data as of March 31, 2006
42
41
40
39
38
37
36
35
34
33
32
MD/PhD
PhD
MD
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
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1998
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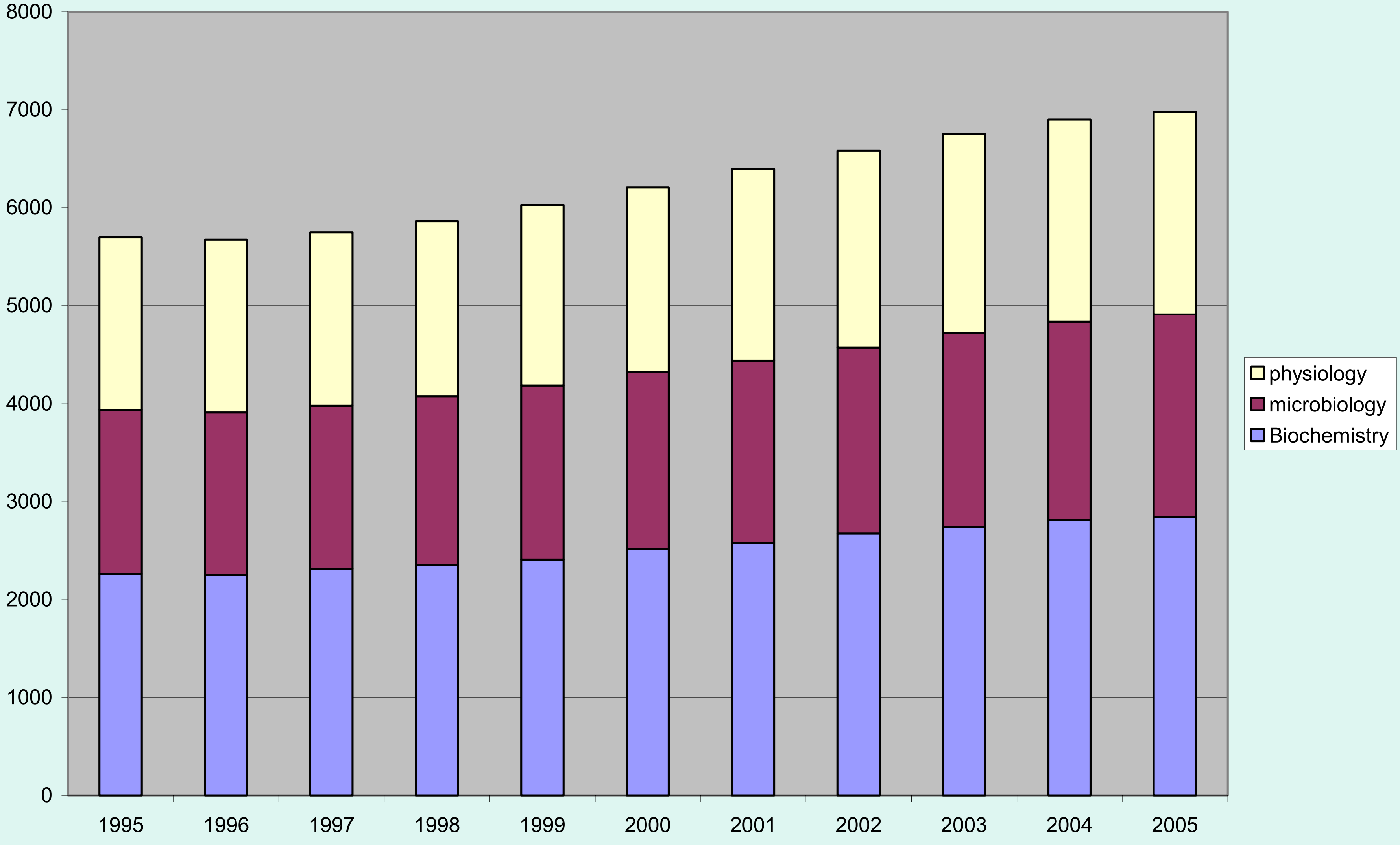
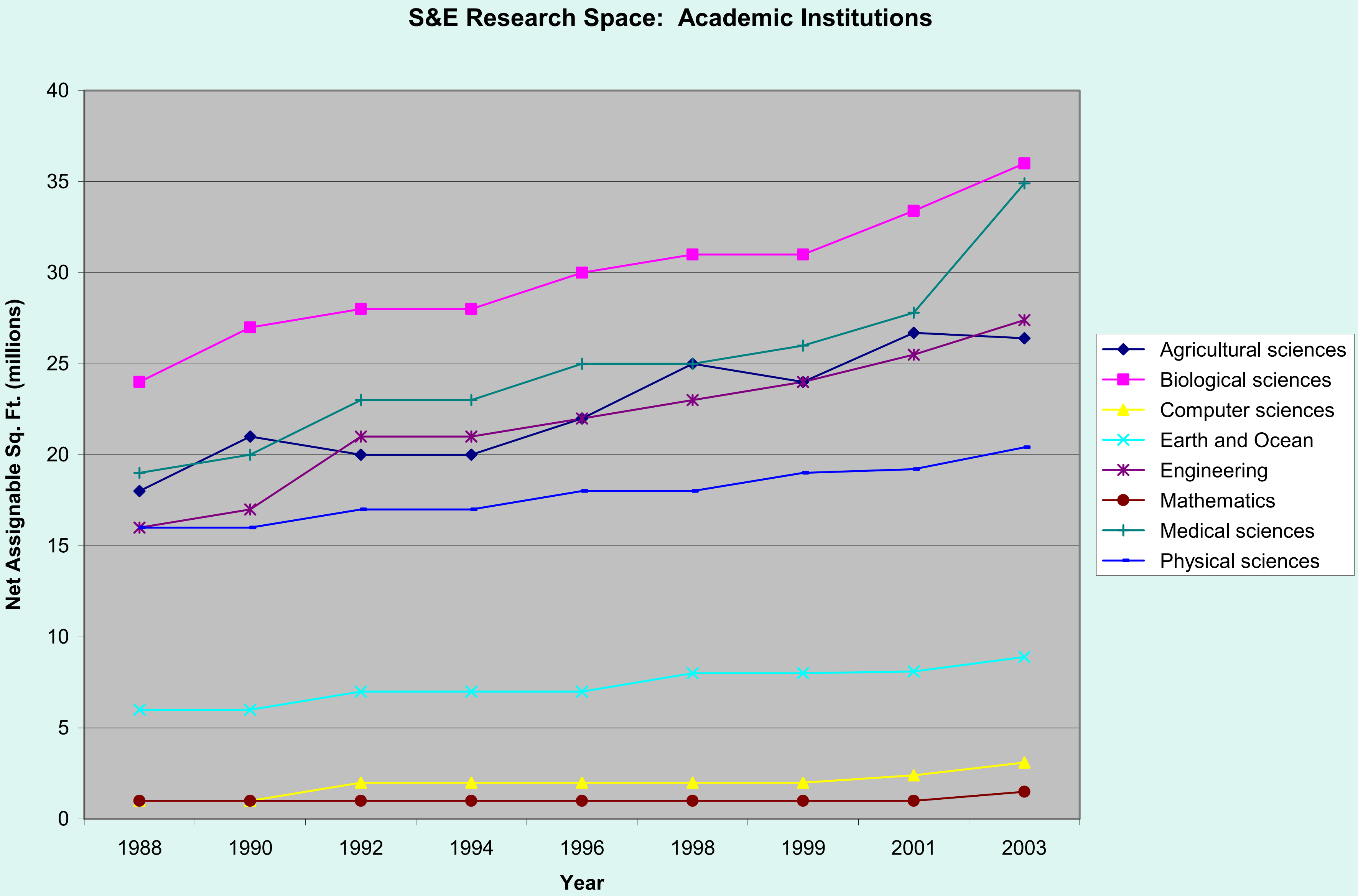
2001
2002
2003
2004
2005

