Local Gains from Global Minds? The Influence of International Scientific Mobility on Non-Mobile Scholars

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2025 ASSA Annual Meeting
San Francisco, 03 January 2025

International scientific mobility

Mobile scientists benefit from international mobility (Bozeman et al., 2001)

- Acquire co-authorship networks (Gibson & McKenzie, 2014; Jonkers & Tijssen, 2008); are more productive (Franzoni et al., 2014; and Aykac, 2021); and diversify their research agenda (Aman, 2020; Petersen, 2018)

Brain Drain vs Brain Circulation

- **Reduced scientific production** in sending countries, when scientists remain abroad (Cañibano & Woolley, 2015)
- **Diaspora scientists** may contribute to technological development (Saxenian, 2005) and facilitate knowledge flows (Kerr, 2008) collaborating with scientists from their country of origin (Agrawal et al., 2006; Scellato et al., 2015)
- **Returning scientists** carry knowledge, skills and networks when returning home (Cañibano, 2017; Trippl, 2013)

The Role of Internationally Mobile Scientists in Linking Nonmobile with Foreign Scientists (Ito et al, 2024)

- Brazilian and Colombian nonmobile scientists who co-author with at least a mobile scientist, co-author **20-30% more publications with foreign scientists** than their colleagues with similar characteristics
  - Similar effects for STEM and SSH
- The positive effect lasts the year of the co-autorship: **triadic closure** (nonmobile scientist joins a team with the mobile and foreign scientists)
  - Mobiles are gatekeepers: the more mobile scientists a nonmobile co-author with, the greater the extent to which their work include foreign scientists, over the years
- Stronger role of mobile scientists who **do not return home** in Brazil

This paper

We study the **impact of the collaboration between mobile and nonmobile** scientists (from their country of origin) **on the scientific production of nonmobile** scientists

Mobility:

- We use CV and Scholarship data to identify scientists from Colombia and Brazil
- We use publication data to track their mobility pattern

Collaboration

- We consider all research collaborations that produced a co-authored publication between a mobile and a non-mobile scientist

Impacts on nonmobile researchers who co-author with the international mobiles (treated) using an event study (with PSM to to balance the treated and control groups on observed pre-treatment covariates)

- Scientific productivity: publications, citations and novelty
- Research agenda diversification into new topics

Key findings

- On average, co-authoring with mobile researchers **increases the scientific productivity of nonmobiles**: 20-30% more publications; 20% more citations; 4-8% more top journals; more novel research (Brazil)
  - Especially for STEM and diaspora/intermittent (Brazil)
- But these benefits **do not stay with the nonmobiles when they do not co-author**
- Non-mobile researchers are 20pp **less likely to diversify into new topics** than the control group after collaborating with mobile researchers

Paper contribution

- We explore the effects of collaborating with mobile researchers **on nonmobile researchers,** beyond the mobiles (Miller et al., 2024; Fry, 2023)
- We integrate standard measures of **scientific performance** with measures of **novelty of the knowledge produced**
  - **Elasticity of science**: changes in topics investigated by the nonmobile researcher
  - **Global novelty**: novel combination of knowledge
- **Data**: we combine data from CV, Ph.D. lists, and Publications.
- **External validity**: we run the analysis for two rather different countries: Colombia and Brazil

Data and sample

Data (1990-2021)

- **Curriculum vitae data**: Lattes Platform (Lattes snapshot) and Currículum Vitae de Latinoamerica y el Caribe (CvLAC).
- **Ph.D. scholarship list data** from main funding agencies from Brazil (CAPES and CNPq) and Colombia (Colciencias, Colfuturo, and Fulbright Colombia).
- **Publication data**: OpenAlex.

Researcher typology and sample

- **Nonmobile researchers**: have completed their graduate studies in Colombia (Master and PhD) or Brazil (PhD), and never worked abroad (3,833 Colombians and 13,100 Brazilians)
- **Mobile researchers**: have completed their PhD entirely abroad or have worked abroad for more than one year (Kahn MacGarvie, 2016; Liang et al., 2022).
  - Diaspora or Intermittent; Returnees

