

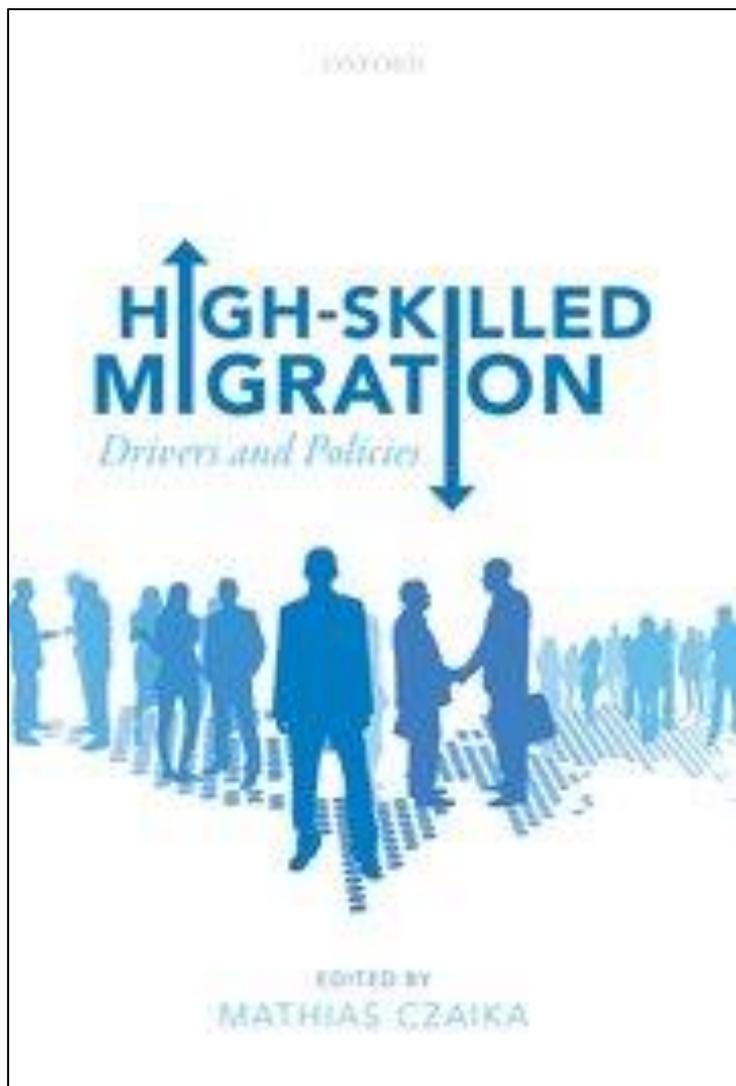
Measuring Global Scientific Mobility

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The Issue

- International **mobility of scientists** contributes to the creation and diffusion of scientific knowledge
- It is hoped that scientific mobility contributes to **bring scientifically deprived societies** to the **frontier** of technological progress, innovation and economic development.
- **Policy implication:** Attracting high-level academics and researchers is an objective of many countries and institutions around the world
 - Share of foreign-born scientists in Switzerland (56%), Canada (47%), Australia (45%), US (38%), UK (32%)
 - India-born researchers working abroad: ~40%

The project

Research questions:

- How has global scientific mobility evolved over past decades?
- What drives mobility of scientists?
- What is the role of scientific mobility in international knowledge diffusion and concentration?

Data:

- Construction of migration flow database of (research-active) scientists using bibliometric information which allows comprehensive identification of CHANGES in institutional affiliations of research-active academics/scientists
- Global coverage of bilateral flows of research-active scientists between 180 countries in period 1970-present
- [International research collaborations (co-authorships)]
- [International citations]