AAMC Data

Faculty Medical Schools: Basic Sciences



AAMC Data



S&E Research Space: Academic Institutions
Net Assignable Sq. Ft. (millions)
0
5
10
15
20
25
30
35
40
1988
1990
1992
1994
1996
1998
1999
2001
2003
Year
Agricultural sciences
Biological sciences
Computer sciences
Earth and Ocean
Engineering
Mathematics
Medical sciences
Physical sciences

New Construction

- NSF reports greatest number of institutions began construction in fields of biological and medical sciences in FY2002 or FY2003.
- 56% of newly constructed space to be used for these 2 fields

Appears to be good news for early career biomedical scientists

- Age of first assistantship fell for first time in 2003
- Jobs on an increase (or were). But SDR data is already out of date
- The pickup was relatively modest for the young. Even in the best of times fewer than one-in seven of young biomedical PhDs have an academic appointment (tenure-track or non-tenure track).
- Hiring was concentrated in non-tenure track positions.
- The pickup that occurred was fueled in part by new buildings coming on line which in turn were fueled by NIH budget growth. Lagged the doubling.
- But…

Jobs come with high expectations

- Faculty expected to generate grants
- Not new, but more and more frequently this is a condition of employment. Three years to cover salary.
- Many tenure-track positions paid out of soft-money
- Not one grant or two grants but three became expectation at many research institutions
- Not surprising that
  - Number of NIH applications on increase
  - Many established investigators increased their number of grants and size of their labs.

