The Changing Distribution of Research Activity Across Universities: Evidence from Evolutionary Biology (1980-2005)

Ajay Agrawal, University of Toronto and NBER
John McHale, National University of Ireland, Galway
Alexander Oettl, Georgia Institute of Technology

The Changing Frontier: Rethinking Science and Innovation Policy Pre-Conference
NBER, October 26, 2012

What is Evolutionary Biology?

- Evolutionary biology is a sub-field of biology concerned with the study of the evolutionary processes that have given rise to the diversity of life on Earth

- Evolutionary biologists study the descent of species and the origin of new species

Characteristics of Evolutionary Biology

1. Theory and applied (lab)
   - Like science, not mathematics

2. Mature subfield
   - Unlike biotechnology

3. Location not pre-determined
   - Unlike particle physics (CERN), astronomy

Observations at the Institution Level

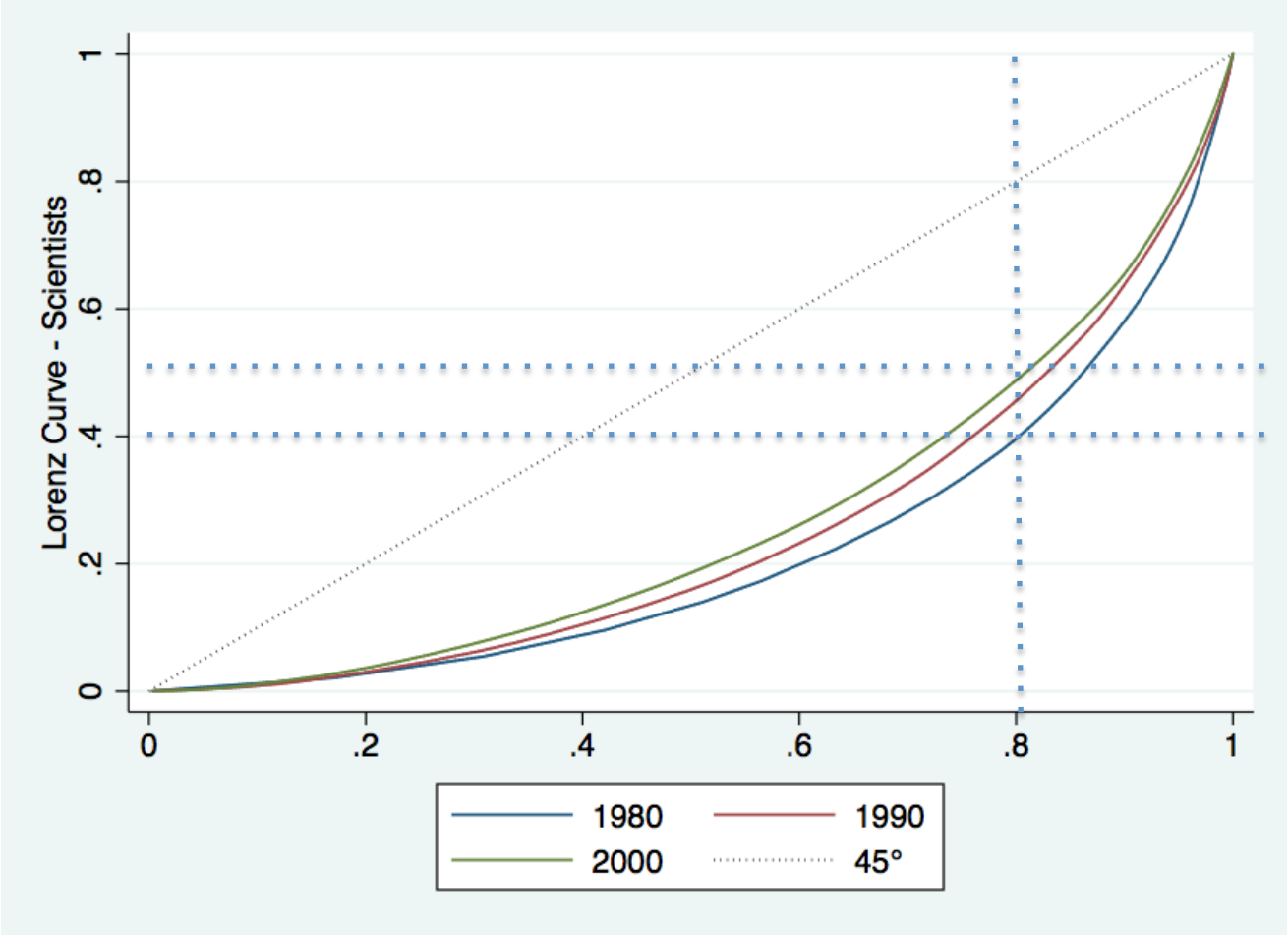
1. Broadening base of knowledge production

2. Agglomeration of stars

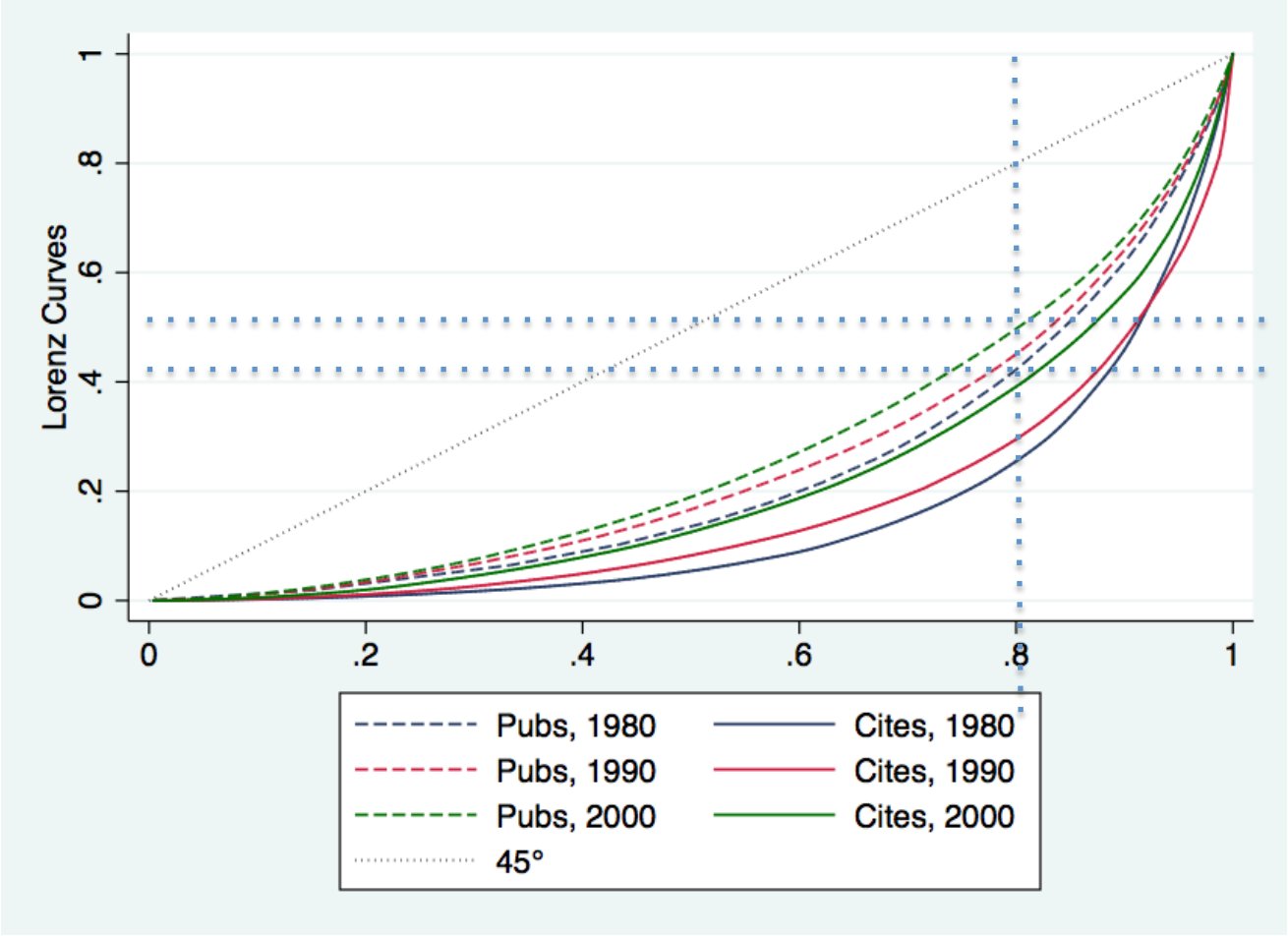
3. Increasing collaboration, including across tiers