Empirical strategy

- DiD with multiple treatment periods (Callaway and Sant'Anna, 2021)

$$ATT(g,t) = E[\, Y_1(g,t) - Y_0(g,t) \mid \; G = g, T \geq g \,]$$

- **Scientific productivity**:
  - Number of **publications** (log)
  - $\sum_t$**citations** per publication (log)
  - Number of **high-ranked** publications (log)
  - Share of **English** publications
  - $\boldsymbol{Novelty_p} = \frac{\sum_{(i,j)\in E_p} 1 - \delta(C_i, C_j)}{|E_p|}$ (i.e. proportion of pairwise combinations of references from different scientific communities)
    - where $\delta(C_i, C_j)$=1 if references *i* and *j* are from the same community, 0 otherwise. E_p is the number of reference of publication *p*.
- *T*: treatment year
- **Treatment**: 1) at least one mobile co-author; 2) distinguish by number of mobile co-authors

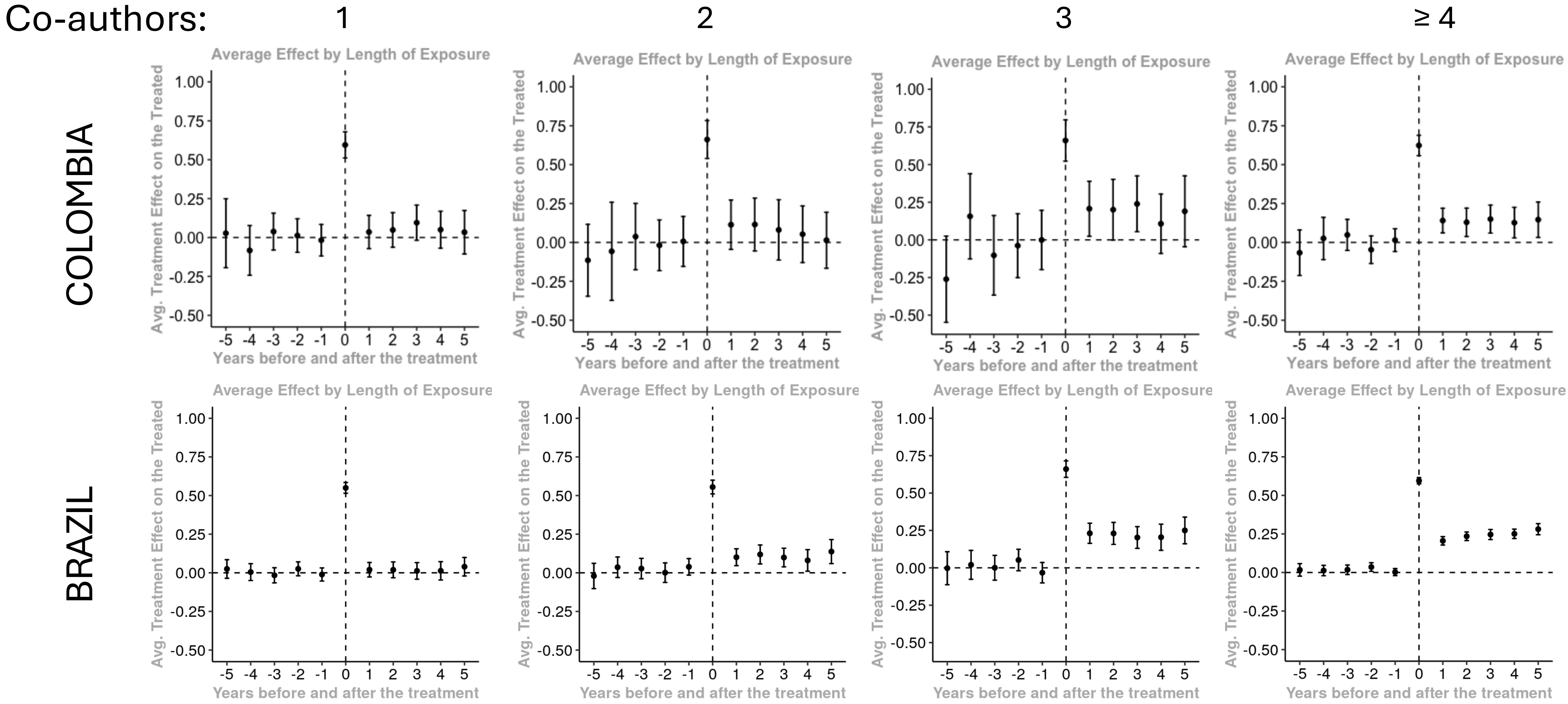
Identification

- **Staggered treatment adoption:** co-authored publications remain
- **Parallel Trends Assumption based on never-treated units**:
  - Propensity Score Matching (👉 balance before and after matching)
    - We use the year before *g* (the first co-authorship) as the baseline year ("current year").
    - We match researchers based on: year of first publication, scientific field, education level (Col), gender (Col), stock of co-authors, stock of publications, stock of citations, stock of English publications (Br), and the current year.
- **No-anticipation**: although researchers plan their career, "similar" researchers have a similar likelihood to meet with mobile researchers who work on topics of common interest