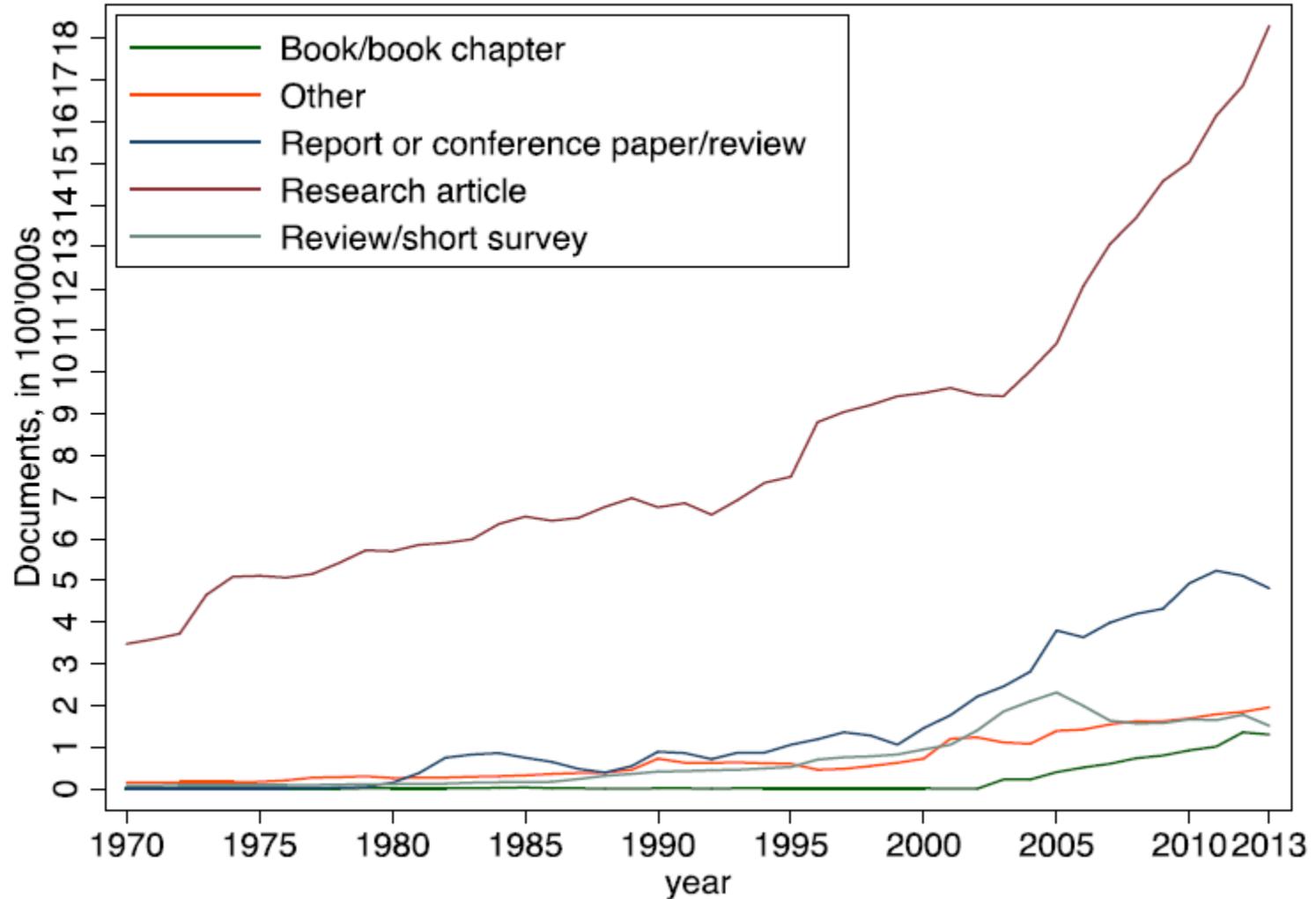
Source of information

- **Bibliometric information from** Elsevier's Scopus database (cf. Moed/Halevi 2014, Appelt et al 2015).
- Every author's **country of affiliation** in any given year is used to infer their **place of residence** in that year
- After **extracting affiliation information** of authors, based on the name disambiguation data provided by Scopus we can infer whether a **person's country of affiliation has changed** between different publications.

Methodological issues

- Unique author IDs
- “Research-(in-)active” periods
- Non-English publications underrepresented
- Migration data suffer a **time lag** of the actual location due to the publishing lag
- Multiple affiliations across different countries
- Records are **less accurate for less prolific authors** and for those who move from and into roles for which disclosure in scholarly journals is not the norm (e.g. **researchers working in industry**) or researchers in some domains **using books as the main scholarly communication vehicle.**
- Disciplinary bias