1. BROADENING BASE OF KNOWLEDGE PRODUCTION

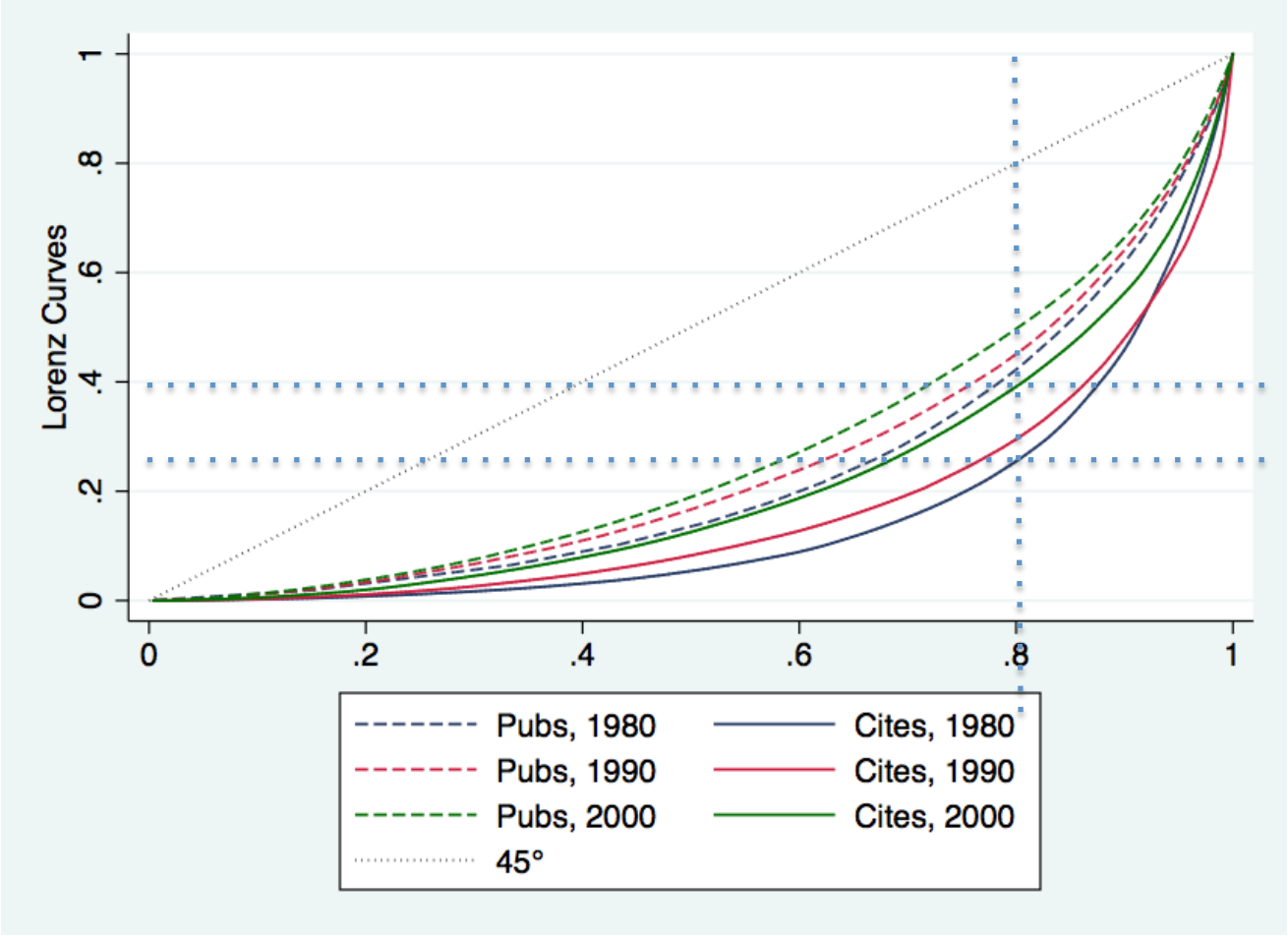
Lorenz Curves
Scientists by Institution



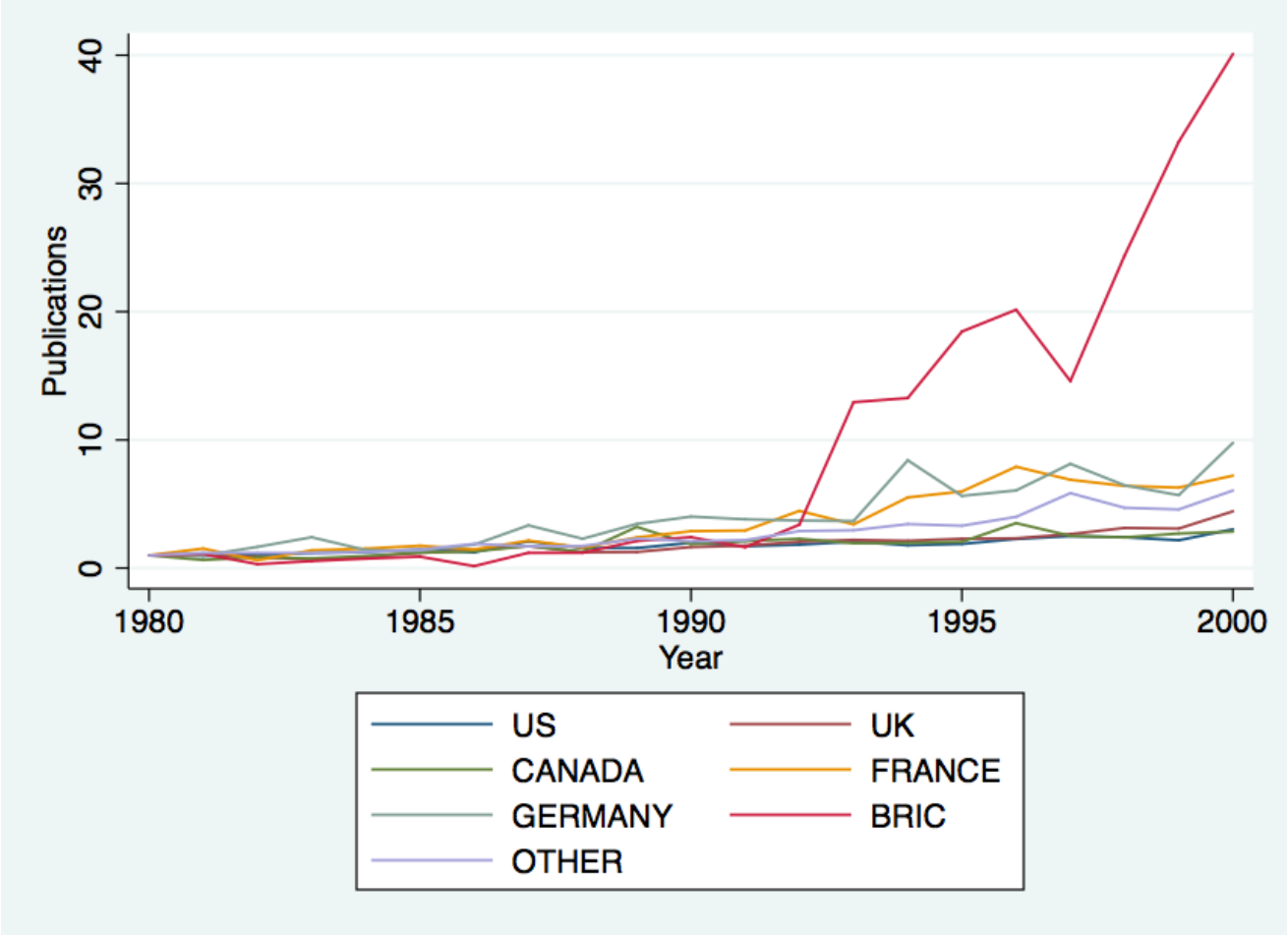
Lorenz Curves
Publications and Cites by Institution