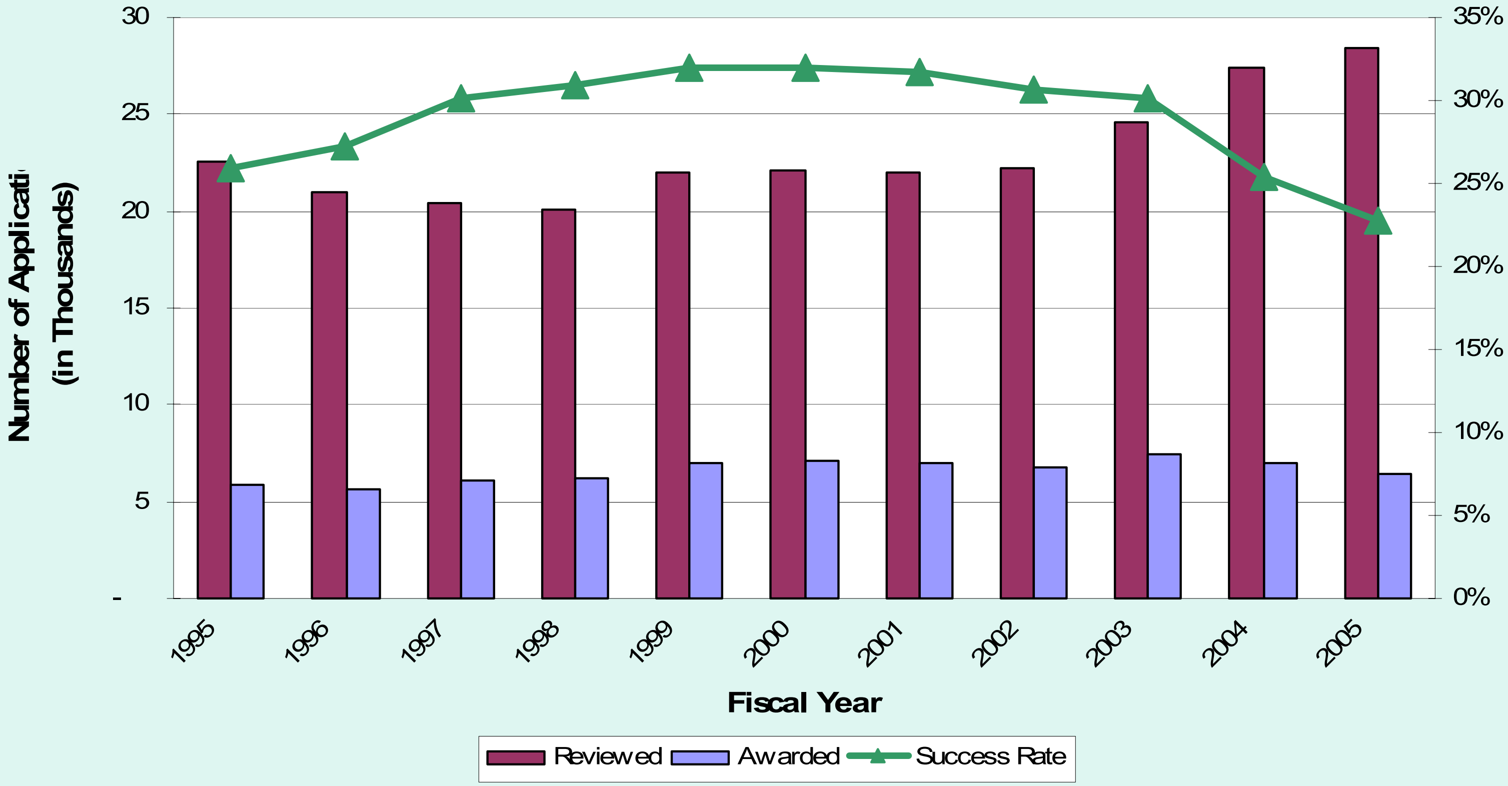
NIH Situation

- Budgets have been flat, growing at less than inflation. From $27.2 billion in 2003 to $28.7 in 2006.
- Costs of grants are rising
- Results in more grant applications chasing constant to declining pool of resources
- Translates into lower success rates
- Most applications come from individuals who already have grants.
- New investigator pool is on decline after peeking in 2003.

NIH Primer

- R01 is basic grant for independent research; in earlier years R29 existed as the "first" independent award for new investigators. Duration of three to five years.
- Type 1 is a new application
- Type 2 is a continuing application
- Type 1's can be from "new" investigators who have never been funded or from established investigators
- Review process: triage—group that is not scored; possible to submit up to two amendments; can resubmit even if not scored.
- Important to distinguish between applicants and applications

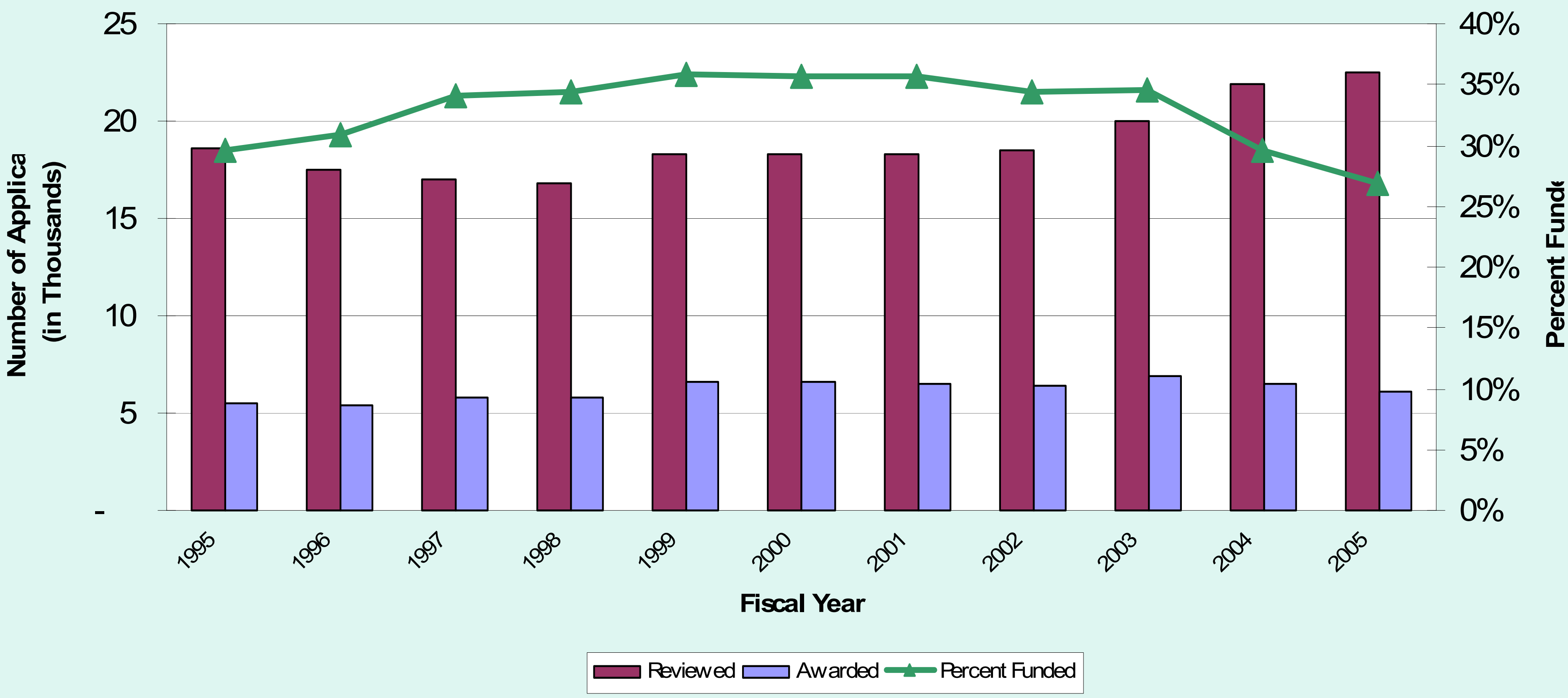
Number of NIH Competing R01 Equivalent* Applications, Awards and Percent Funded (Success Rate)



NIH, OER: "Investment…"

