
# Recruiting Domestic Students to Ph.D. Programs: From Data to Recommendations

**Susanne Hambrusch, Purdue**

**Ran Libeskind-Hadas, Harvey Mudd**

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# Acknowledgements

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# A Few Words About CRA-E

- Mission
- Projects
- Membership
- Website
- Conquer!

"CRA-E's mission is to address society's need for a continuous supply of talented and well-educated computing researchers."

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PURe: Preparing Undergraduates for Research

PIPE: Understanding the pipeline of domestic students to CS Ph.D. programs

CRA Undergraduate Research Awards

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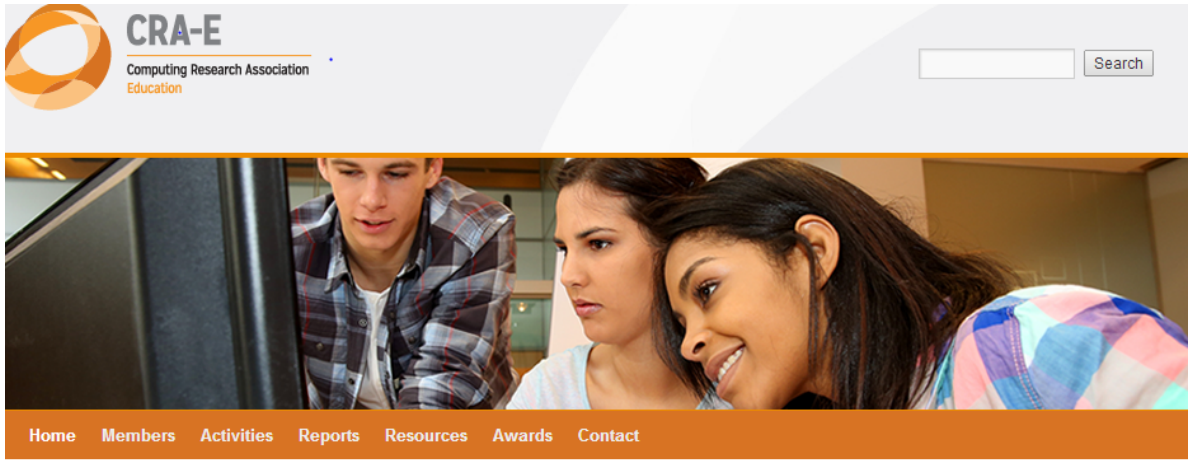


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**Draft of report presented today available from "Reports" section**

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CCC Computing Community Consortium
CRA-W Computing Research Association Women
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- For students
  - Summer research opportunities
  - Why go to graduate school
  - How to apply to graduate school
- For faculty
  - Resources on supervising undergraduate research
  - Advising students on applying to graduate school
  - PowerPoint slides for “Why grad school?” presentations
- For students and faculty
  - Listing service for summer research positions

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CRA-E Computing Research Association Education
CCC Computing Community Consortium
CRA-W Computing Research Association Women
CDC
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# Understanding the Domestic Pipeline of Ph.D. Students in CS

- Less than 50% of CS Ph.D. students are U.S. citizens or permanent residents
- Many graduate schools have difficulty enrolling highly qualified domestic Ph.D. students
- Funding agencies are concerned about the domestic research pipeline in CS
- International students are finding more opportunities in their home countries after finishing a Ph.D.

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# Two Studies

- "Baccalaureate Origins"
  - At what type of institutions do domestic students completing a Ph.D. in computer science complete their undergraduate degree?
  - Computing Research News, January 2013
- "Admissions Study"
  - Where do domestic students applying/being admitted/matriculating complete their undergraduate degree?
  - Recently completed study

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# The Baccalaureate Origins Study…

COMPUTING RESEARCH NEWS, JANUARY 2013
Vol. 25 / No. 1

## Exploring the Baccalaureate Origin of Domestic Ph.D. Students in Computing Fields

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**Fen Zhao,** *AAAS Fellow, NSF*
**David Rabson,** *AAAS Fellow, NSF and University of South Florida*
**Amy Csizmar Dalal,** *Carleton College*
*Ed Fox, Virginia Tech*
**Charles Isbell,** *Georgia Institute of Technology*
**Valerie Taylor,** *Texas A&M University*

### 1. Introduction

Increasing the number of US students entering graduate school and receiving a Ph.D. in computer science is a goal as

*students*) who apply, matriculate, and graduate from doctoral programs in computer science. This article is the first of two articles from CRA-E examining this issue.

This article provides an initial examination of the baccalaureate origins of domestic students who have matriculated to Ph.D. programs in computer science. We hope that trends and patterns in these data can be useful both in recruiting and, ultimately, in improving the quality and quantity of the domestic Ph.D. pipeline.

### 2. Sources of Data

from FastLane (https://www.fastlane.nsf.gov/grfp/AwardeeList.do?method=loadAwardeeList)

Figure 1 shows the number of Ph.D.'s awarded in the U.S. in computer science from 1982 to 2010 as reported by WebCASPAR. Another data source for Ph.D. production is the Taulbee report released annually by the CRA and available at http://www.cra.org/resources/taulbee/. The Taulbee data on Ph.D. production complements WebCASPAR data. Taulbee provides Ph.D. production for institutions in the US and Canada and considers degrees in computer science, computer engineering and information science.

# Sources of Data

- Public databases
  - NSF WebCASPAR
  - National Center for Science and Engineering Statistics
  - NSF Graduate Research Fellowship Awardees/ Honorable Mention Database