Lorenz Curves
Publications and Cites by Institution

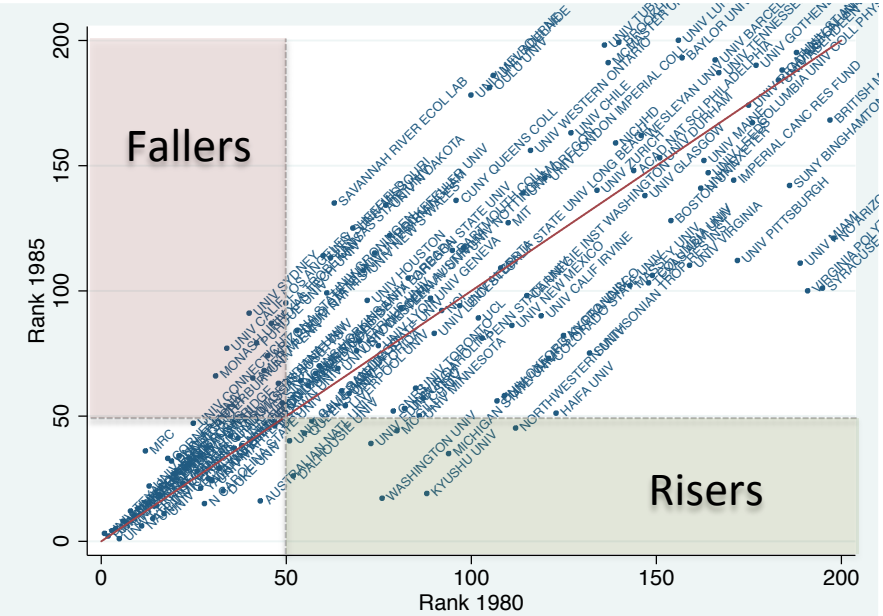


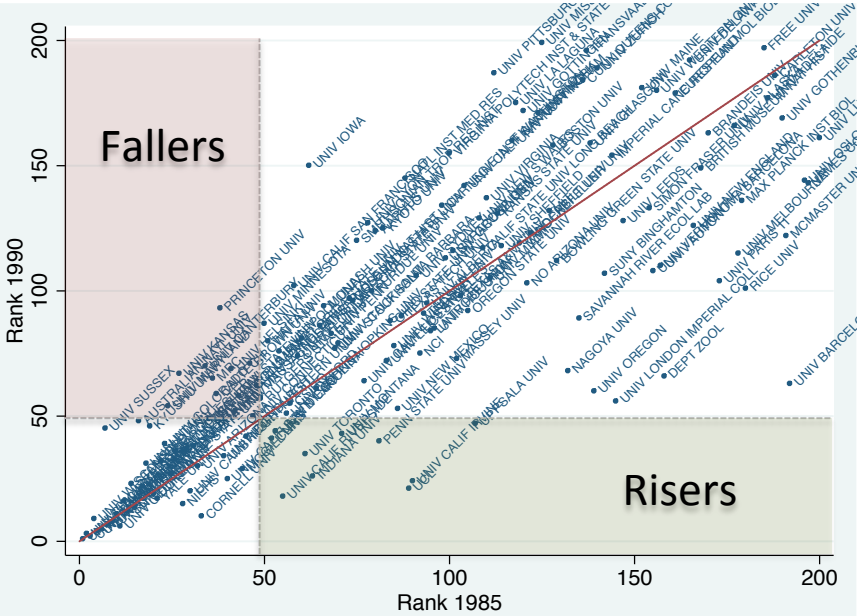
Rise of Other Regions

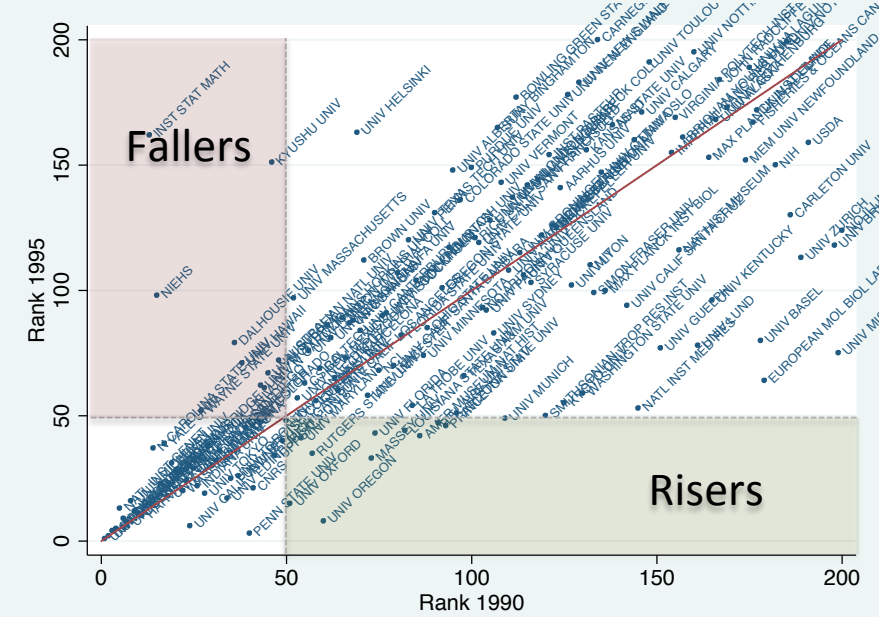


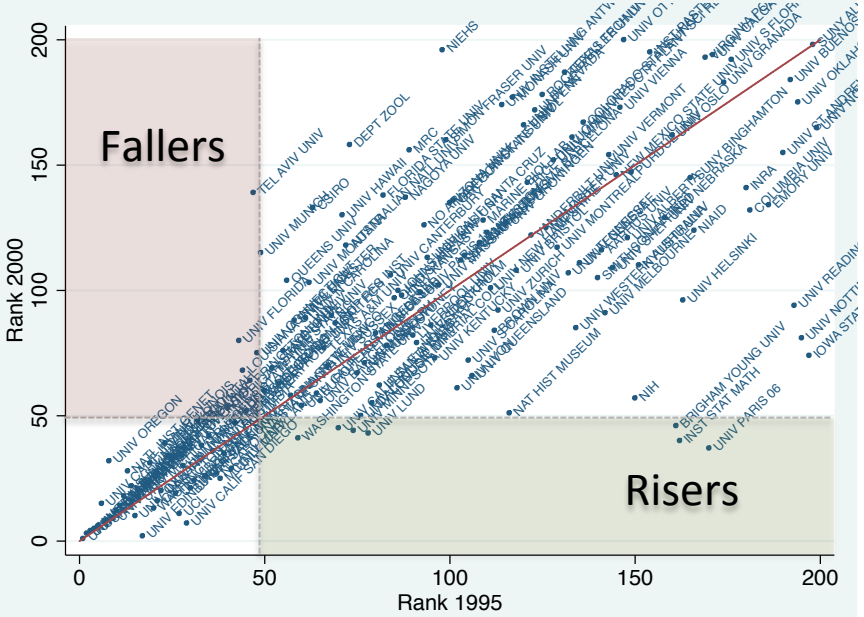
2. AGGLOMERATION

Institution Rank (5Yr Increments)



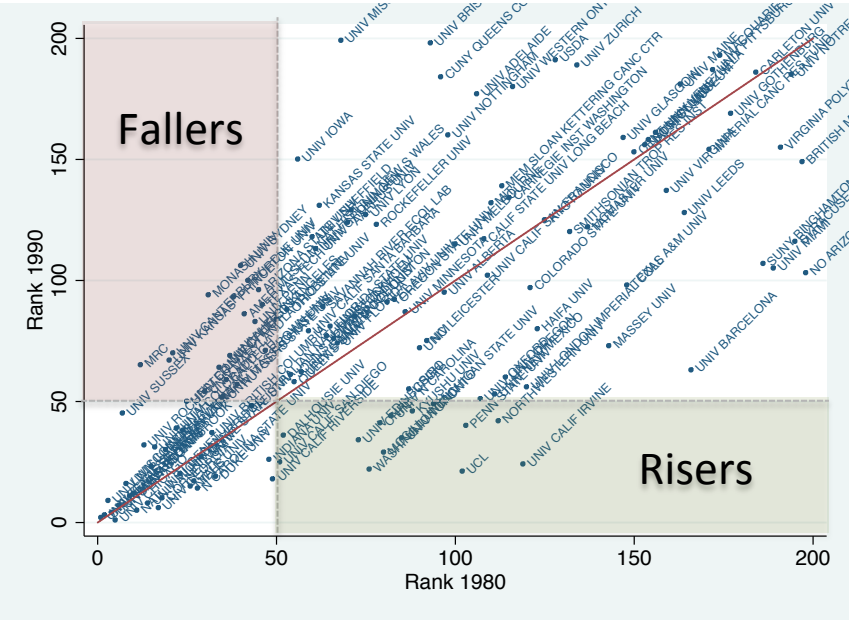




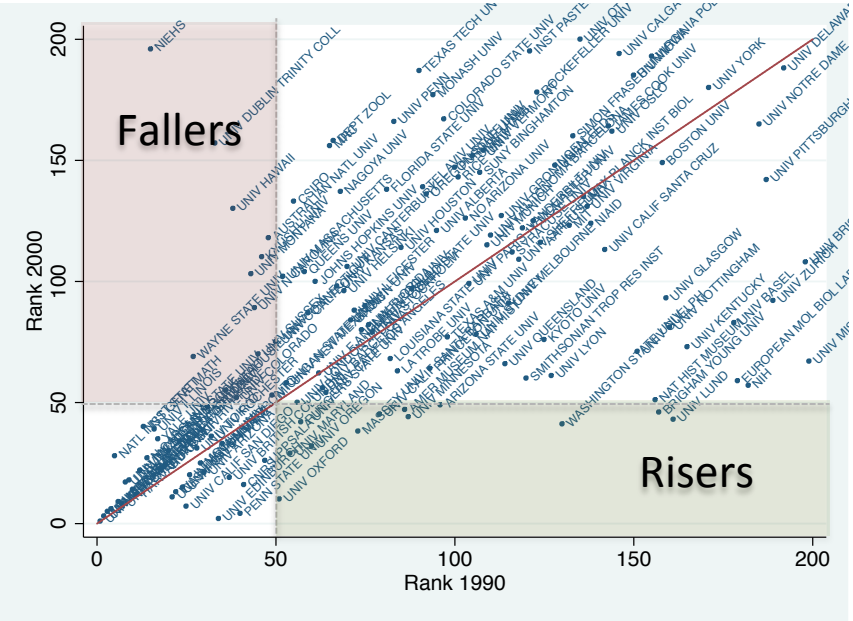


Institution Rank Change (10-Yr Increments)