Growth in the number of documents in the Scopus database

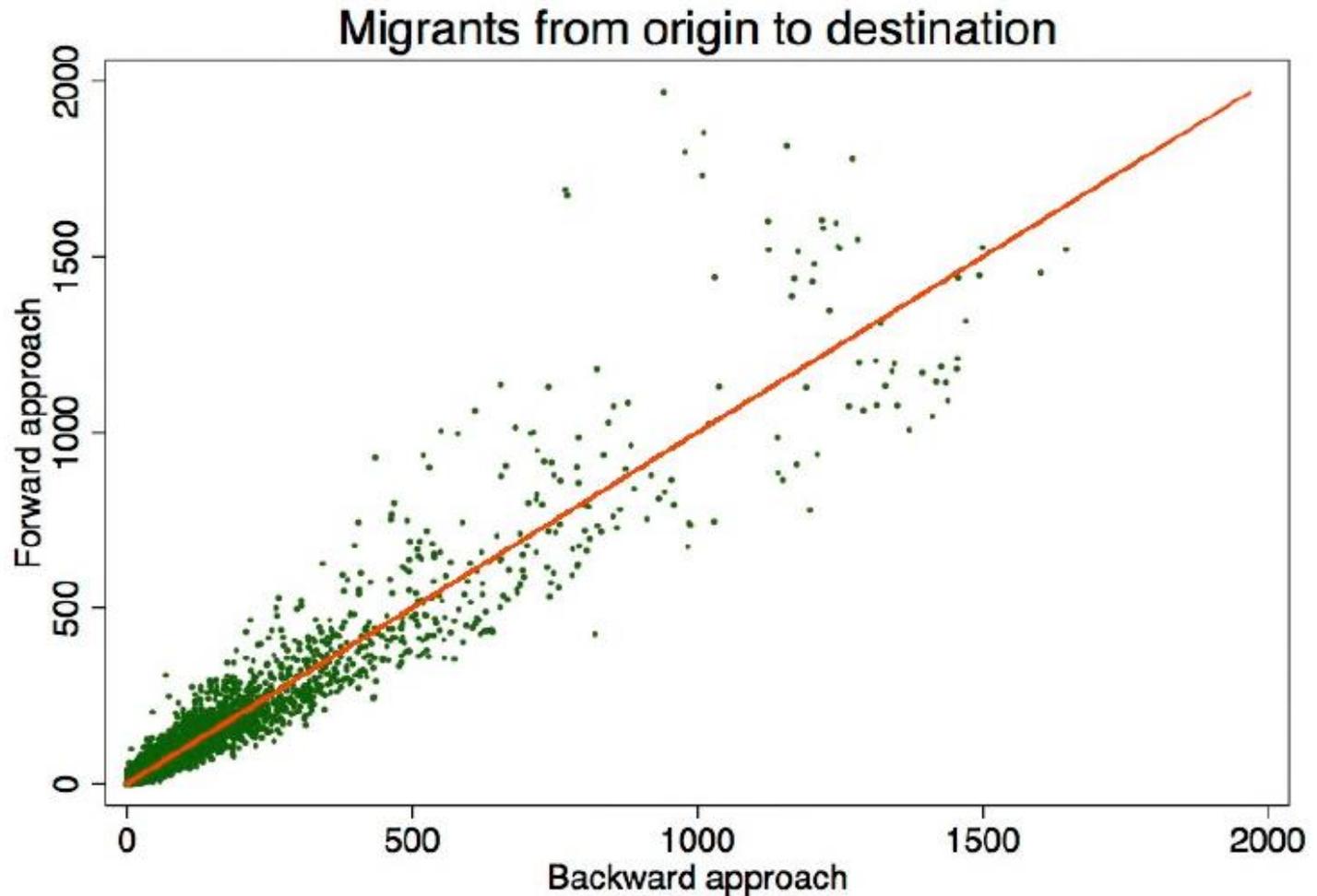


Imputing data:

Forward vs. backward fill approach

- If information on the **country of affiliation is missing** for any given year, then this information is inferred based on past and future countries of affiliations using two approaches.
- The fill-forward approach assumes that the author did not change country of affiliation during the inactive years, i.e. during the years when there are no publications;
- the fill-backward approach assumes that the author changed the country of affiliation one year after the last known affiliation.
- Once the information on each author's country of affiliation in every year was obtained/constructed, the migration episodes were calculated whenever the author changed country of affiliation.