R01 Equivalent* Includes R01, R23, R29 and R37

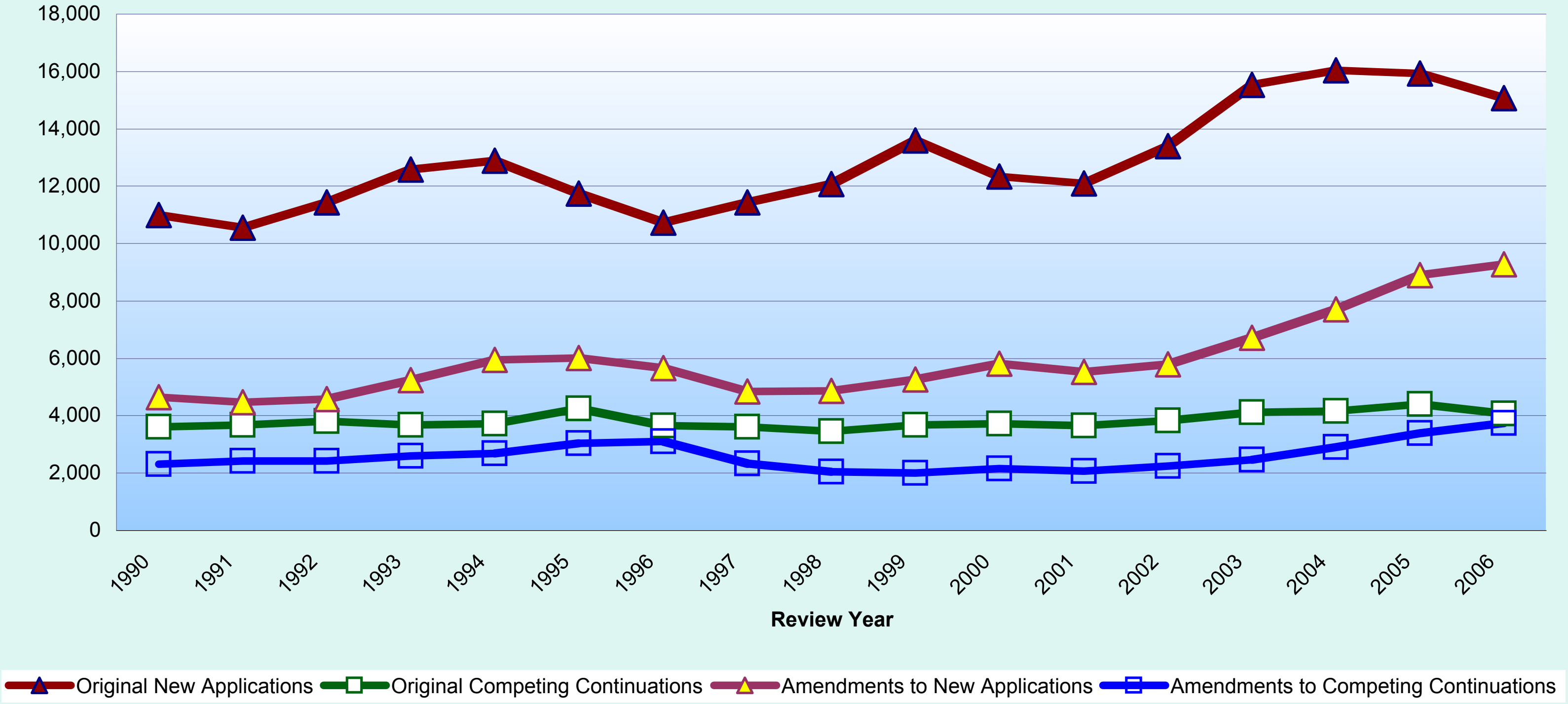
Number of NIH Competing R01 Equivalent* Applicants Reviewed, Awarded, and Percent Funded (Success Rate)



R01 Equivalent* Includes R01, R23, R29 and R37

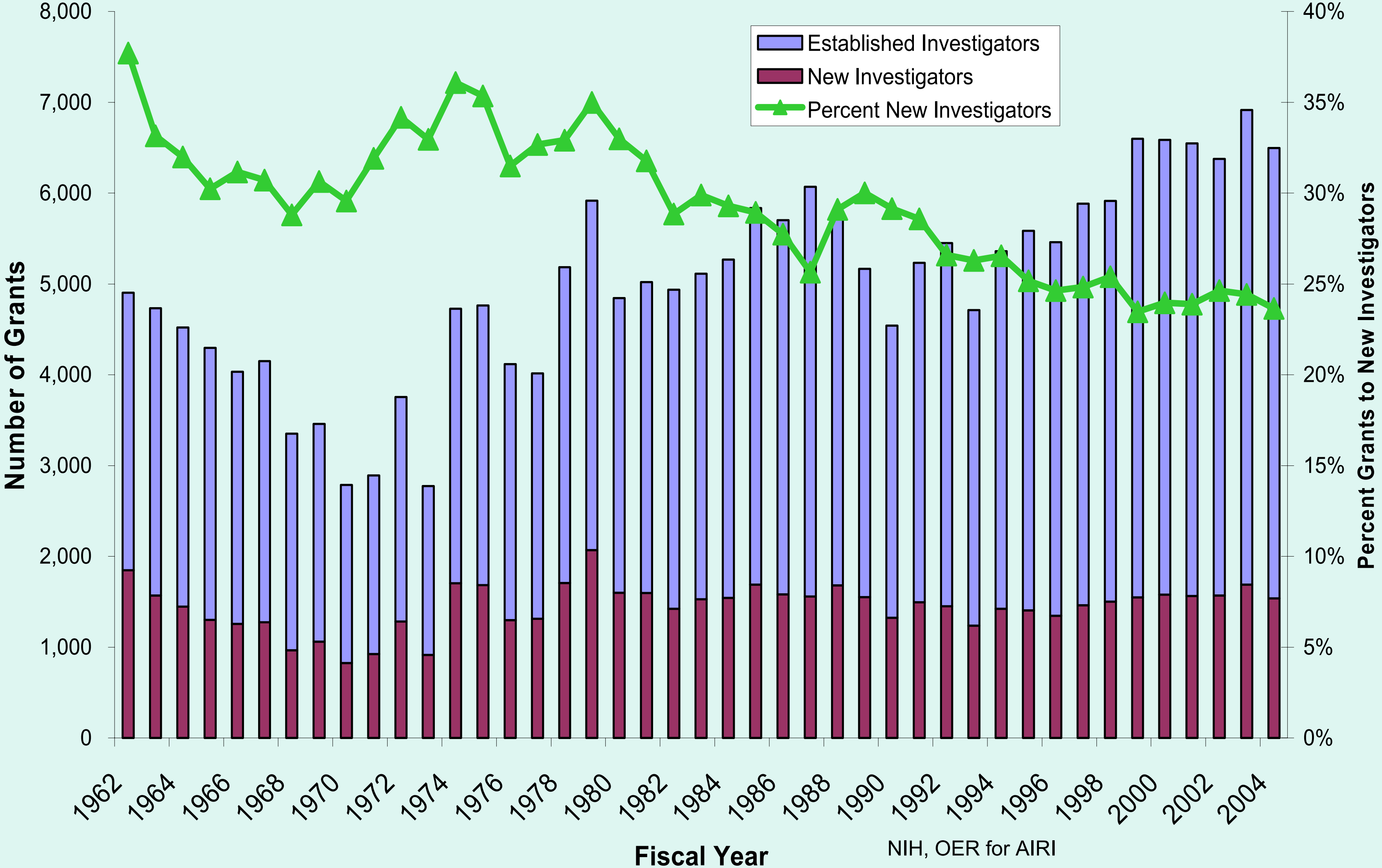
NIH, OER: “Investment…”