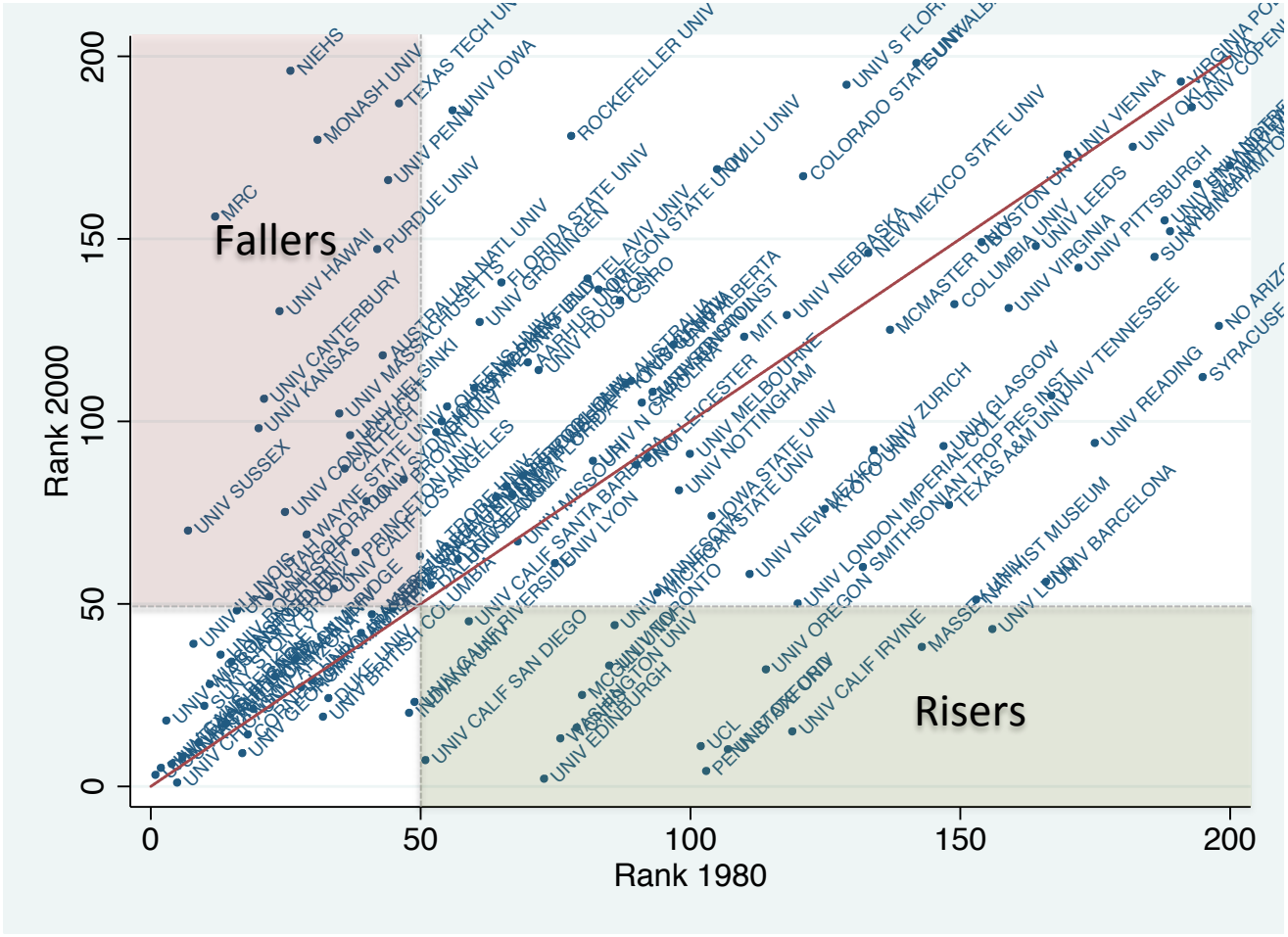
1980-1990



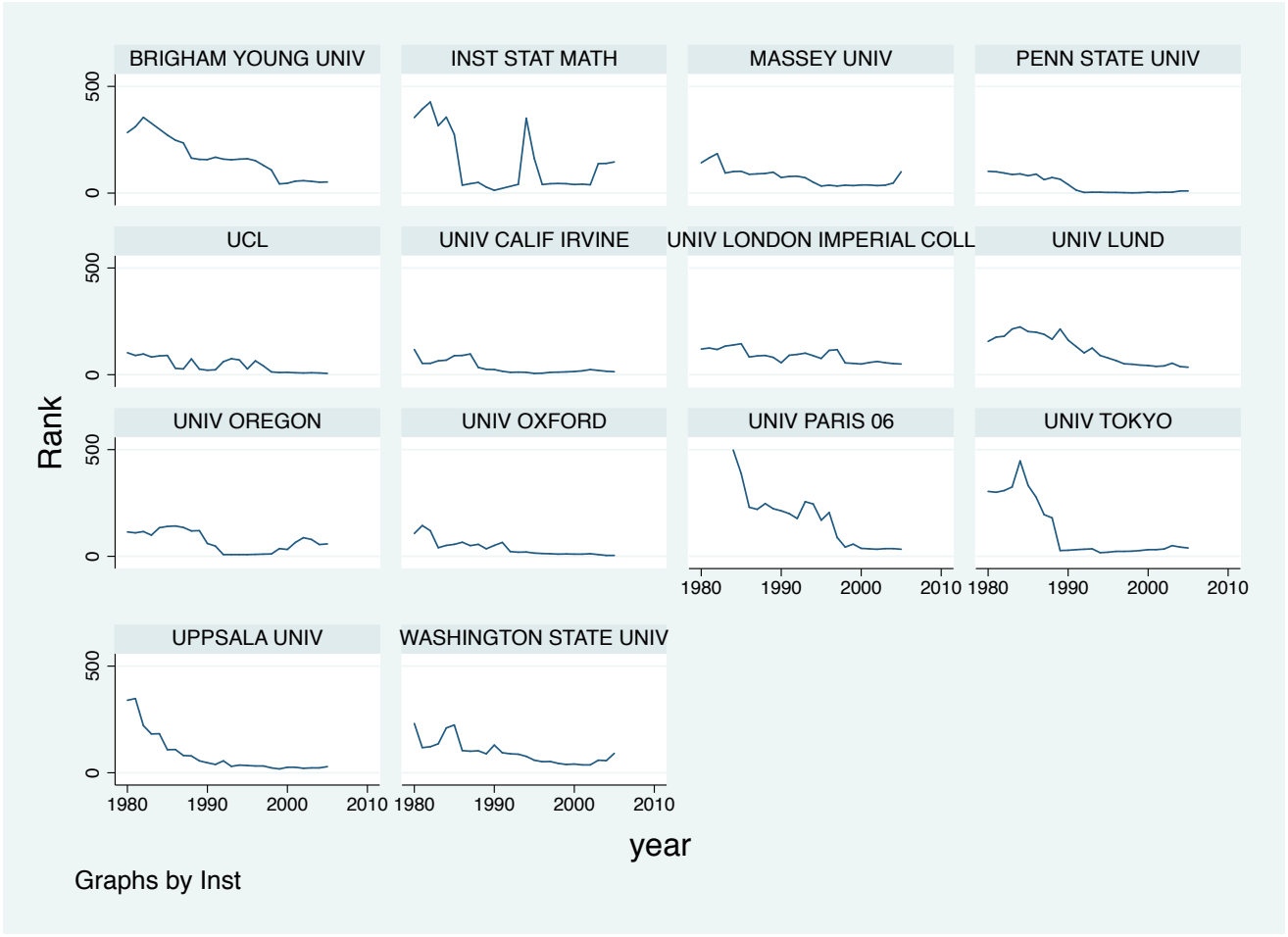
1990-2000



Institutions Rank Change: 1980-2000



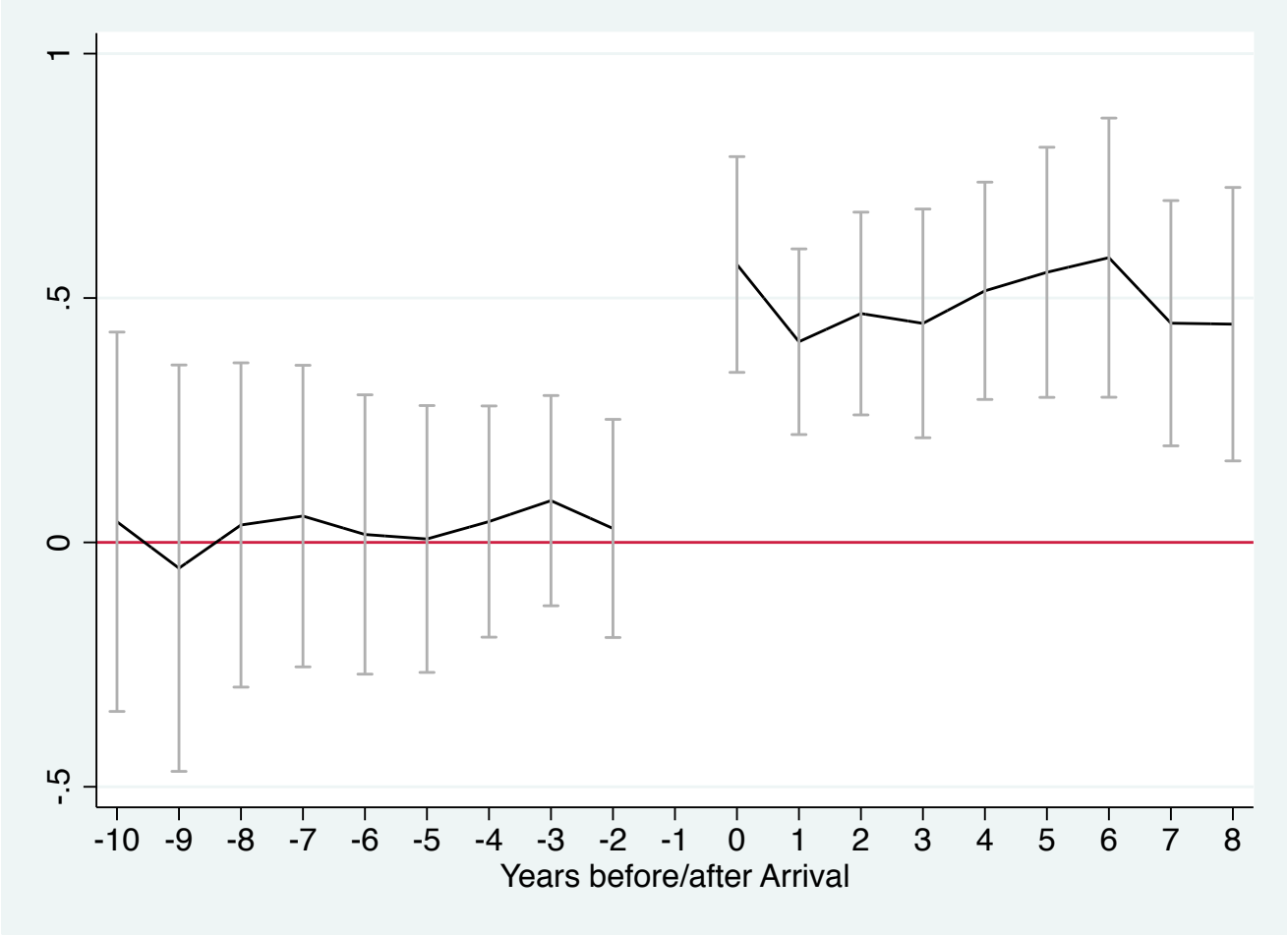
Rank Change for Institutions not in Top 100 in 1980 but in Top 50 by 2000