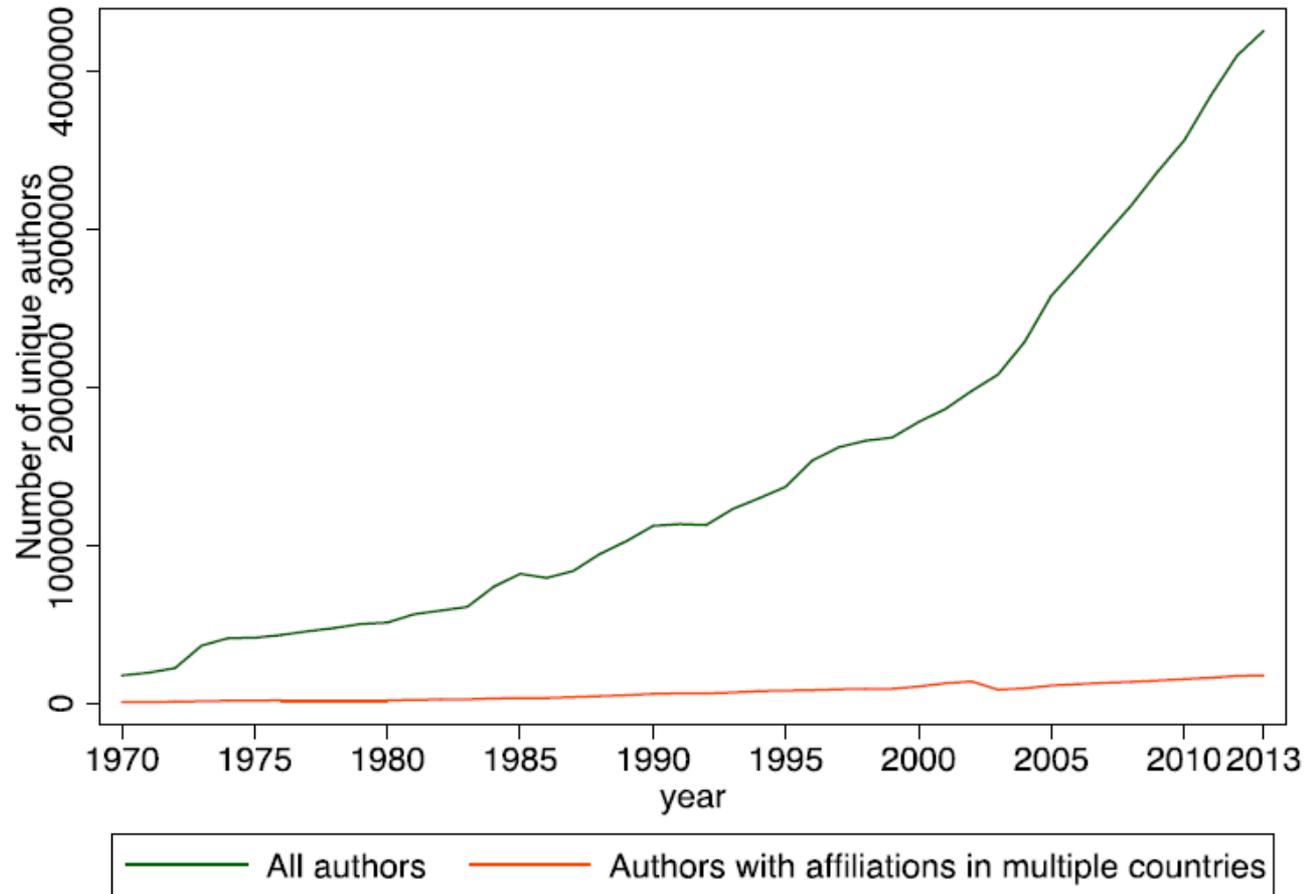
Comparison of migration flows calculated using forward and backward approaches