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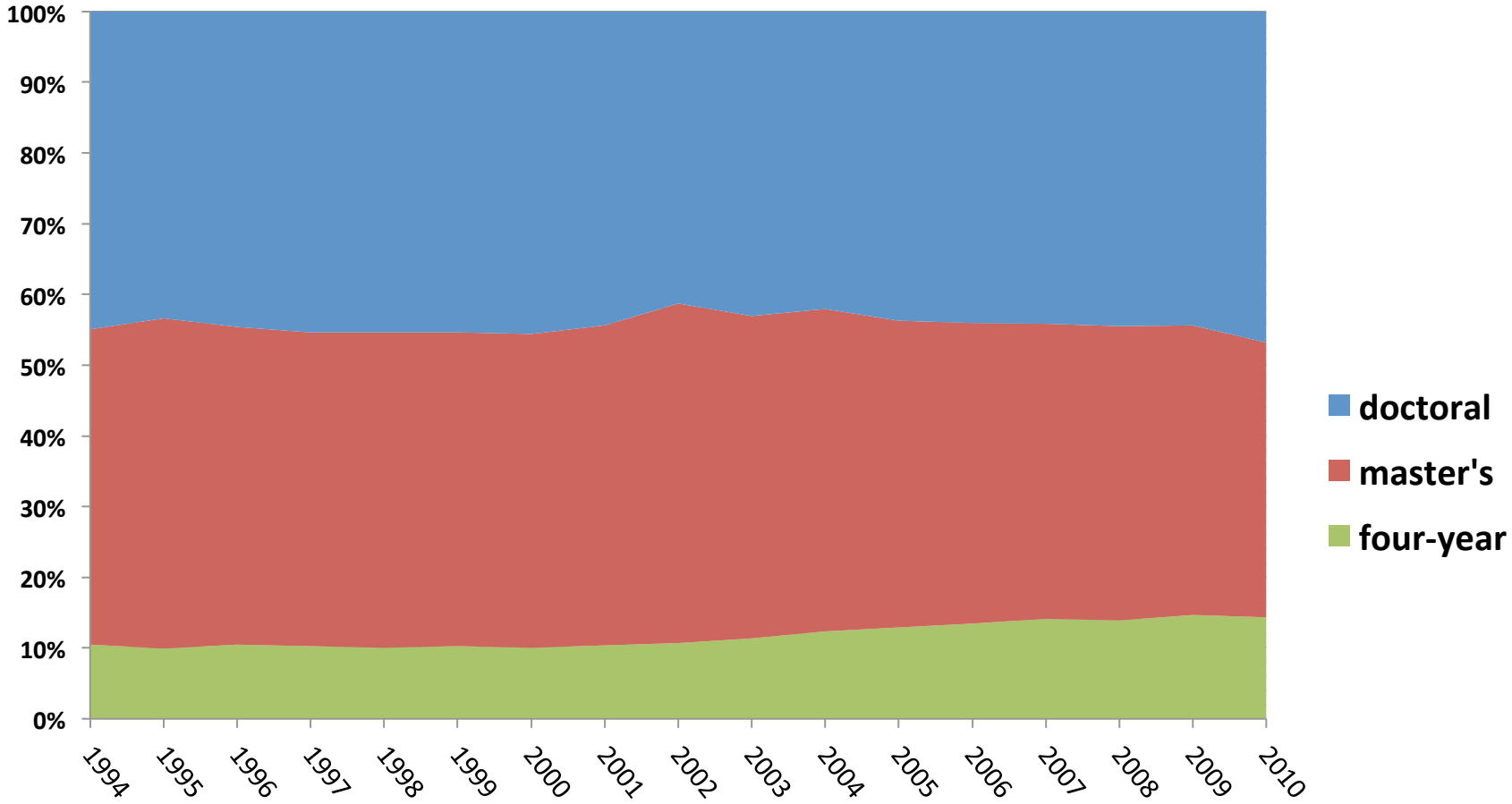
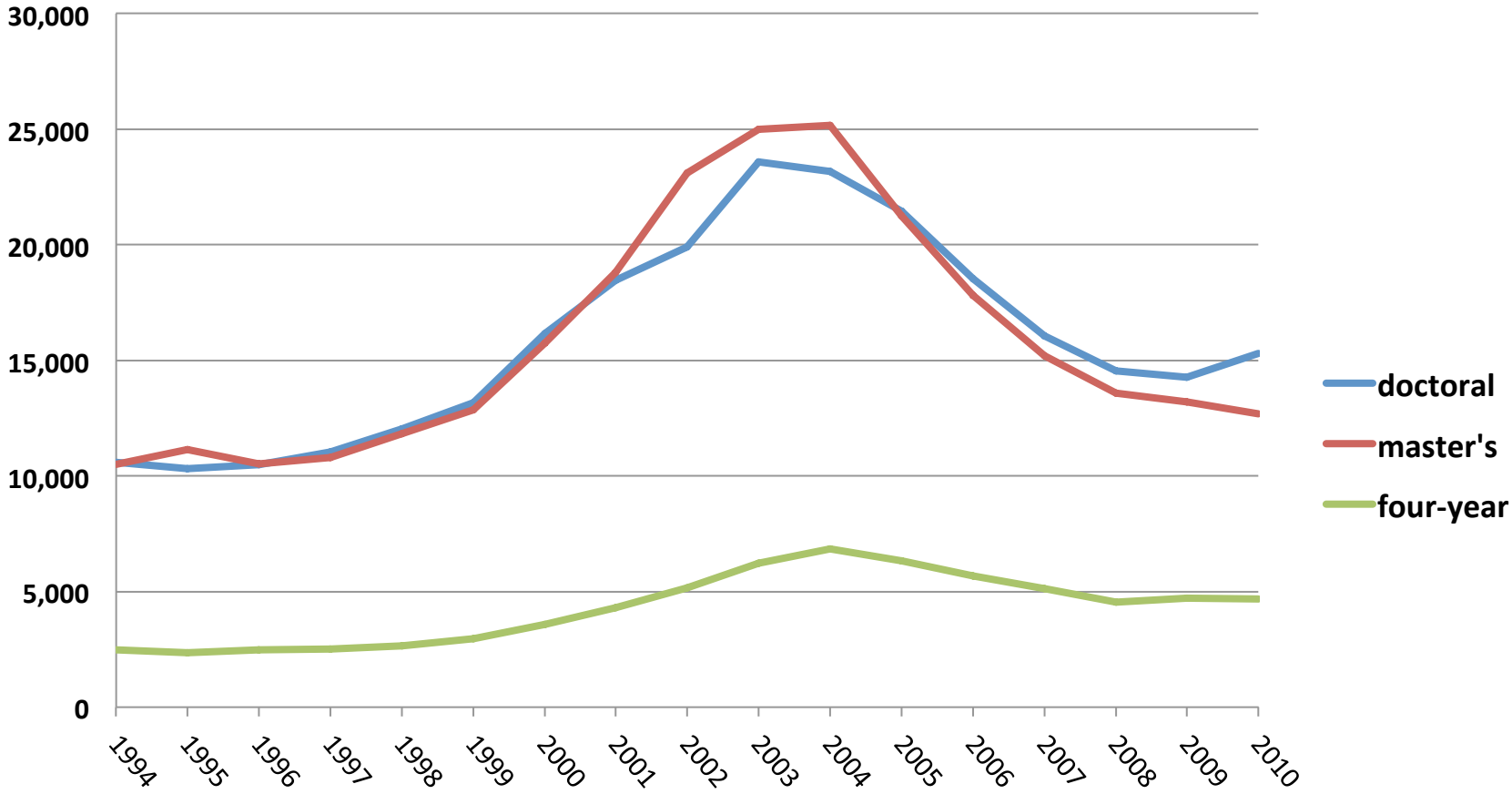
# Percentage of domestic bachelor CS degrees by type of institution