Stars and Institution-Level Productivity

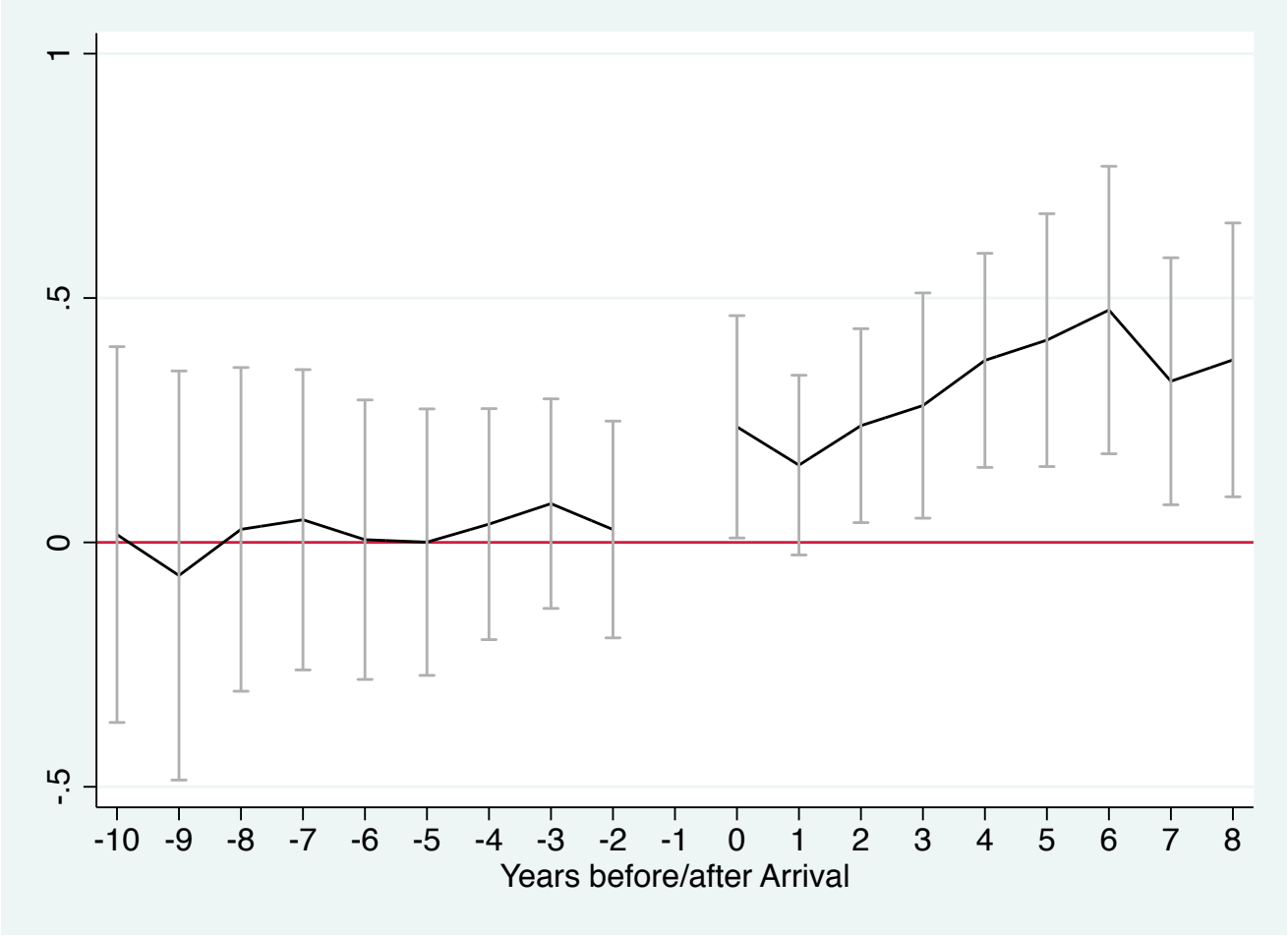
- Estimating Equation
- $Y_{it} = \exp(StarArrival_{it} + Scientists_{it} + d_t + r_i)$
- Where
  - Y: citation-weighted publication count for institution *i* in year *t*
  - StarArrival is set to one the year institution i receives a star for the first time and stays on thereafter
  - Scientists is the number of scientists at institution i in year t.
  - d is a series of year fixed effects
  - r is a series of institution fixed effects