Multiple affiliations and change in academic status

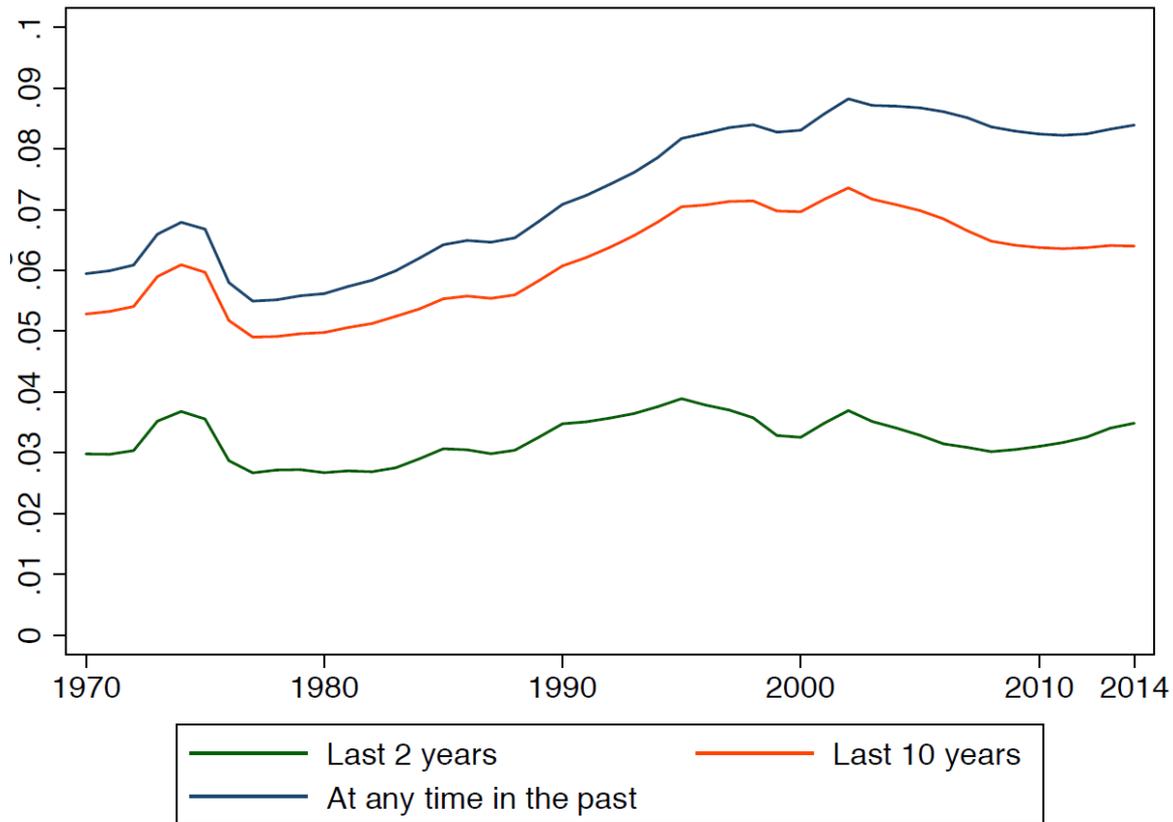
- Most authors have affiliations that allow unique identification of country of residence.
- However, a small share of the research-active authors report **affiliations in multiple countries.**
- The share of authors with affiliations in multiple countries varies over time, but is about **4% of the active authors** in any given year.
 - Drop multi-affiliations or authors
 - Calculate migration events assuming that the multi-country authors move between the (multiple) countries of their affiliation.
- Changes in academic status from a Ph.D. to a post-doc position or from associate to full professorship cannot be identified based on the information available
 - Restrict migration episodes within the first two, three, and five years of the research careers as proxy for PhD students/Post-doc periods (cf. Moed et al 2013).

Number of unique authors in the Scopus database



Global migration intensity of scientists, 1970-2014

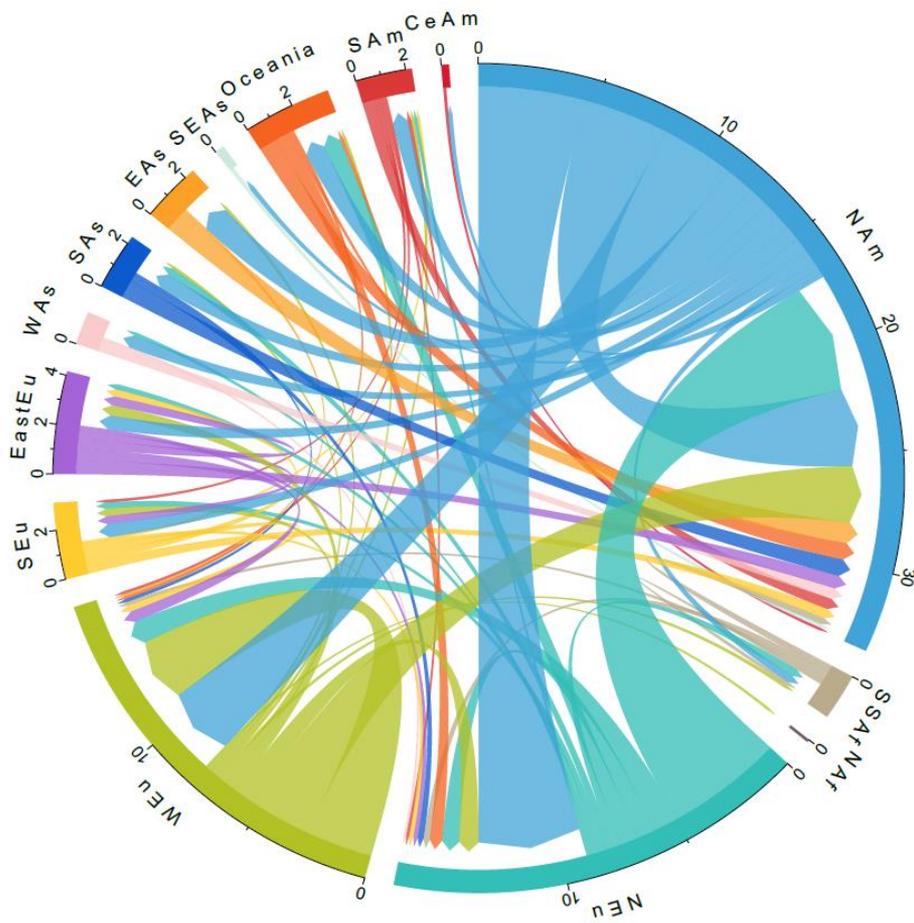
Share of scientists who changed country affiliation within...