NIH Competing R01 Applications by Year of Review



NIH, OER for AIRI

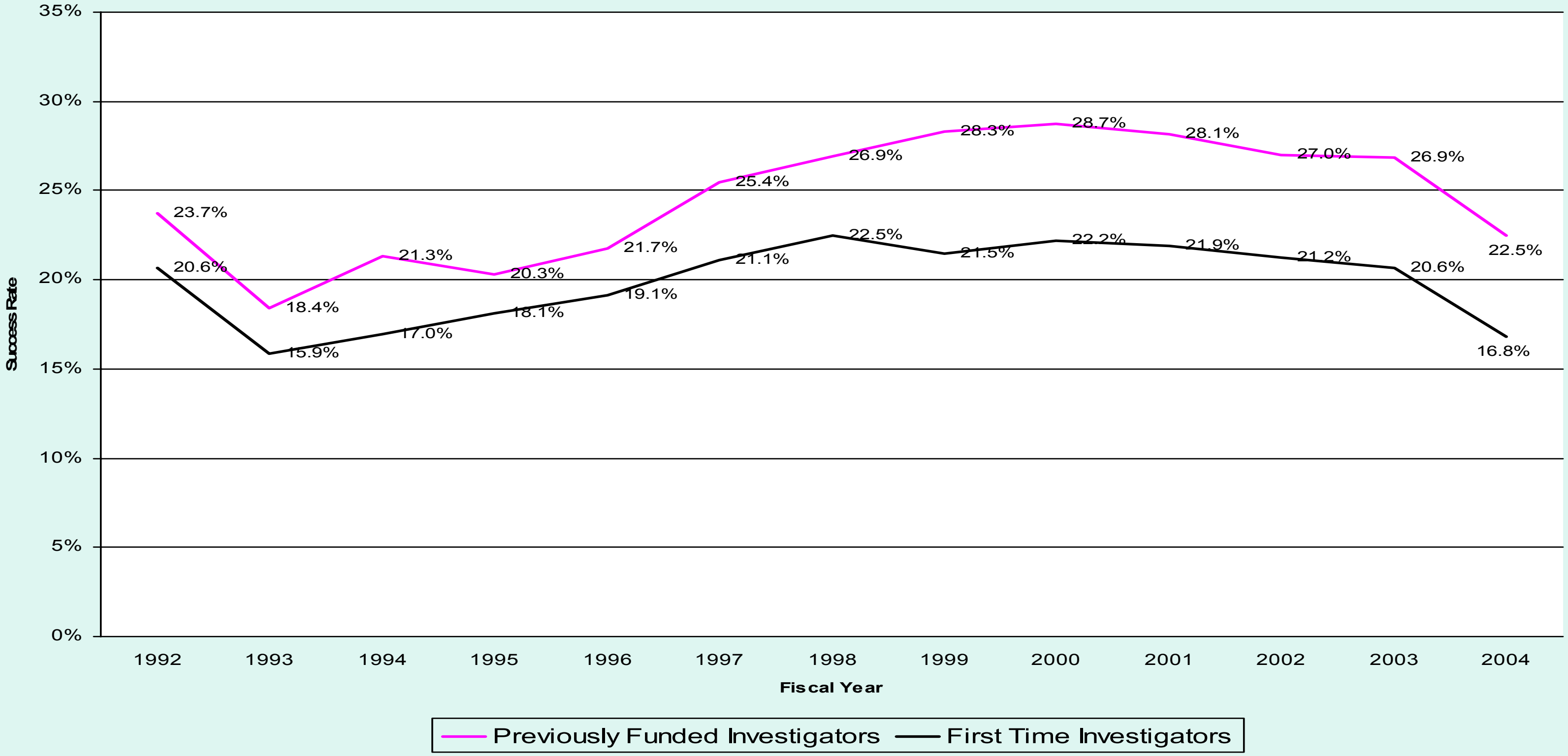
Number of New and Established Investigators Receiving Competing and R01 and R01 Equivalent Grants to 1962 to 2004