Institution-Level Productivity Before and After Star Arrival



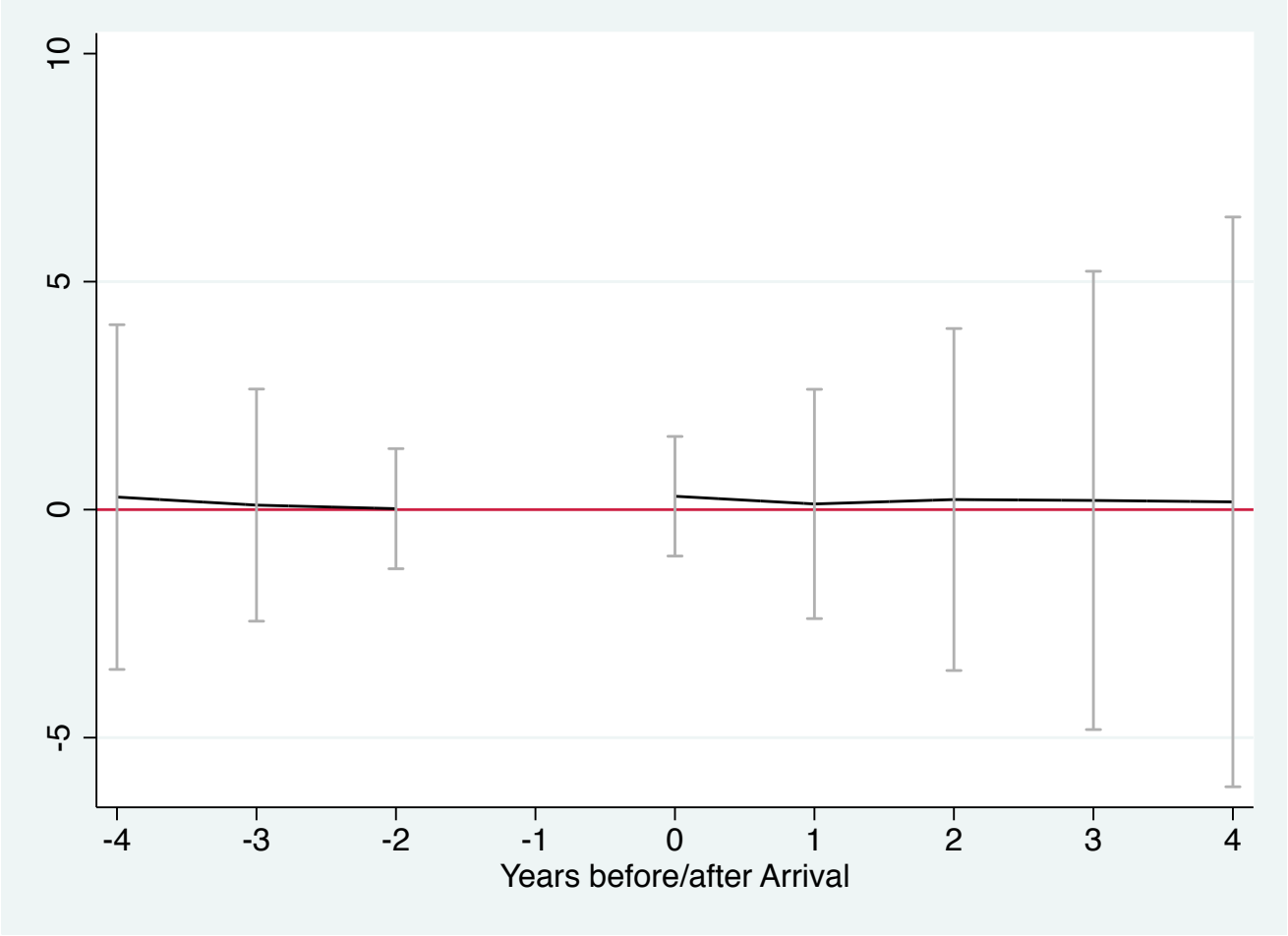
Baseline is year before star arrival

Institution-Level Productivity with Star Data Removed



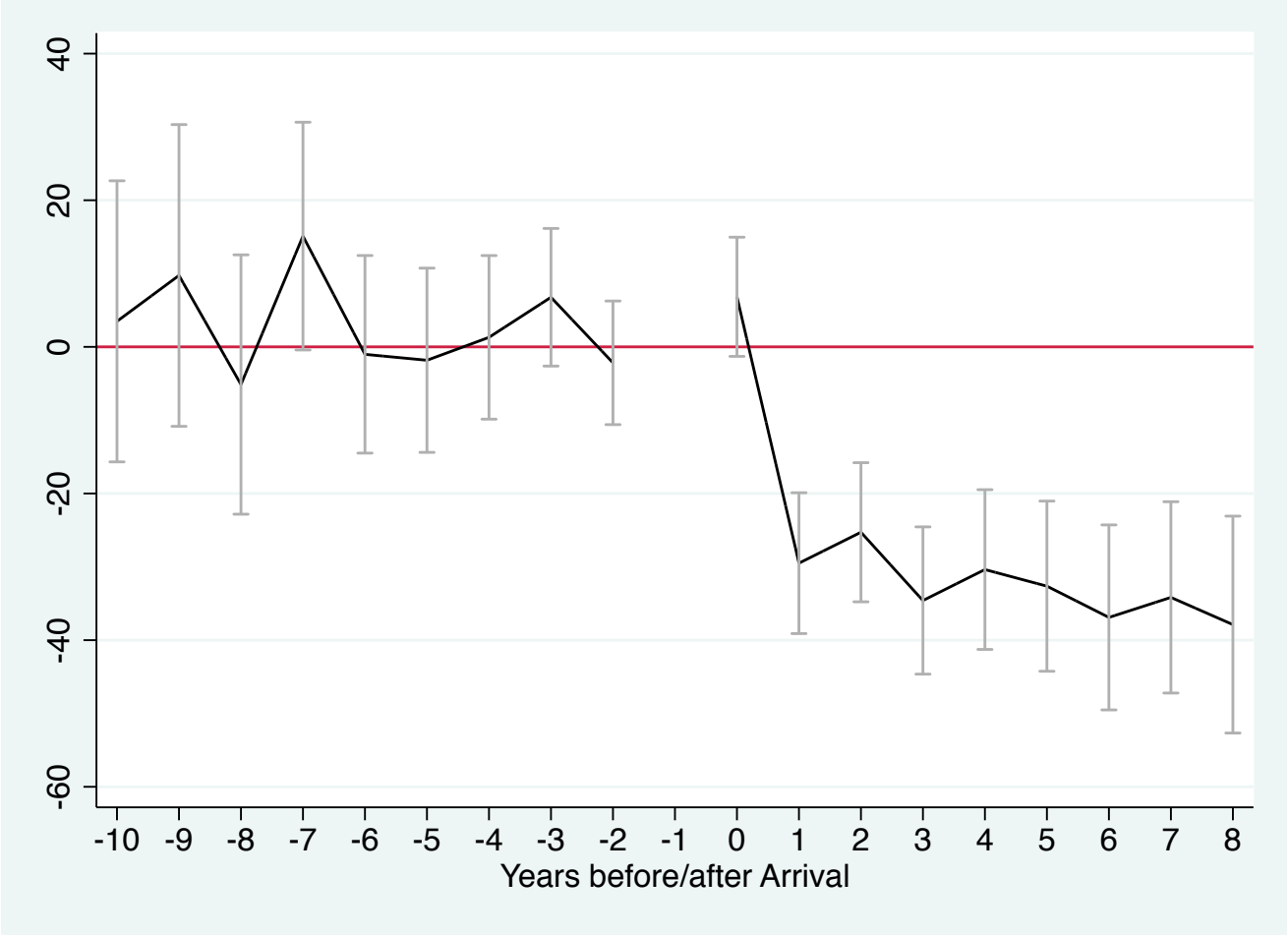
Baseline is year before star arrival

No Effect on Incumbents



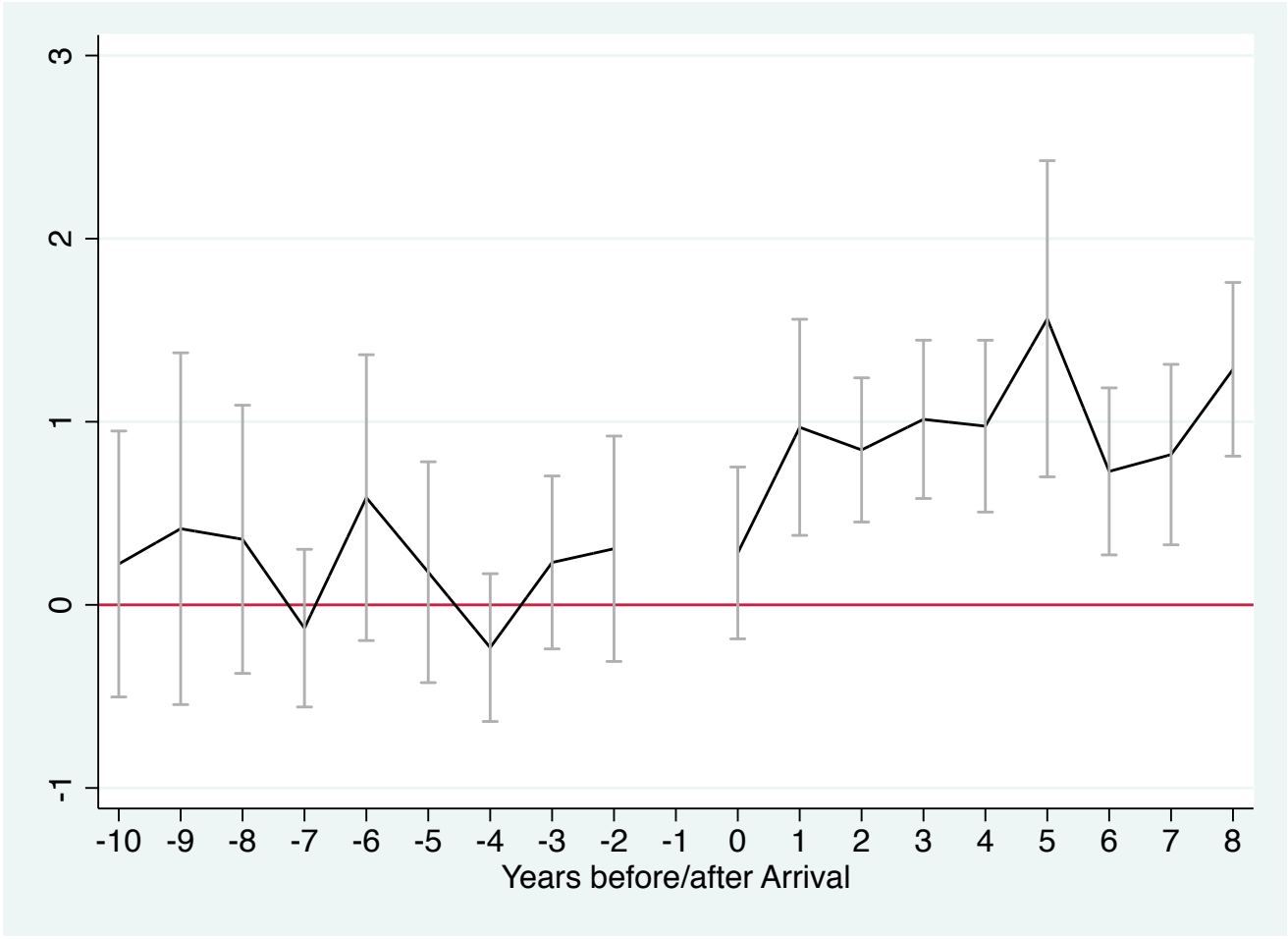
Baseline is year before star arrival