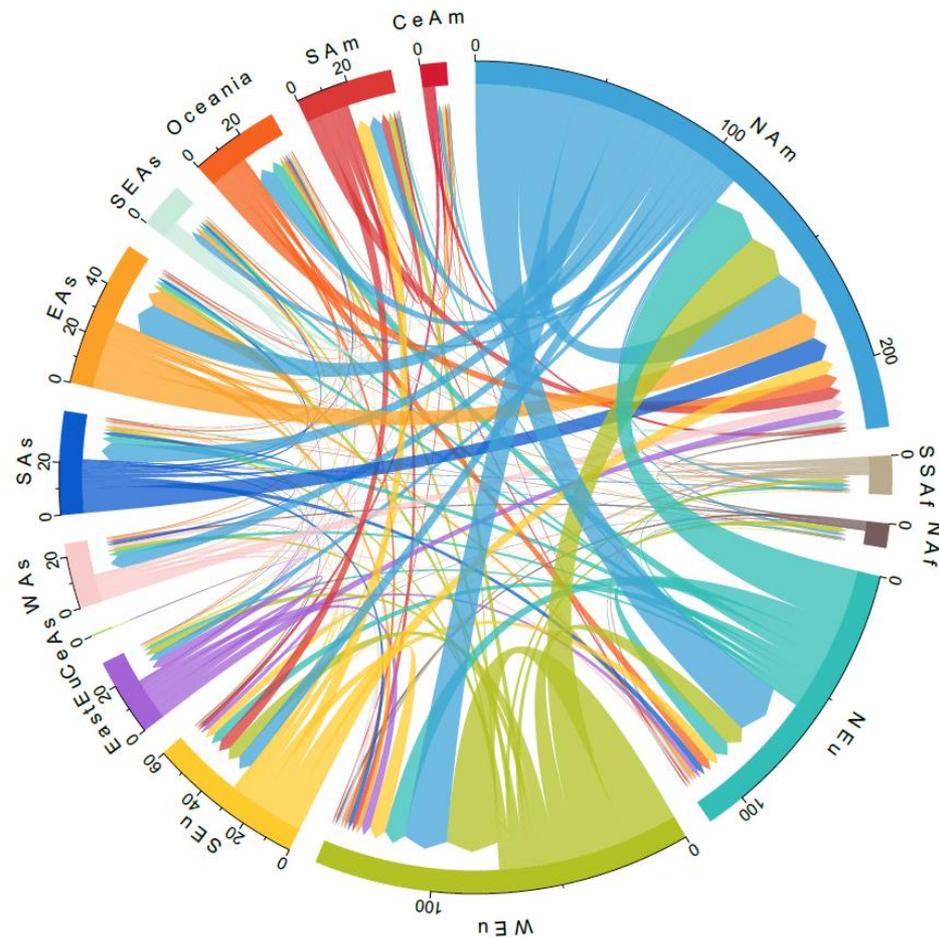
Source: Czaika/Ozarbayev (forthcoming)