# Number of domestic bachelor CS degrees by type of institution



# Number of CS Ph.D.'s granted to domestic students by type of bachelor institution

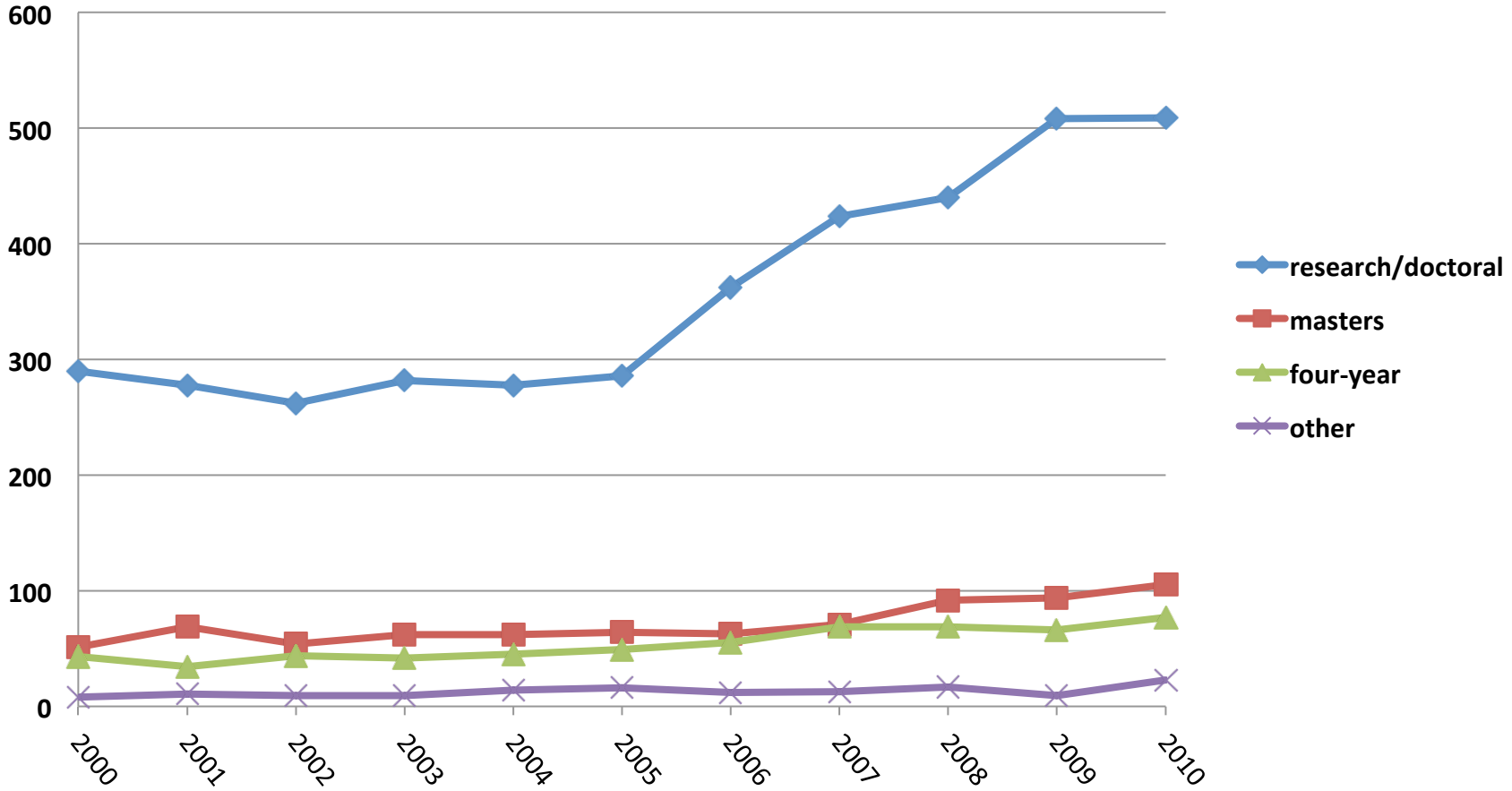
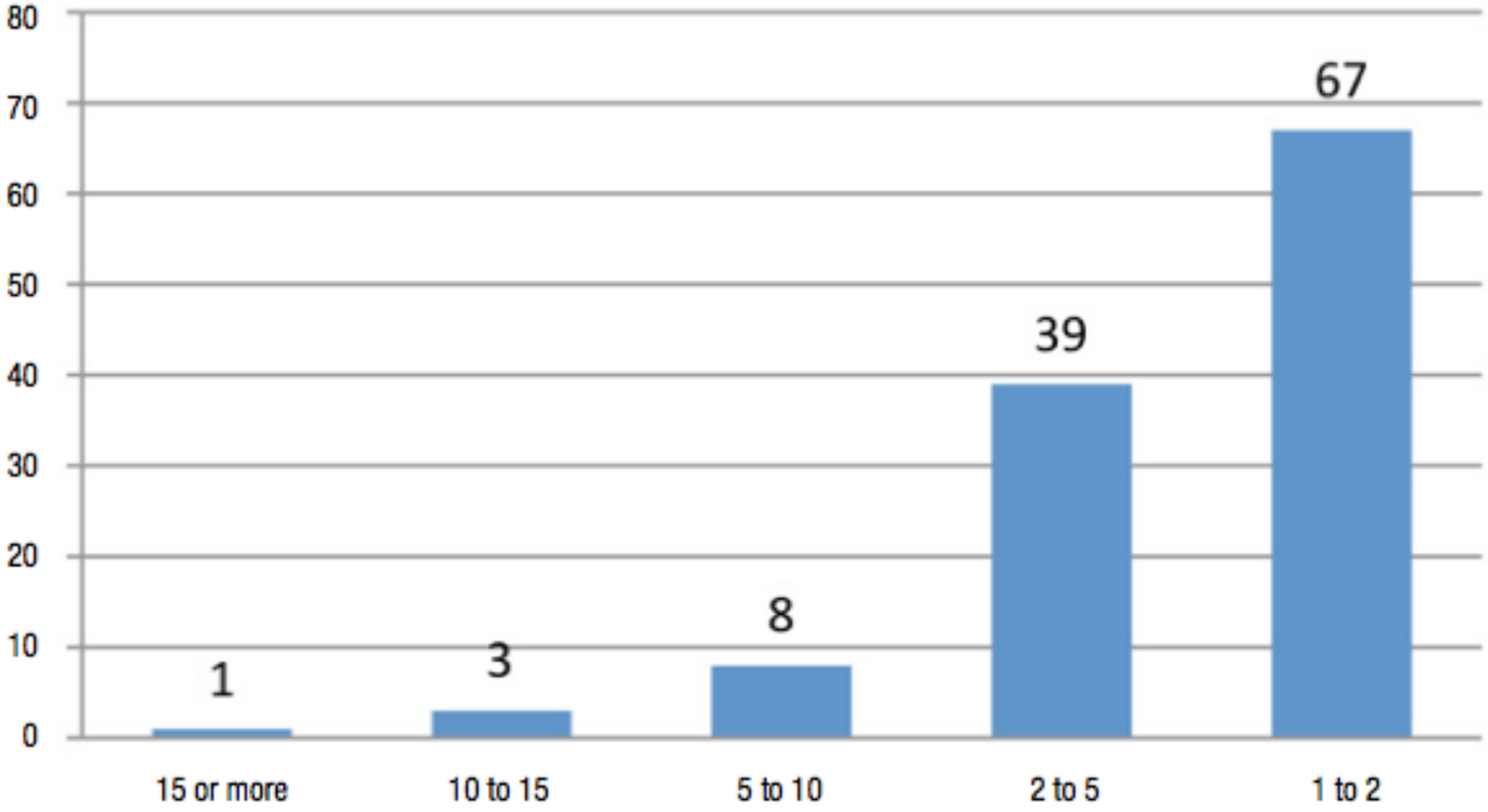


**Figure 7:** The number of institutions with annual average productions of 15 or more, at least 10 but less than 15, at least 5 but less than 10, at least 2 but less than 5, at least 1 but less than 2