Source Institution Rank for New Hires Before and After Star Arrival



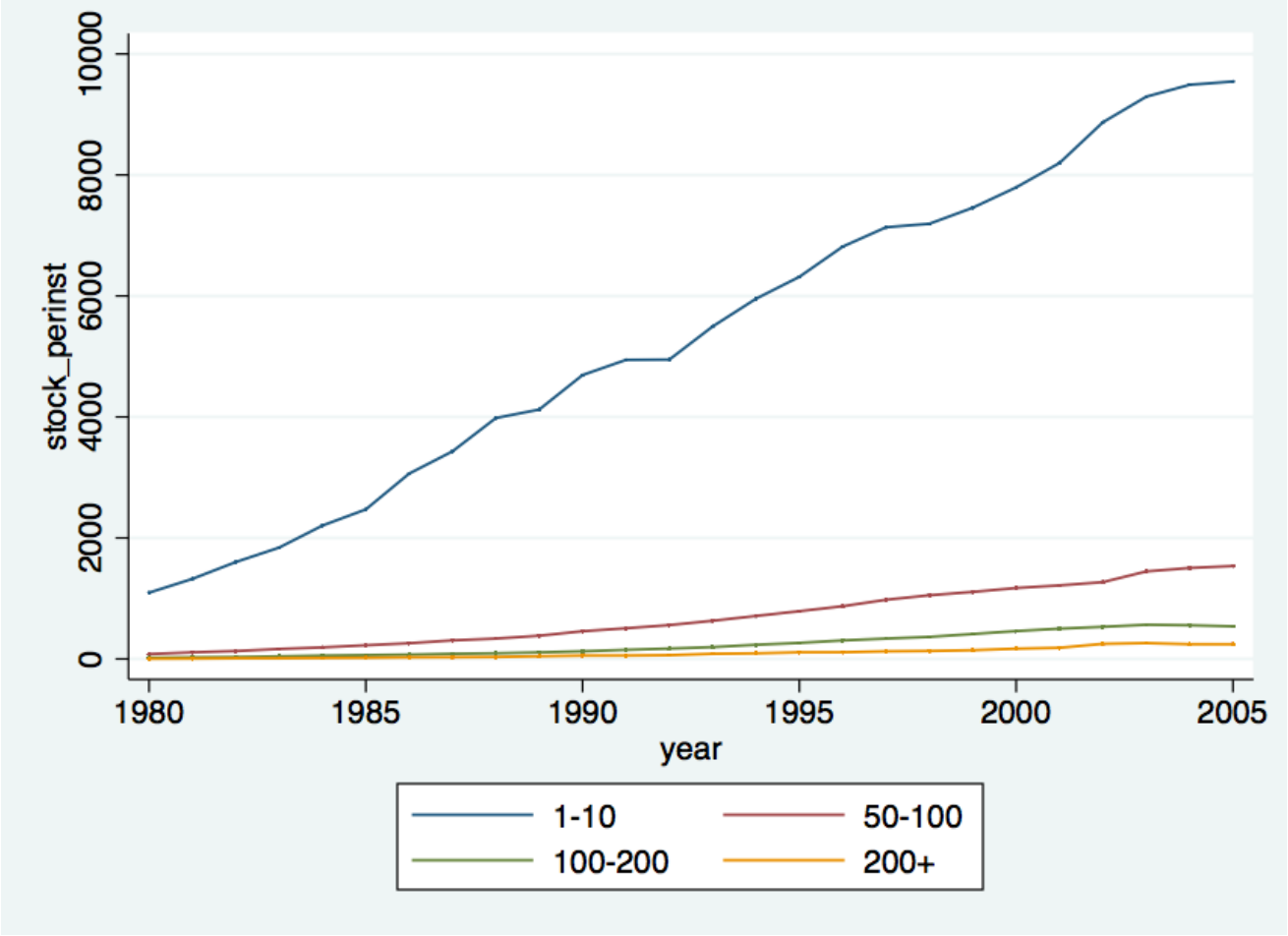
Baseline is year before star arrival

Quality of Incoming Scientists Before and After Star Arrival

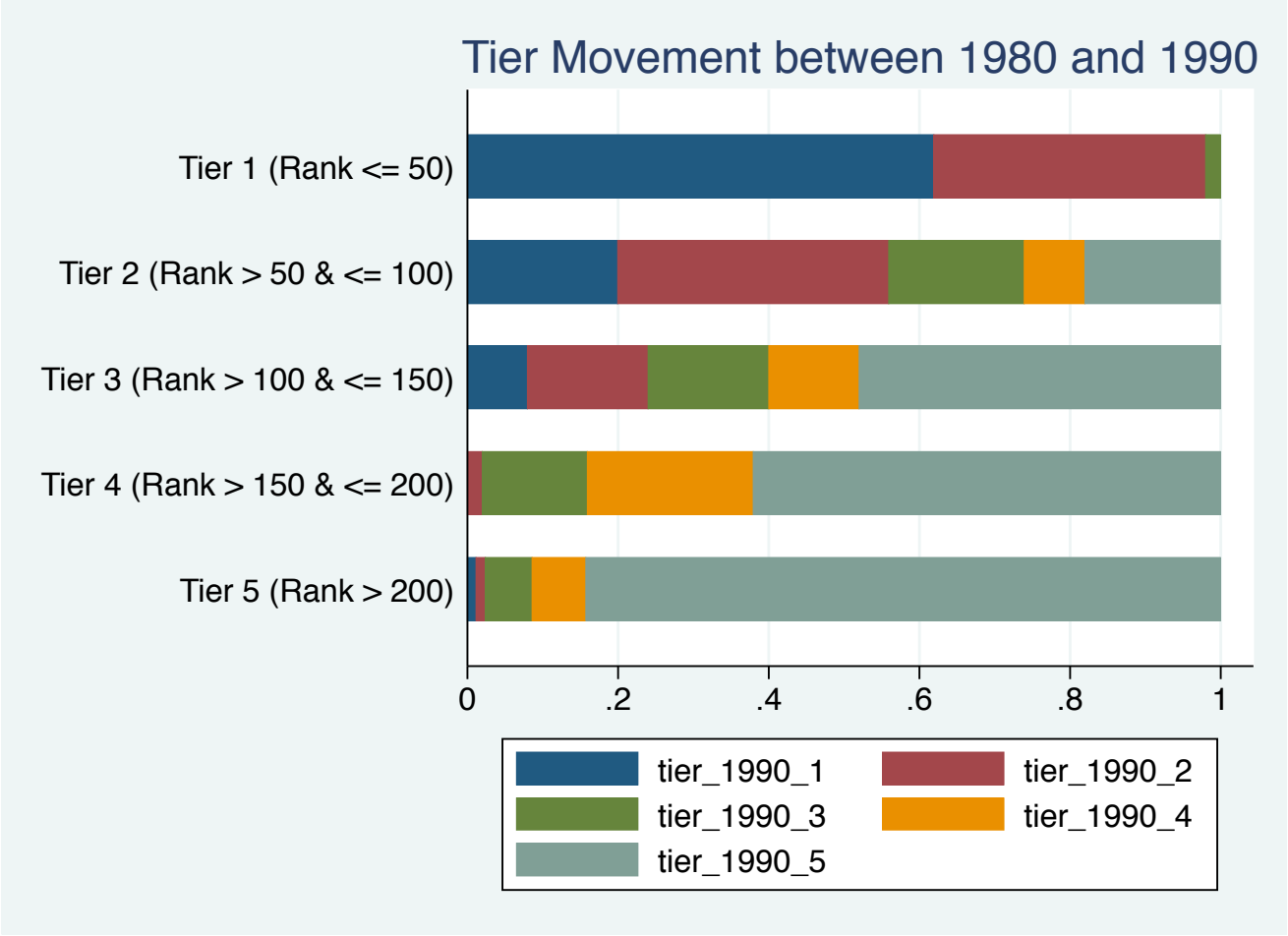


Baseline is year before star arrival

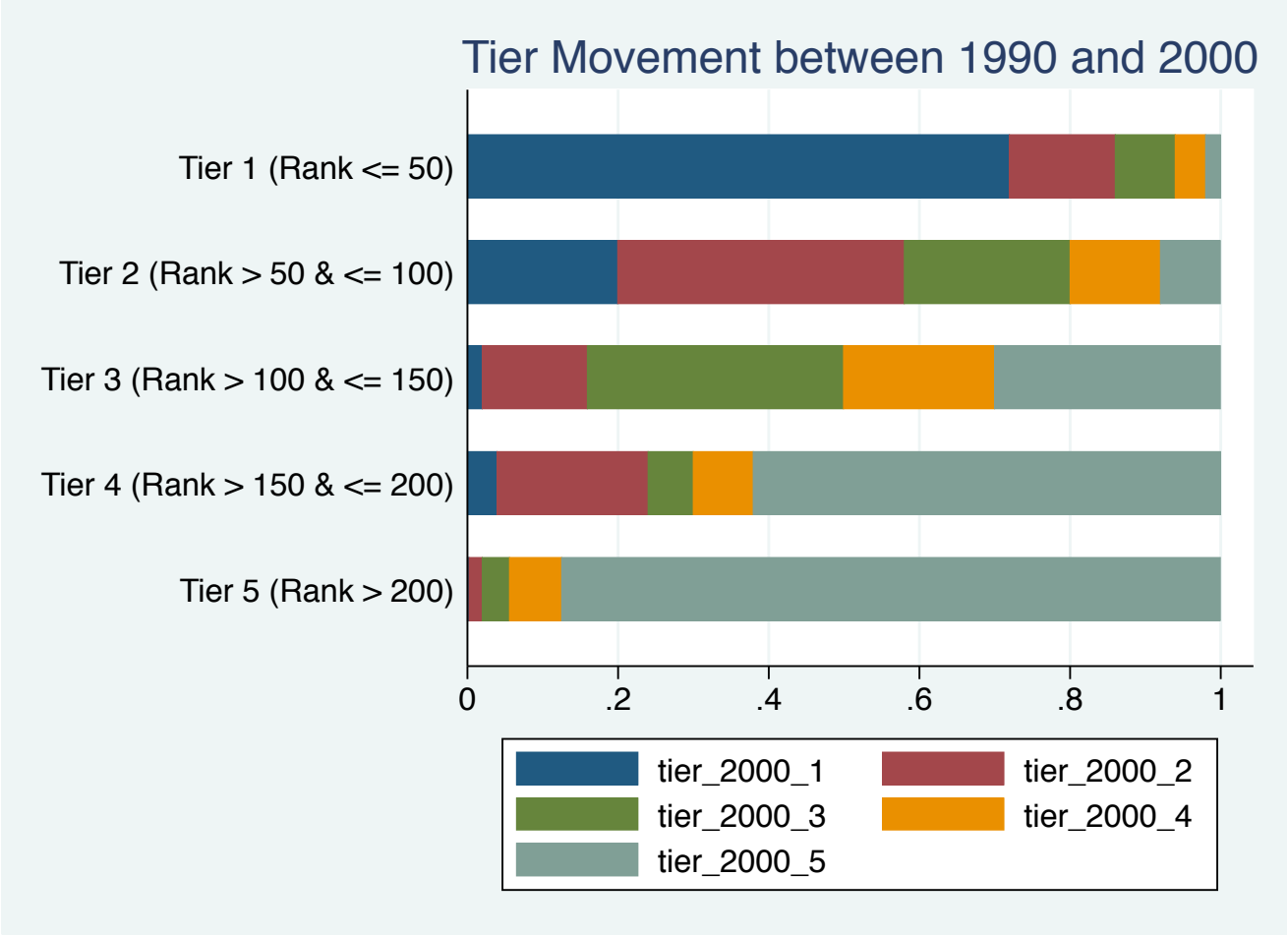
Agglomeration of Talent
Average Pub Stock per Institution