Global migration patterns of scientists, 1970s vs 2000s

1970 - 1979



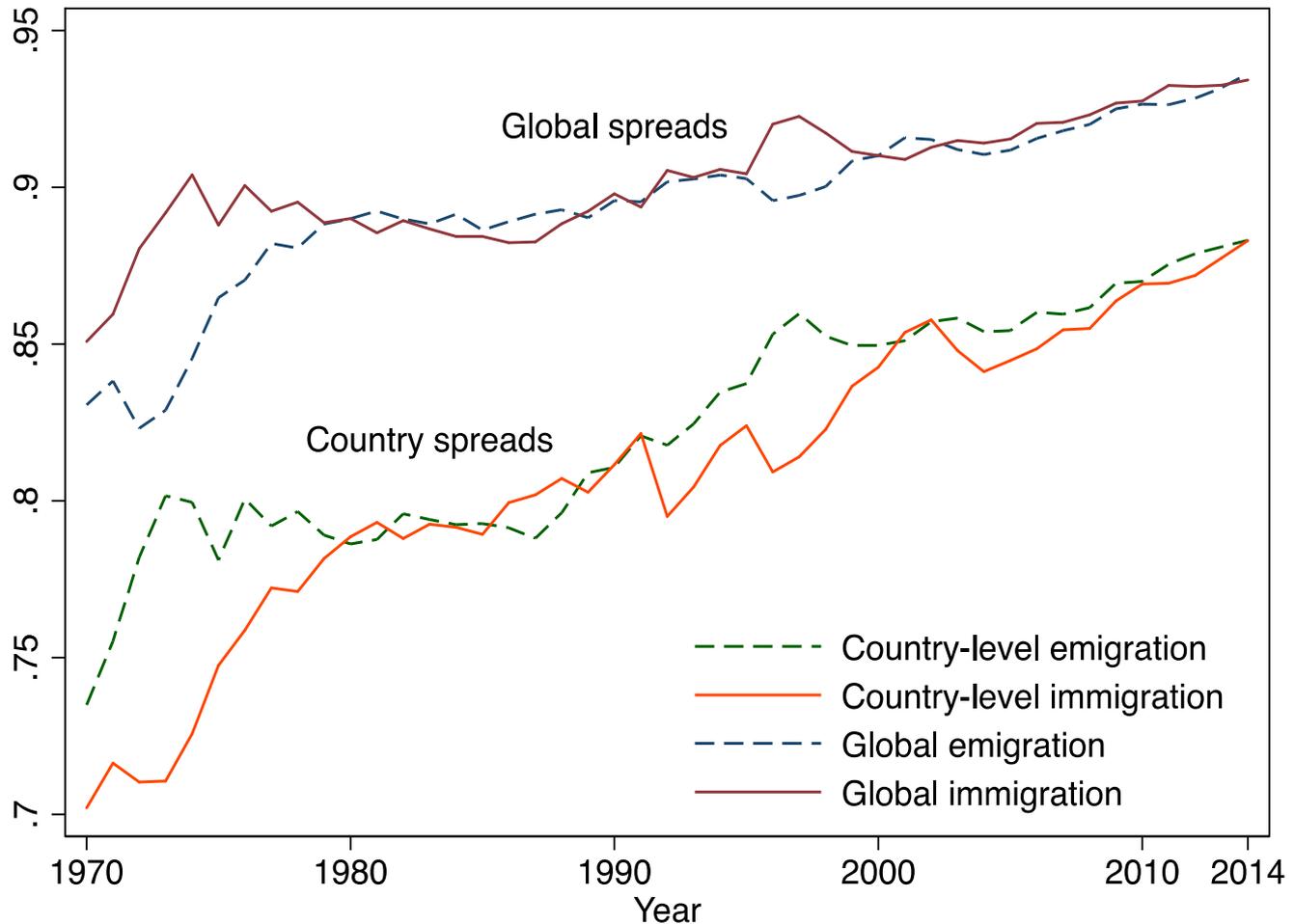
2000 - 2014



Source: Czaika/Ozarbayev (forthcoming)