Data for 2000-2010

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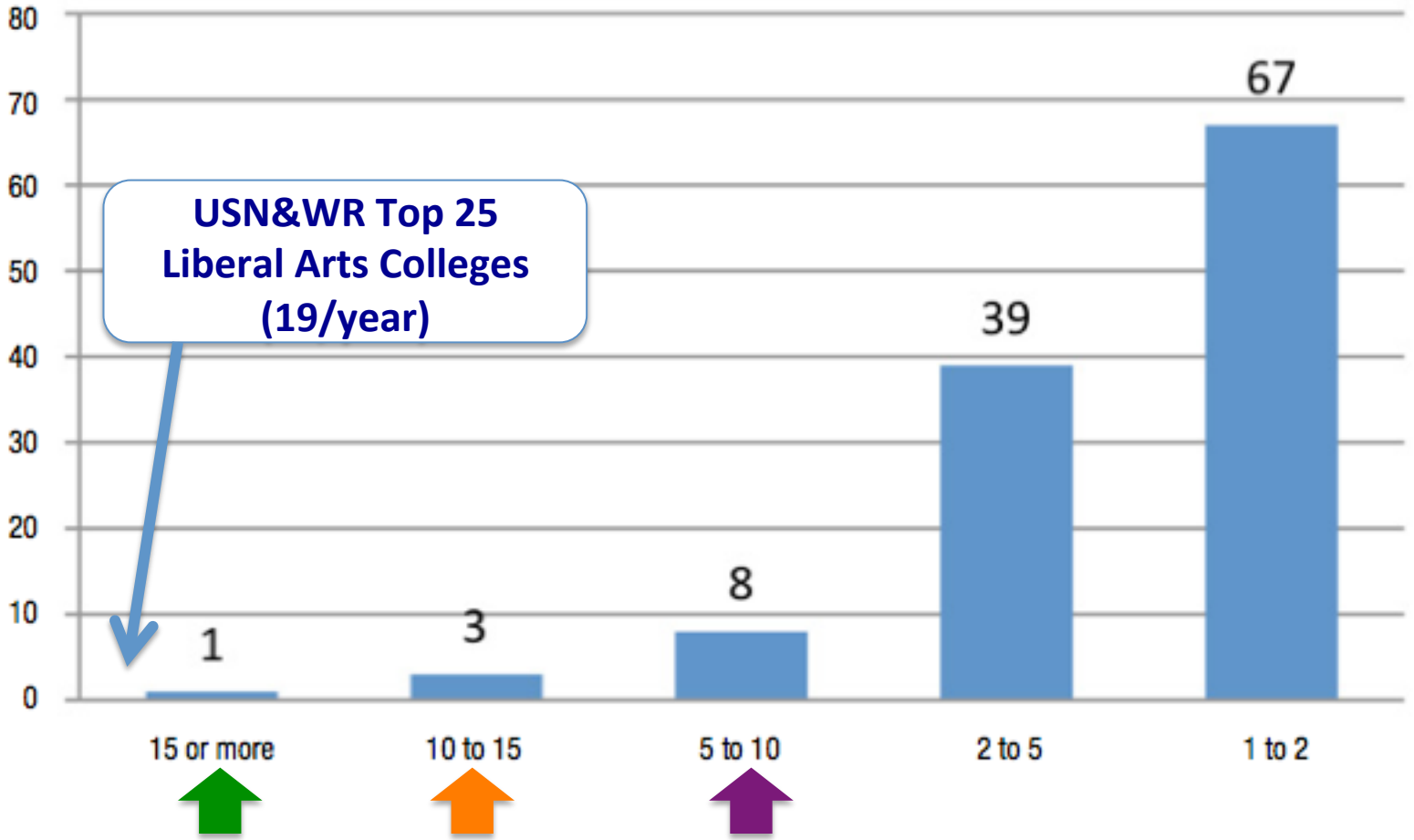


Data for 2000-2010

# Conclusions from Baccalaureate Origins Study

- A small number of universities and colleges are the undergraduate schools of origin for a large fraction of domestic Ph.D. students
- 70% of the Ph.D.'s awarded to domestic students went to students who completed their bachelor at a research institution
- Master's institutions seem to be an underutilized source of prospective graduate students

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# Limitations of Baccalaureate Origins Study

- No data on acceptance and matriculation rates at Ph.D. programs
- Cannot see the "flow" from different types of baccalaureate "producers" to different types of graduate schools "consumers"
- No data on gender or ethnicity of applicants, admits, and matriculated students

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# Admissions Study Goals

- Use graduate admissions records to get a clearer and finer-grained picture of the domestic pipeline
- Examine differences in acceptance rates and matriculation rates  across different types of institutions
- Explore patterns and trends among traditionally underrepresented groups
- Make observations and recommendations useful to admissions committees and to undergraduate advisers

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# The Data

- 7032 graduate admissions records from 14 schools between 2007 and 2013
- Each admissions record contains
  - Graduate school name
  - Undergraduate origin
  - Year applied
  - GPA, GRE, ethnicity, gender (if reported)
  - Admitted/not admitted
  - If admitted, matriculated/not matriculated

**Clearly, this is just one piece of the puzzle!**

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# Who are the 14 schools that provided admissions records?

- Four depts. ranked 1-10 by USN&WR (the "1-10" schools) **(but excluding MIT, CMU, Stanford, and Berkeley)**
- Ten depts. ranked 11-70 (the "11+" schools)
- The applications to these 14 *consumer* schools came from 1204 distinct baccalaureate *producer* schools

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# Methodology: Producers and Consumers

## Producers

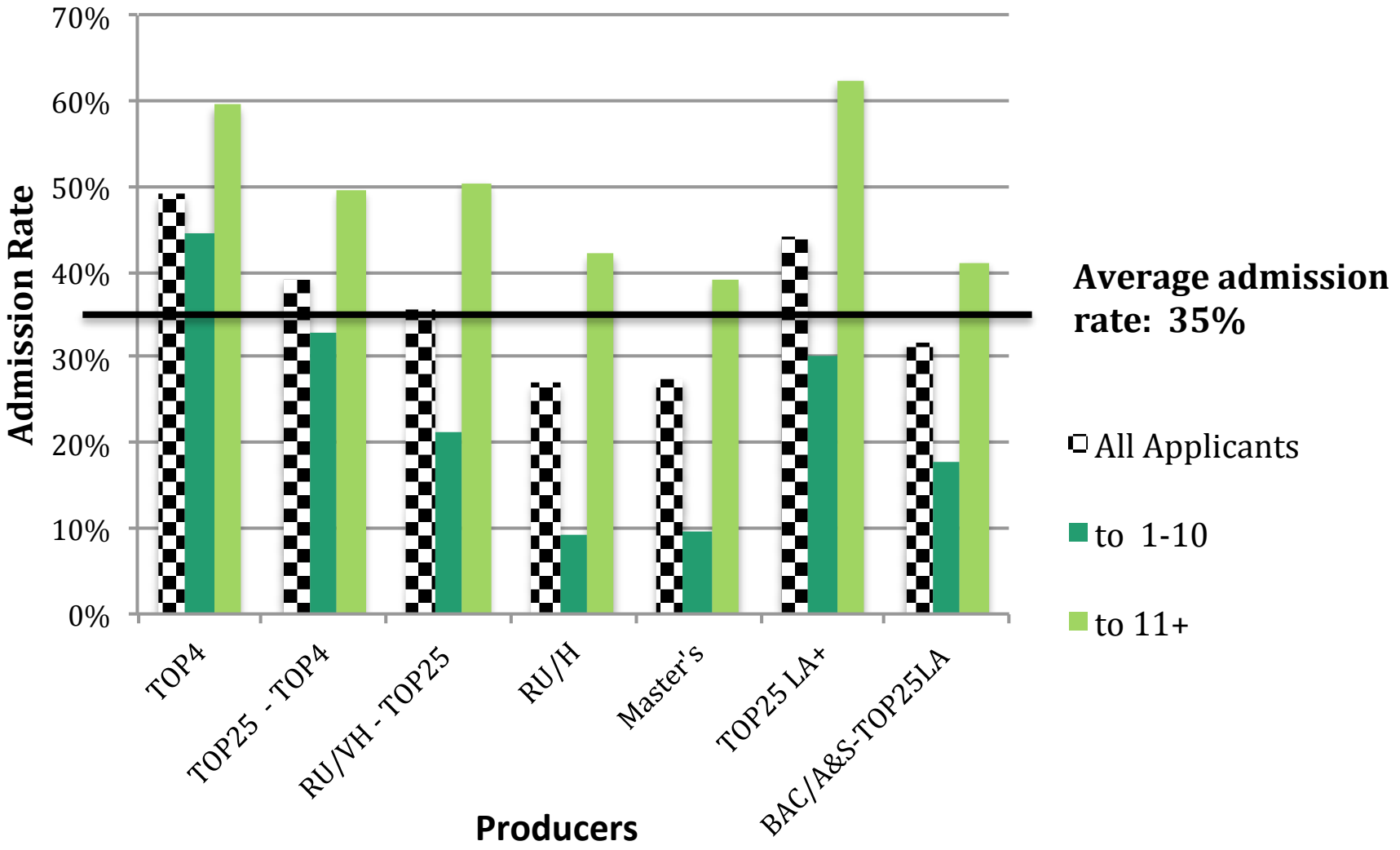
| | # of Schools | Applications | |
|---|---|---|---|
| TOP4 | 4 | 620 | 9% |
| TOP25-TOP4 | 21 | 1637 | 23% |
| RU/VH-TOP25 | 83 | 1835 | 26% |
| RU/H | 99 | 667 | 9% |
| Master's | 724 | 807 | 11% |
| TOP25 LA+ | 27 | 421 | 6% |
| BAC/A&S-TOP25LA | 246 | 453 | 6% |
| Other | | 592 | 8% |
| TOTAL | 1204 | 7032 | 100% |

