Collaboration and Leadership

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Leadership in science
The traditional idea of scientific leadership

• Popular characterizations of (western) scientific history is full of scientific “leaders”
But science has changed, it's more...

- collaborative, with bigger teams
- international
- expensive
What does leadership mean in global, collaborative science?
The many faces of mobility leadership
Who/what do we think of as “leader”?

• People?

• Institutions?

• Countries?
What makes them a leader?
Leadership in an *activity measure*

- Who produces the most publications?
- Who receives the most citations?
- Who builds most on the most recently published literature?
Leadership in expenditure

• Who spends the most money?
Leadership in *contribution*

- Who contributes the most to international publications?

- Authorship indicates leadership
  - First
  - Last
  - Corresponding

Many ways of thinking about leadership
But here, we are concerned mostly with *contribution* at the *country-level*
Country’s leadership, mobility, and collaboration has been studied, but...
Well-studied “elite” countries
Understudied Periphery
Moving away from the elite

To understand the global system of science, we need to move away from the “elite” and towards a comprehensive analysis of international scientific partnership.
Goal: Investigate the costs/benefits of international collaboration and leadership in science for countries while bringing non-elite countries into the fold and assessing the impact of
Terminology and considerations
3 categories of collaboration

Defined at the publication level
No collaboration
Domestic collaborations
International collaboration
Operationalizing leadership:

*Corresponding, first, or last* authorship...
Leadership relative to size
Leadership relative to size...

8 total

2 leading
Leadership relative to size...

16 total

2 leading
Data and methods
Web of Science

papers, reviews and conference proceedings

19,460,980

100 Countries
Research and development expenditure (% of GDP)

Expenditures for research and development are current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development.

Source: World Bank – WDI: Research and development expenditure (% of GDP)
Results
Collaboration profiles

Blue = % International collaboration

Yellow = % National collaboration

Grey = % No collaboration
Collaboration profiles

**China:**
Low international collaboration
High domestic collaboration

**Peru:**
High international collaboration
Very little international work
Collaboration profiles -> Leadership
The more dependent on international collaboration, the less they are in leadership positions.
Citation score (MNCS) by collaboration type

X-axis = MNCS

Blue dot = international collaboration

Red x = National (domestic) collab

Green triangle = No collaboration
International collaboration results in high-impact research

Notice that the blue dots (international collaboration) have a higher citation score than other dots.
% of international publications in leadership role and proportion of country’s research expenditure

![Graph showing the relationship between % of papers in leadership role and GERD/GDP ratio with an R² of 0.41.]
Scientifically “rich” countries are most often leaders
Now citation score (MNCS) by proportion research expenditure
Scientifically “rich” countries also have higher citation scores when leading.
Does leading give a citation benefit over not leading, in an international collaboration?

Added benefit from leading

Has a cost to leading
Only the U.S.A. sees a citation **advantage** from leadership

- Added benefit from leading
- Has a cost to leading
International collaboration has benefit, but leadership rarely gives additional benefit.
But its complicated...
Heterogeneity...

<table>
<thead>
<tr>
<th>Country</th>
<th>Non-leading country</th>
<th>Red = high citation percentile</th>
<th>Blue = low citation percentile</th>
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<td>Japan</td>
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Legend: Red = high citation percentile, Blue = low citation percentile.
Heterogeneity...

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Strong collaborations
Heterogeneity...

But not as strong collaboration between high and low investment countries

**Leading country**

**Non-leading country**

Red = high citation percentile
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Heterogeneity...

Leading country

Non-leading country

Red = high citation percentile
Blue = low citation percentile

Argentina

A regional leader?
Summary of findings
Summary (1): Money Matters

• The greater the research activity and investment, the more *internalized* the production

• But these countries likely to lead when they do collaborate

• Low-investment, low-activity nations are highly international, less likely to lead
Summary (2): Collaboration and leadership

- International collaboration almost always has benefits to citations

- But leading on publications rarely offers much more benefit
Summary (3): Not all partnerships are equal
Closing thoughts
What detail do we lose with bibliometrics?
What about disciplinary specialization?

Tropical Medicine

Experimental Physics

Miao & Murray, 2018 (not yet submitted)
Who sets the agenda?

• “Following” leads to more citations

• Is the “periphery” able to set their own agenda and follow their own priorities?
Thanks!

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