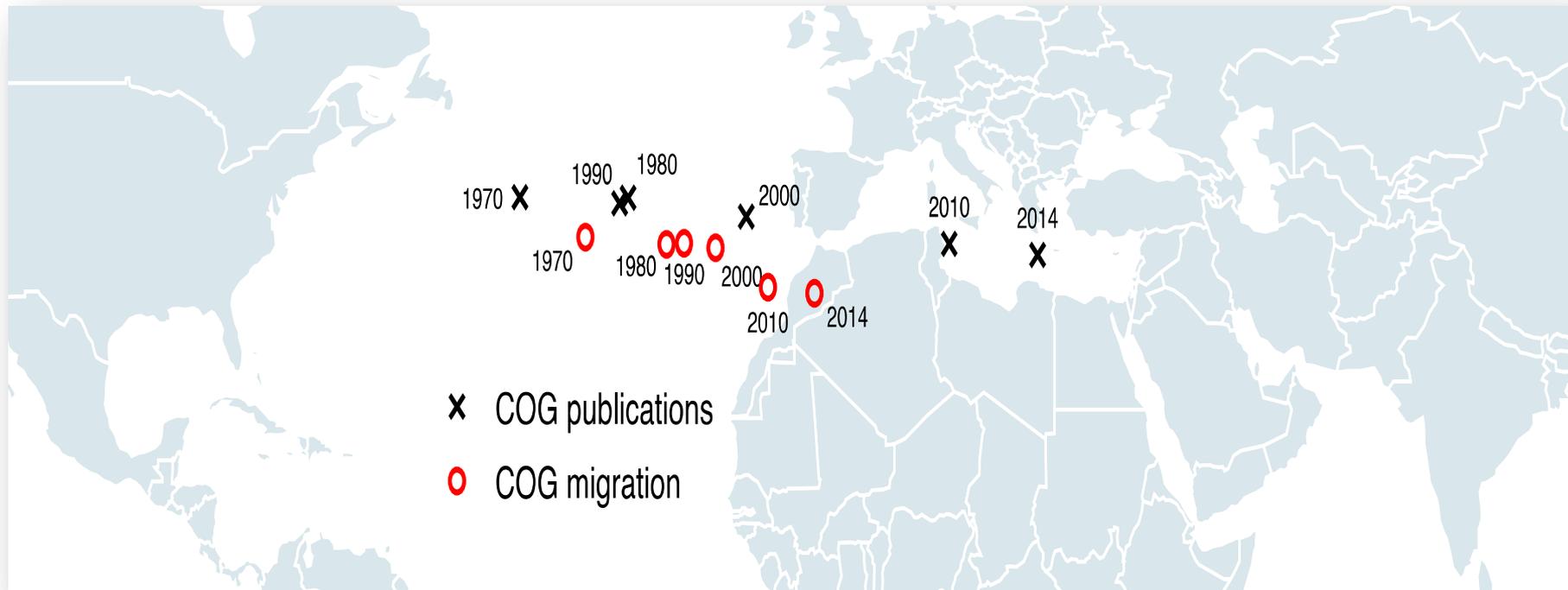
Global 'de-concentration' of scientific mobility

Emigration and immigration spread at global and country level



Source: Czaika/Ozarbayev (forthcoming)

Moving global centres of gravity of scientific activity and migration destinations, 1970-2014



Source: Czaika/Ozarbayev (forthcoming)

Visa restriction and scientific mobility (Panel FE regression), 1973–2013

$$\ln M_{odt} = \beta_1 + \beta_2 visa_{odt} + \eta_{od} + \gamma_{ot} + \theta_{dt} + \varepsilon_{odt}$$

DV: Scientists flow (log)	(1)	(2)	(3)	(4)
Estimator	OLS	OLS	OLS	Pseudo-Poisson
Visa	-0.065*** (0.009)	-0.032*** (0.011)	-0.018*** (0.002)	-0.031*** (0.010)
R-squared (overall)	0.82	0.88	0.81	.
Observations	74,559	72,017	420,632	303,097
Dyad fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	No	No	No
Origin-time fixed effect	No	Yes	Yes	Yes
Destination-time fixed effect	No	Yes	Yes	Yes

Note: Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Some findings

- An **increasing diversification of countries of origin *and* destination** attracting (back) increasing numbers of mobile scientists.
- **Migration rates for scientists** are more than **three times larger** than average rates for other international migrants
- However, **major shifts** in the globalisation of science are **largely directional** with new world regions increasingly integrating into the global scientific system of knowledge mobility.
- The **global centre of gravity of scientific knowledge production** and scientists-attracting places has been **moving continuously eastwards**
- Increasing **average migration distances** reflecting a continued integration of former scientific peripheries into the global science system.
- **Low but non-negligible mobility frictions for internationally mobile scientists** compared to other international migrants, with visa restrictions establishing a measurable barrier of international mobility of scientists and the global diffusion of scientific knowledge.
- Growing intensity of international **research collaborations**

Conclusion

Bibliometric approach is promising, but outcomes should be interpreted with care, and ideally combined with complementary data sources such as administrative data, (online) surveys or CV data

Thank you for your attention!

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