I thought you said "Top 4" schools weren't included?!

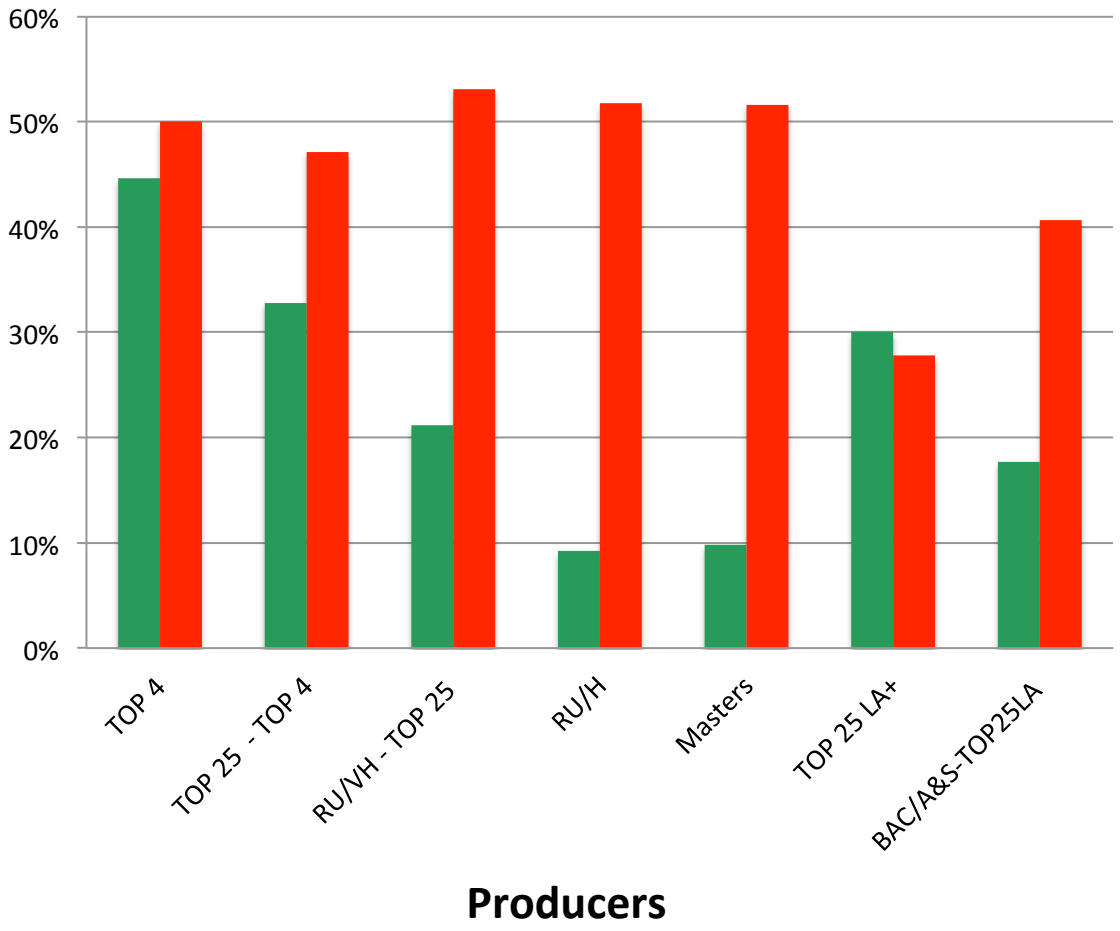
## Consumers

| | Applications | |
|---|---|---|
| 4 Departments ranked 1-10 | 3670 | 52% |
| 10 Departments ranked 11+ | 3362 | 48% |
| TOTAL | 7032 | 100% |