Institution Rank Change: 1980 – 1990

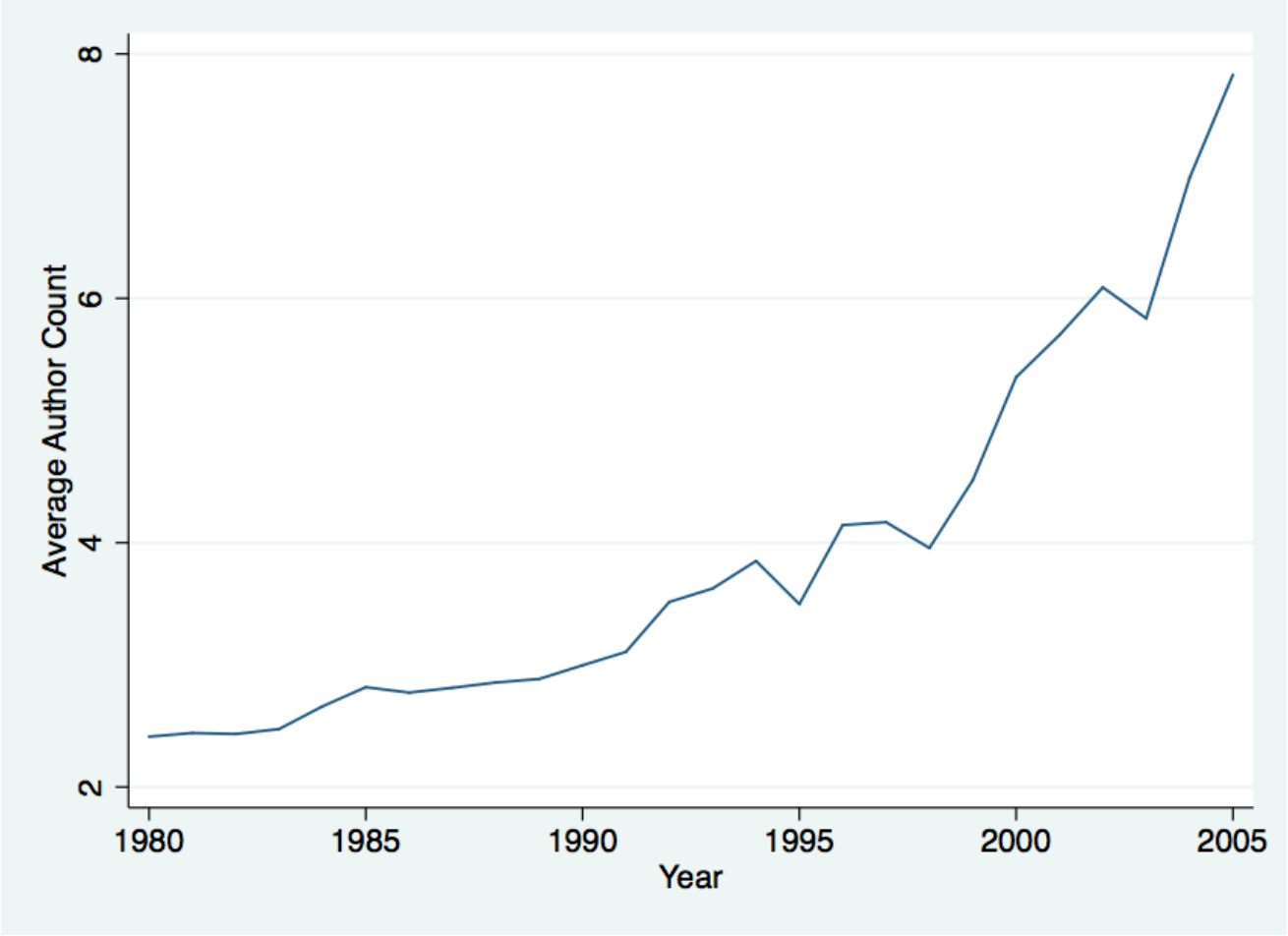


Institution Rank Change: 1990 – 2000

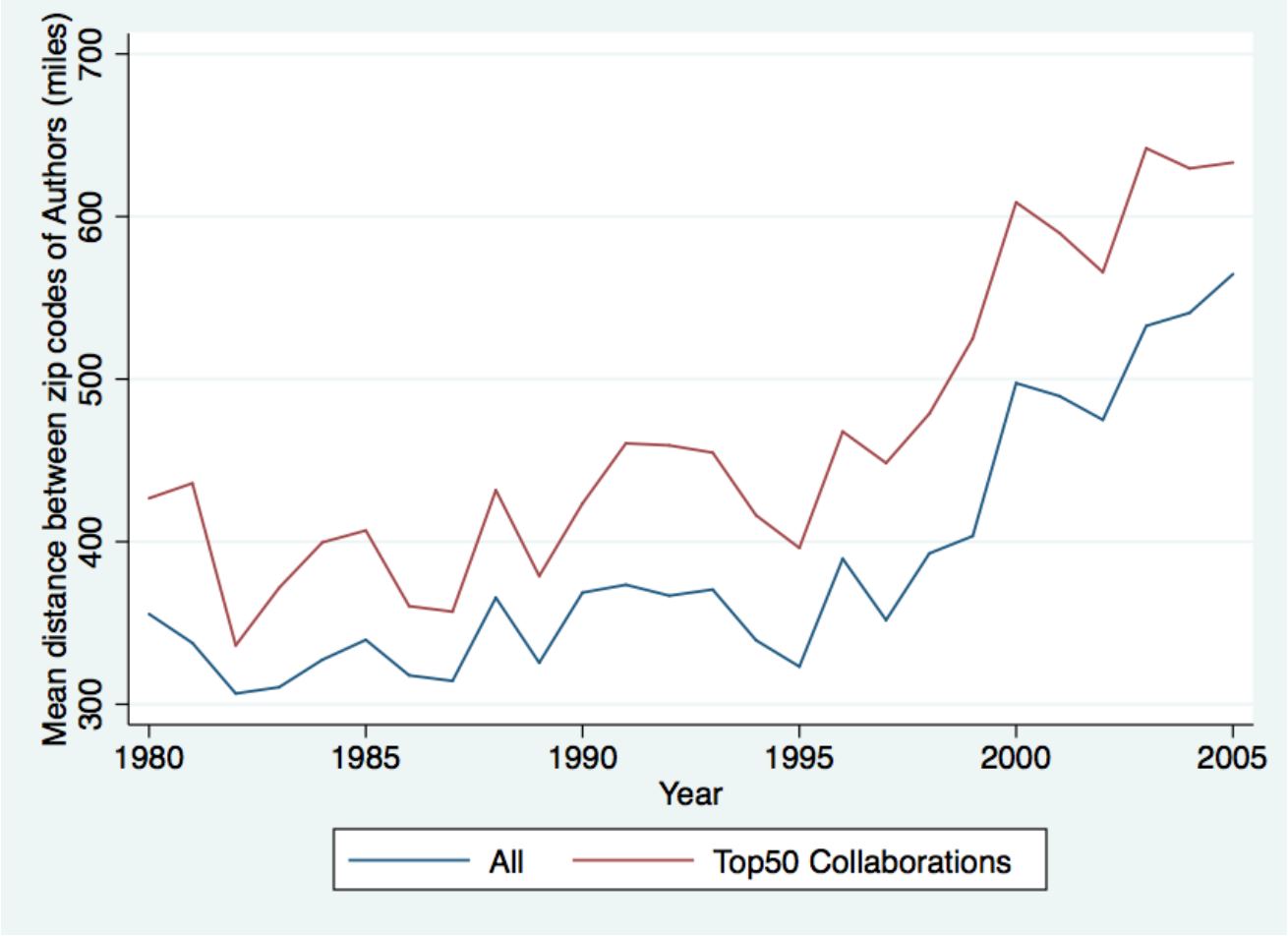


3. COLLABORATION

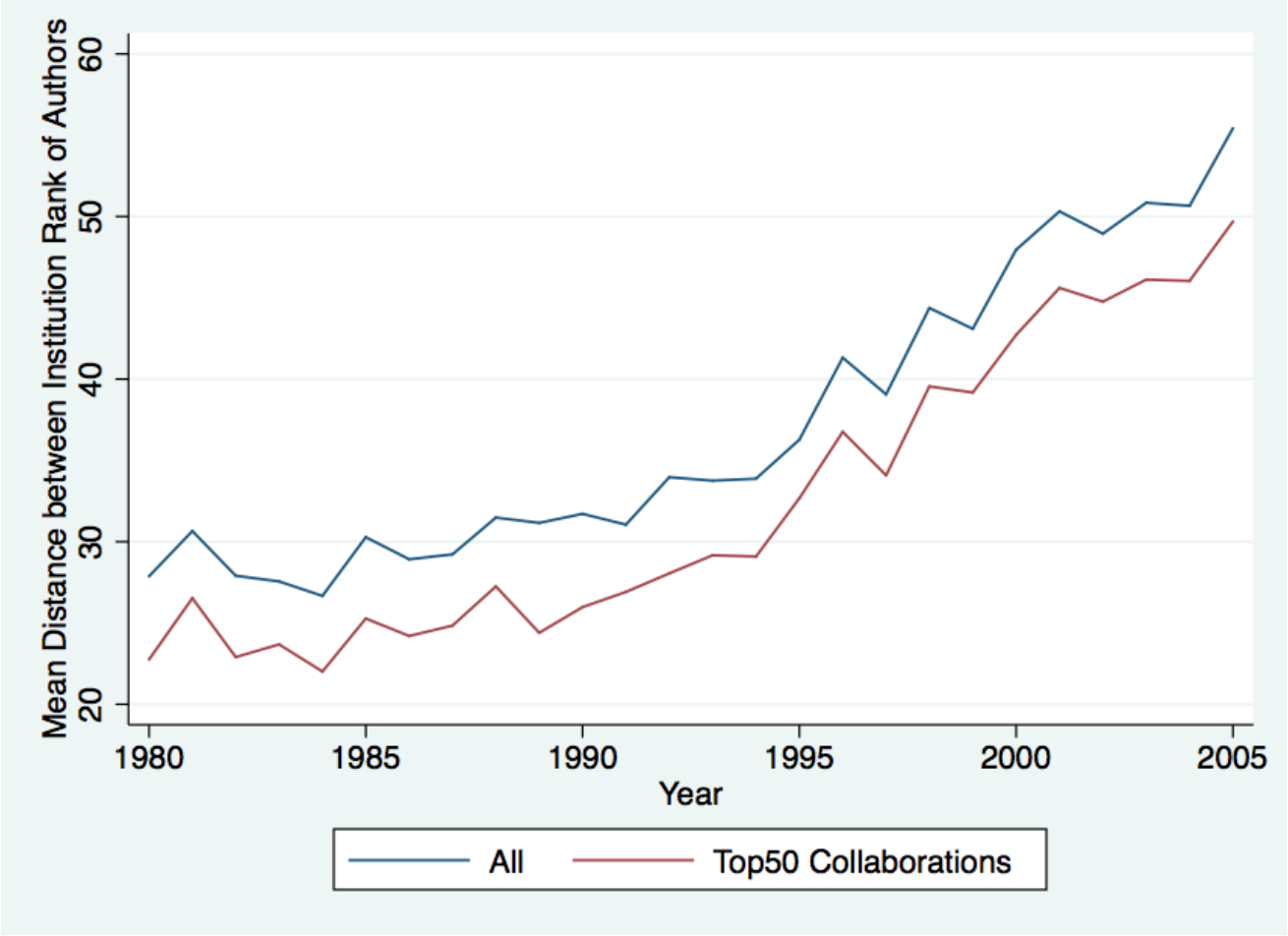
Collaboration
Number of Coauthors



Collaboration
Geographic Distance Between Coauthors



Collaboration
Rank Distance Between Coauthors



Unifying Explanation?

1. Broadening base of knowledge production
2. Agglomeration of stars
3. Increasing collaboration, including across tiers

- Increasing returns to division of labor?
- Leaders and workers
  - Within versus across project division of labor
    - Within: leadership, funding, ideas versus execution
    - Across: Radical versus incremental
- Increasing returns to co-location for sharing ideas relative to execution?
  - Knowledge frontier, communication costs, equipment costs, funding

THANK YOU