NIH, OER for AIRI

NIH New (Type 1) Competing R01 Equivalent Applications

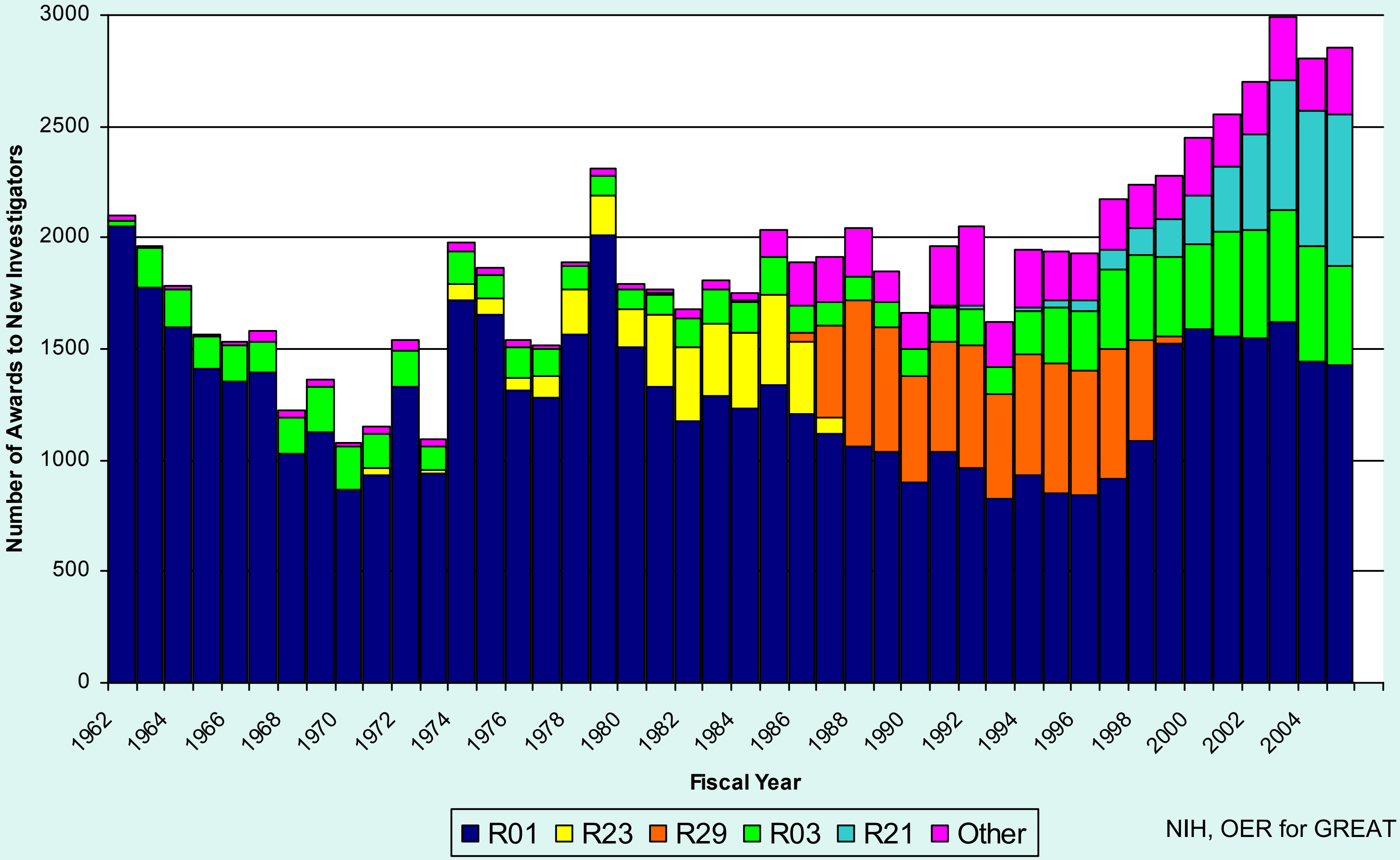
Success rates for first time and previously funded investigators



R01 Equivalent = R01, R29, and R37 activities.

NIH, OER for GREAT

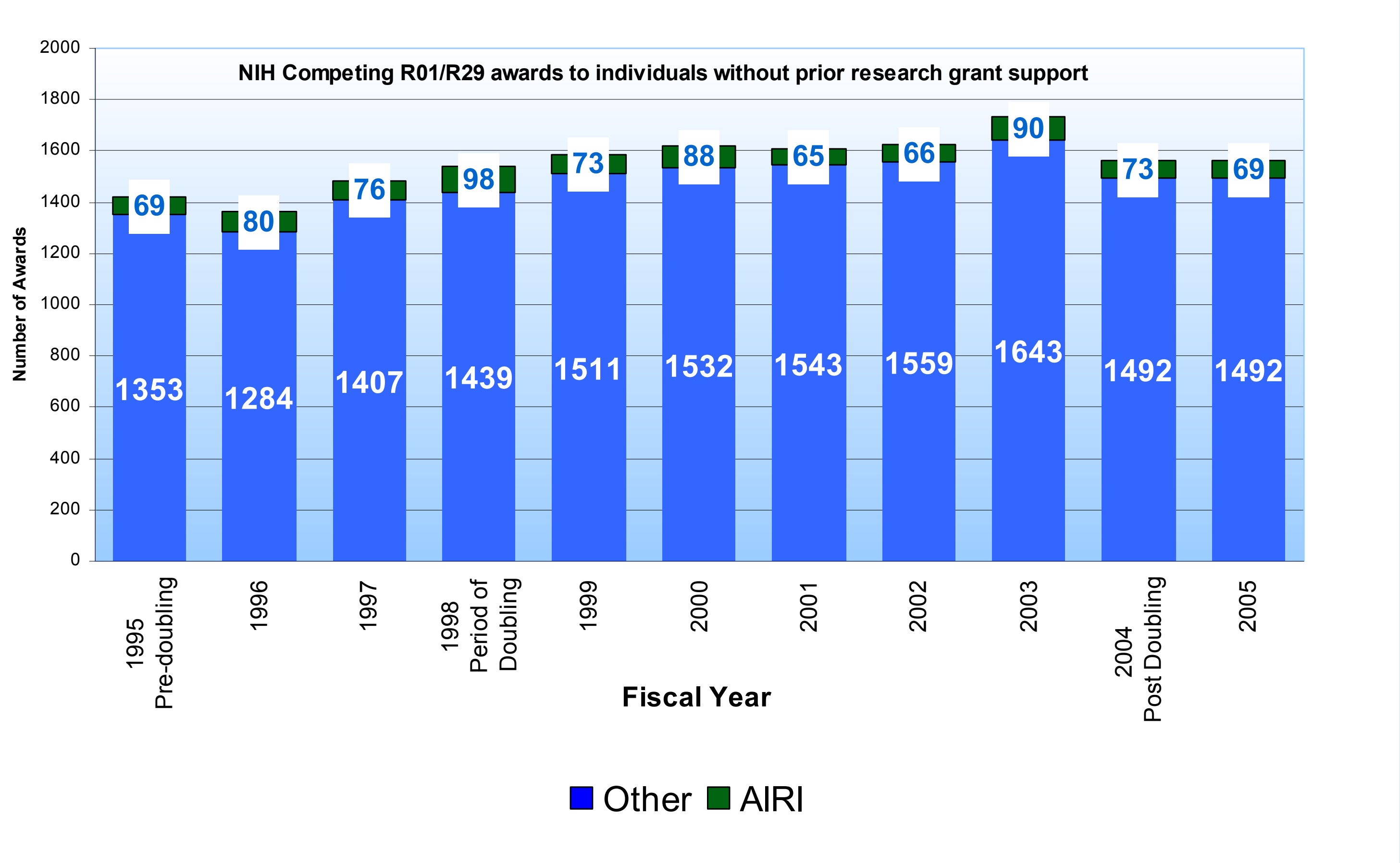
Number of Different NIH Competing Research Project Grants Awarded to New Investigators, FY 1962 - 2005