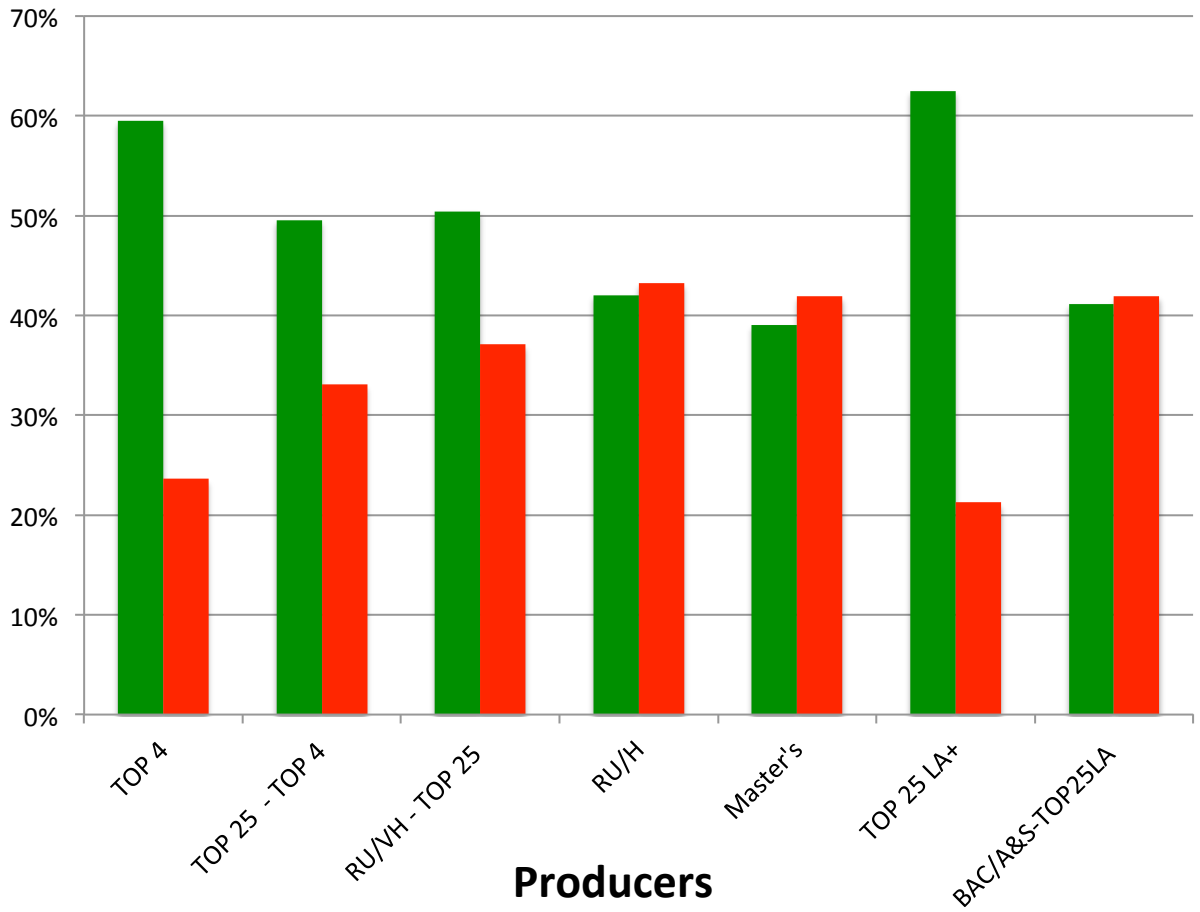
# **Admission** Rates from Producer Groups to Consumer Groups



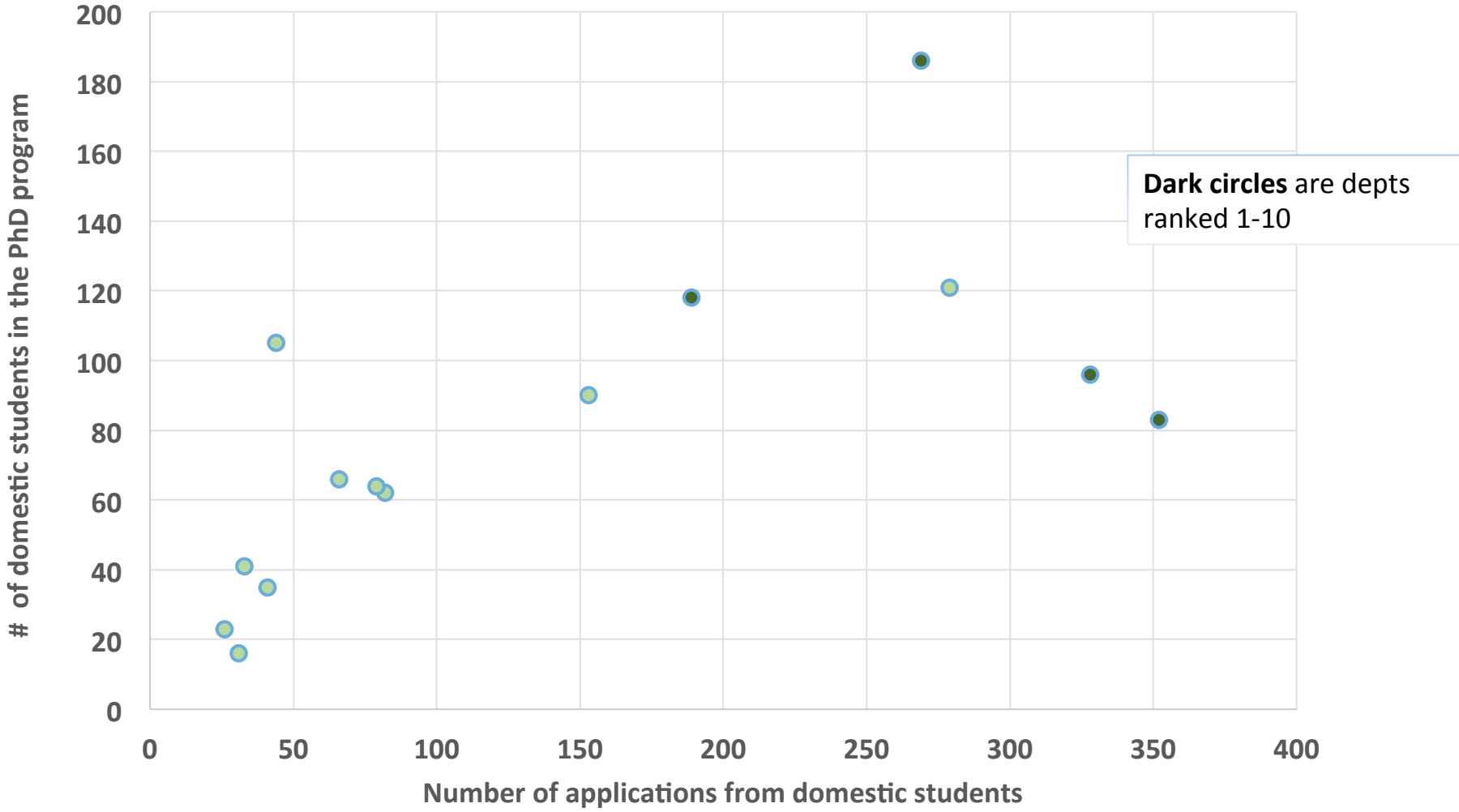
# **Admission** and **Matriculation** rates from Producer Groups to Departments ranked **1-10**



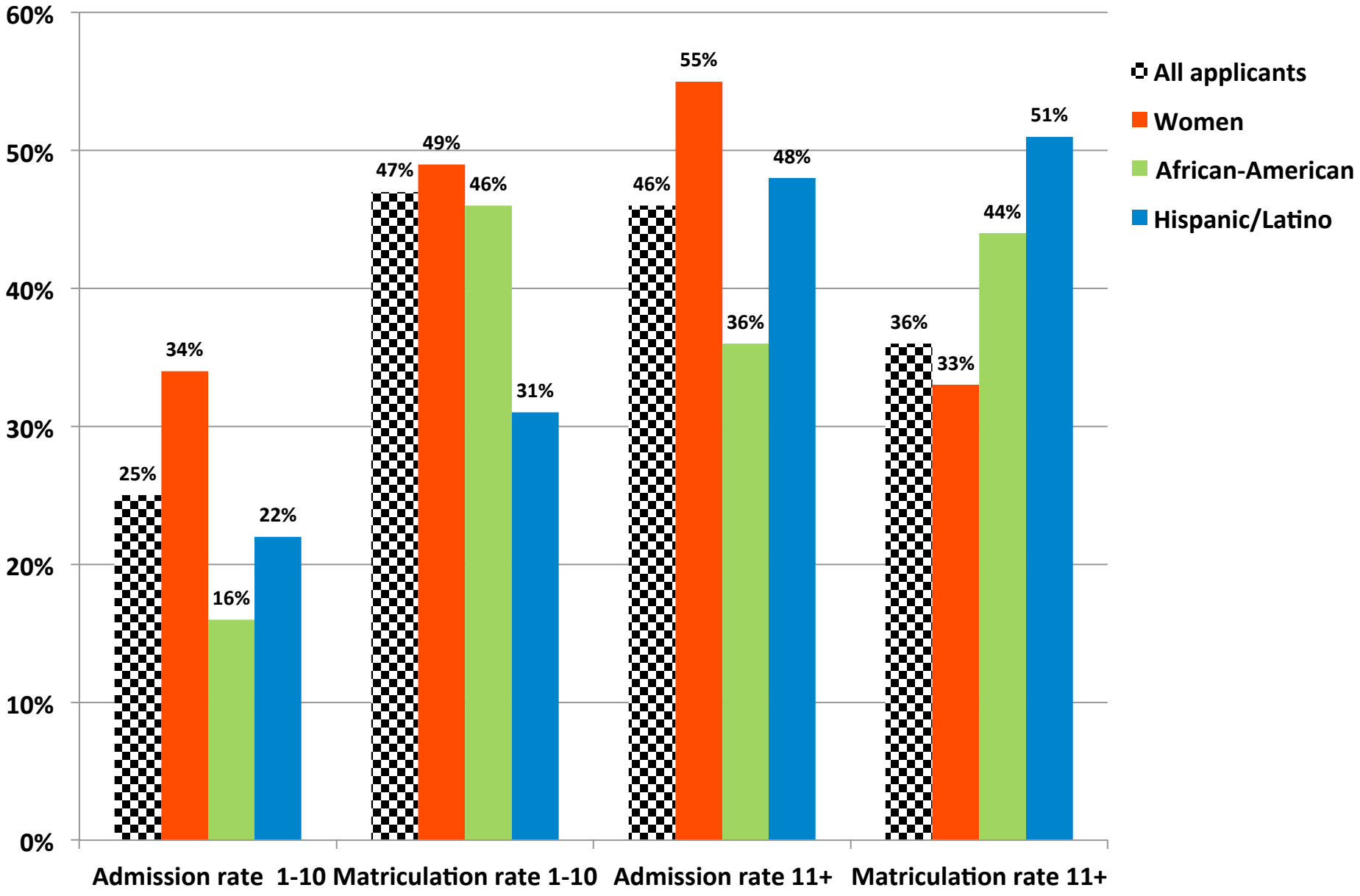
# **Admission** and **Matriculation** rates from Producer Groups to Departments ranked **11+**



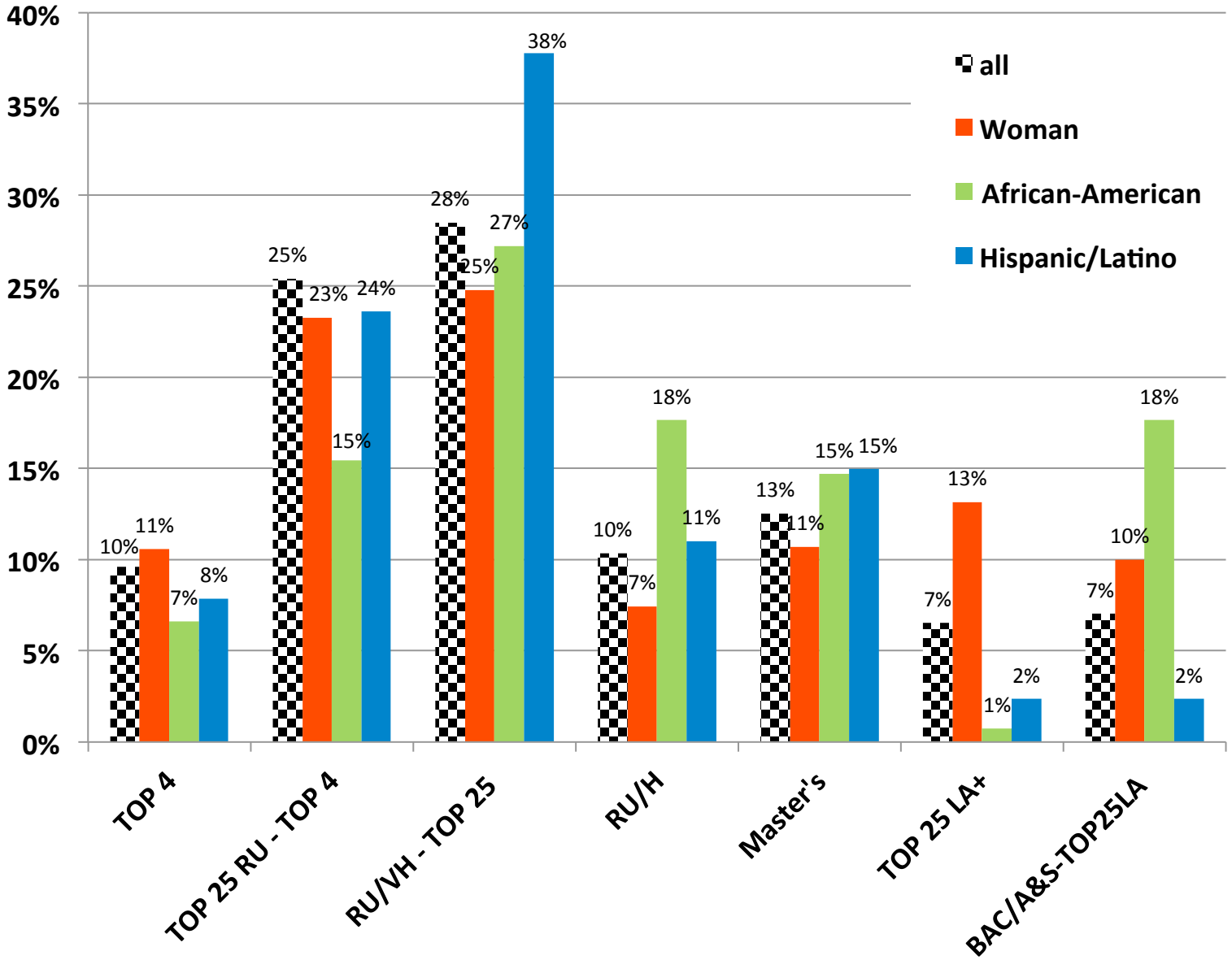
# Domestic students enrolled vs. domestic applications (Fall 2013)



# Underrepresented Groups



# Where do applications within each group come from?



# GPAs and GREs

- Not many surprises, but data can be useful in advising undergraduates
- Report contains data on all students and underrepresented groups

| | all applicants | | admitted applicants | |
|---|---|---|---|---|
| | GPA | Variance | GPA | Variance |
| all applicants | 3.62 | 0.32 | 3.75 | 0.25 |
| female | 3.61 | 0.32 | 3.73 | 0.27 |
| African American | 3.41 | 0.36 | 3.69 | 0.31 |
| Hispanic/Latino | 3.54 | 0.36 | 3.66 | 0.29 |

# For Producers and Consumers…

- Wide range of admit rates for domestic students
  - 8% (top 4), 25% (top 6-10), to 75% (top 30+)
- Students from Master's institutions are underrepresented
  - good opportunities to forge partnerships
- Many schools recruit from within
  - 4+1 programs can be a good strategy
- Top liberal arts colleges represent 14% of all applicants but 21% of female applicants.
  - yield on liberal arts students is very low; recruiting?