NIH, OER for GREAT

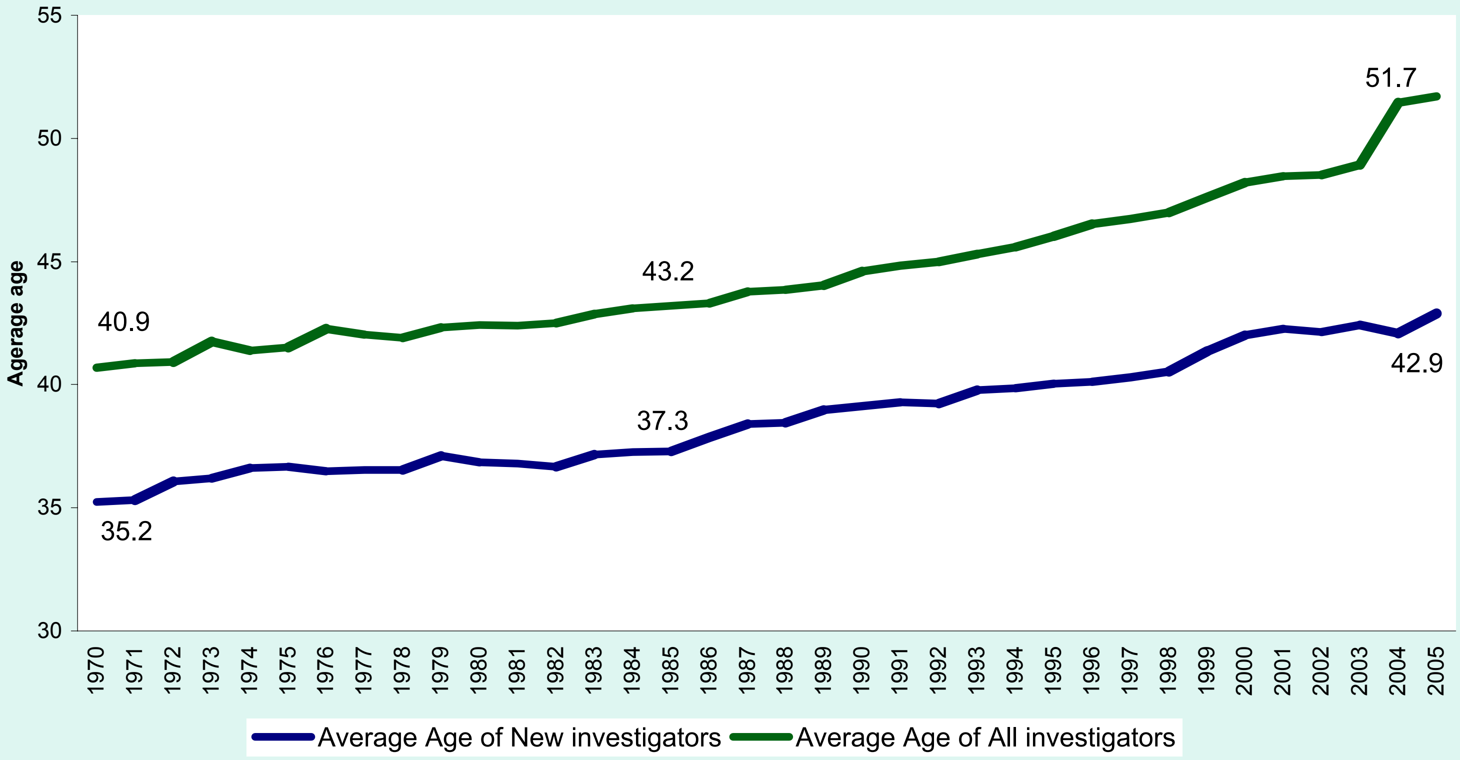
New Investigator Situation

– Virtually no increase in funding of “new” investigators in traditional R01
– Growth for new investigators has been in the R03 and R21 which are small in terms of funding and length of award.
  - R03—small research project-- $50,000 per year for two years;
  - R21 investigator-initiated exploratory development research—up to two years, not to exceed $275,000).