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# Recommendations for Consumers…

- Keep good admissions records
  - compare them to results in this study
  - refine admissions and recruiting practices
- Build pipeline relationships with colleges and universities in your area
- Some schools seem to have particularly effective recruiting strategies
  - Can result in unusually high yield

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# Recommendations for Producers…

- Use available data and your own departmental data to help advise your undergraduates
- Provide advising and information sessions on undergraduate research, research careers, and graduate schools
  - See the CRA-E's Conquer website: `cra.org/conquer`
- Forge relationships with Ph.D. programs to develop a pipeline for your students

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# Questions for the panelists (1)

- From your producer perspective
  - From your perspective, what information would faculty/advisers advising undergraduates find most helpful?
  - What does your department do right now that is most effective in helping undergraduates interested in graduate school to be successful?

# Questions for the panelists (2)

- From your consumer perspective
  - Given the results of this study, are there changes in your recruiting and admissions processes you plan to consider?
  - Does your department keep and make use of detailed records on admission and matriculation rates?
  - Do you cultivate relationships with selected schools to establish a pipeline of graduate students? If so, how do you make it work?

# Questions for the panelists (3)

- Overall
  - What did you find particularly interesting or surprising in the report?
  - Other comments you want to make/ questions you want to pose

# Questions and comments


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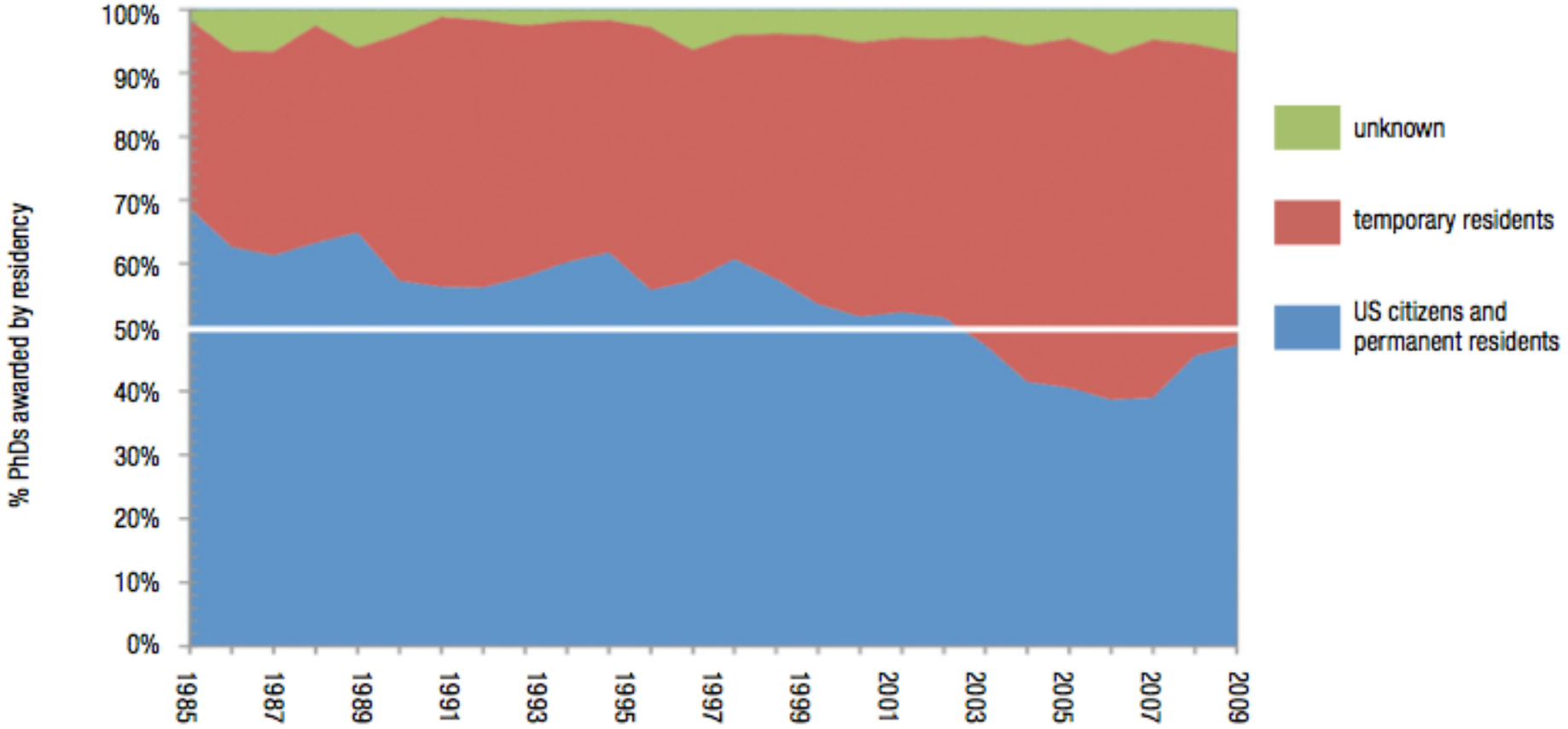
# Additional Data…

**Figure 2:** Percent of Ph.D.'s Awarded to Temporary Residents (i.e., international students) and U.S. Citizens/ Permanent Residents from 1985 to 2010




Source: National Science Foundation (http://webcaspar.nsf.gov and http://ncses.norg.org/NSFTabEngine)

# Percentage of US Citizens/PRs among Earned PhDs in Science & Engineering

| | |
|---|---|
| Psychology | 95% |
| Biology | 84% |
| Geo Sciences | 66% |
| Social Sciences | 65% |
| Chemistry | 56% |
| Physics & Astronomy | 50% |
| Mathematics&Statistics | 48% |
| Engineering | 43% |
| Computer Science | 43% |

From National Center for Science and Engineering Statistics (2007)

# NSF Graduate Fellowships and Honorable Mentions

**Table 1:** Undergraduate Institutions of Students Receiving a GRF Award or Honorable Mention Between 2003 and 2012

| Institution | Awards | Honorable Mentions |
|---|---|---|
| Massachusetts Institute of Technology | 44 | 41 |
| Carnegie Mellon University | 39 | 45 |
| Stanford University | 36 | 31 |
| University of California, Berkeley | 30 | 52 |
| Harvard University | 28 | 24 |
| Princeton University | 27 | 26 |
| Georgia Institute of Technology | 22 | 20 |
| University of Washington | 21 | 27 |
| California Institute of Technology | 18 | 13 |
| The University of Texas at Austin | 18 | 11 |
| Cornell University | 15 | 38 |
| University of Virginia | 15 | 10 |
| University of Illinois at Urbana-Champaign | 13 | 16 |

**Table 2:** 4-year Colleges Whose Graduates Received a GRF Award or Honorable Mention

| Institution | Awards | Honorable Mentions |
|---|---|---|
| Harvey Mudd College | 9 | 13 |
| Franklin W. Olin College of Engineering | 7 | 4 |
| Swarthmore College | 5 | 9 |
| Williams College | 3 | 10 |
| Middlebury College | 3 | 2 |
| Carleton College | 3 | 1 |
| Amherst College | 3 | 1 |
| Pomona College | 3 | 0 |
| United States Military Academy | 2 | 2 |
| Oberlin College | 2 | 2 |
| Bryn Mawr College | 2 | 2 |
| Haverford College | 2 | 1 |
| Wellesley College | 2 | 0 |