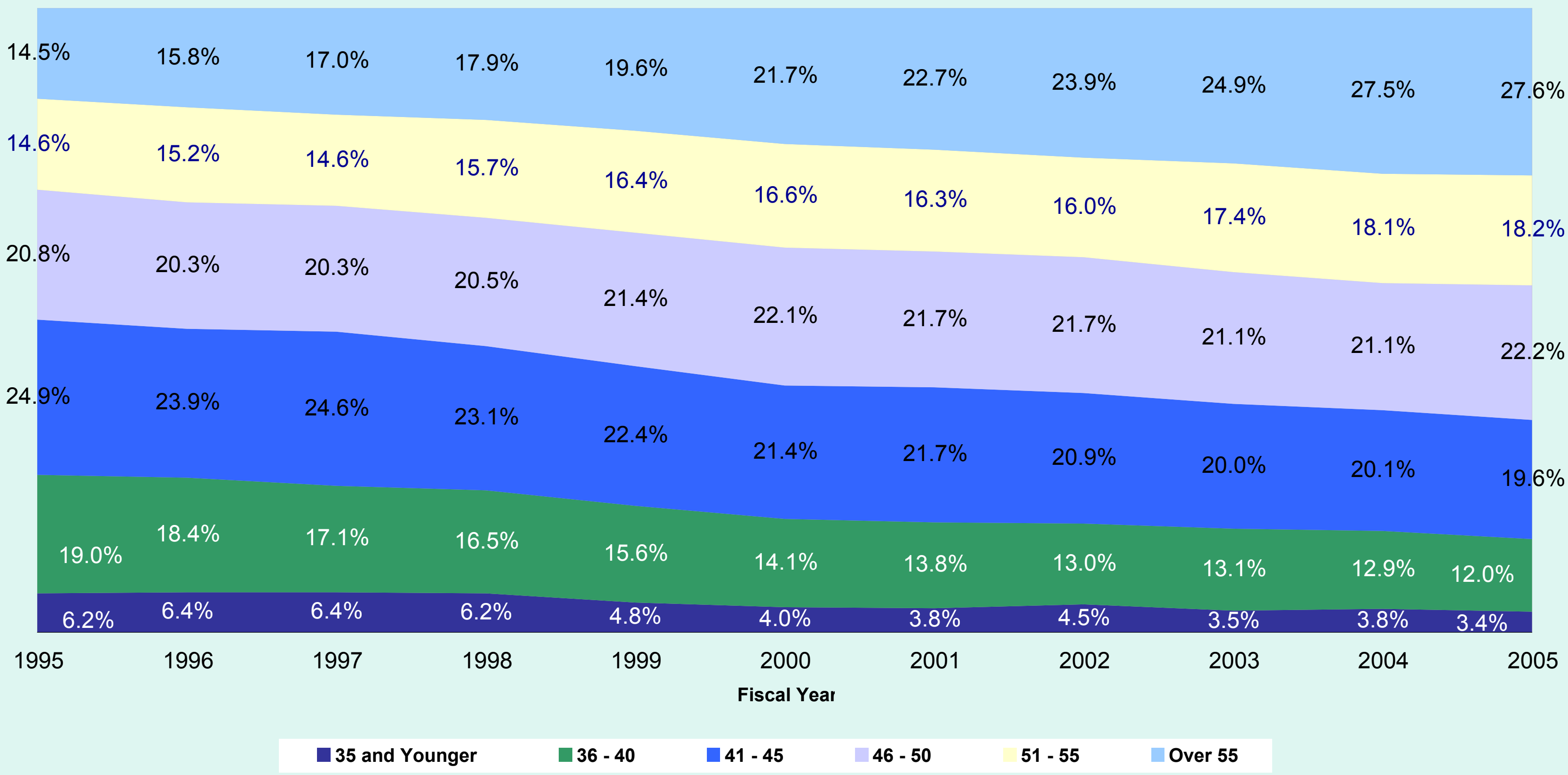
NIH, OER for AIRI

Average Age of Competing R01 Equivalent Awards



NIH, OER for AIRI

NIH Competing R01 Equivalent Awardee



NIH, OER for AIRI

Summarize NIH Data During Doubling

- Tremendous increase in number of new R01 applications
- Majority come from established investigators
- Number of established investigators receiving R01s has increased dramatically
- Increase in percent of investigators who have more than one grant
- Creates significant change in age-distribution of NIH awardees

Kangaroo Solution?

- Pathway to Independence Award Program: K99/R00
- 150 to 200 postdoctoral candidates for each of next 5 years.
- Mentored support while post doc followed by 3 years of R01-level funding, contingent upon securing a tenure-track position with appropriate institutional support and resources.
- A program with unintended consequences?

Program came out of the NRC Committee Report: Bridges to Independence

Summary

- During doubling
  - New grants to established investigators have increased dramatically.
  - Virtually no increase in funding of “new” investigators in traditional R01
  - Growth for new investigators has been in the R03 and R21 which are small in terms of funding and length of award.
  - NIH increasingly is supporting established, older investigators.
  - Small number of Kangaroo awards means that implementation will have little effect on age distribution.
  - Success rates for R01s are declining;
  - Success rates are especially low for new investigators.
  - Increased proportion of applications are being triaged and thus do not receive comments.
  - Speed up review process as a solution?
  - Bridge money is being sought from universities.

What does future hold?

- Assuming NIH situation stays as is
- Universities will have to find alternative ways to pay for buildings. NIH pick up less of tab; some relief as early-funded R01s lapse
- NIH is beginning to put brakes on tuition increases which universities relied on
- Recent faculty hires will have an especially difficult time getting funding and staying funded.
- Bridge money is constrained. Labs will downsize. Staff will be laid off.
- Young and untenured will bear disproportionate share of adjustment costs.

Future continued . . .

- Jobs, especially tenure-track jobs, are unlikely to increase
- Young researchers will increasingly need to look for alternative places to do research
- Unclear whether jobs in industry will expand sufficiently to absorb these young researchers

Lessons/Questions

- Fallacy of composition
- Even in the best of times, the young don't benefit that much from increases in funding
- Soft landing?
- Do additional grants for productive scientists significantly contribute to scientific knowledge?
- Time to rethink the way in which research labs are staffed in the United States?