Overall ATT (any #): non-mobile researchers' performance

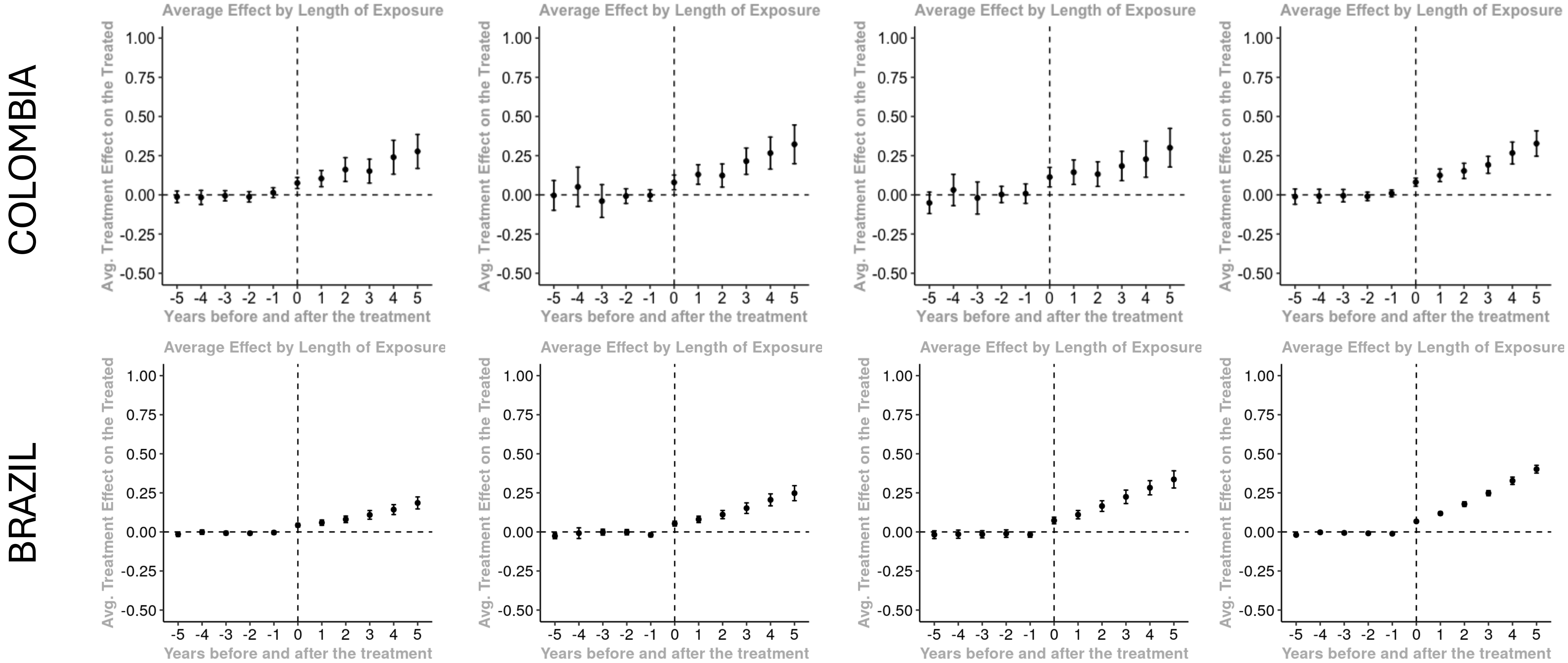
	# publications	Citations per publication	# publications in top journals	% of English publications	Novelty
	(1)	(2)	(3)	(4)	(5)
Panel A: Colombia					
Co-authoring	**0.2193*** **	**0.1906*** **	**0.0393*** **	**0.0645*** **	**0.0131**
	(0.0231)	(0.0177)	(0.007)	(0.0149)	(0.0175)
Observations	16,866	16,866	16,866	16,866	16,866
Nonmobile scientists	1,656	1,656	1,656	1,656	1,656
Panel B: Brazil					
Co-authoring	**0.3022*** **	**0.2234*** **	**0.0791*** **	**0.1347*** **	**0.0622*** **
	(0.0075)	(0.0057)	(0.0031)	(0.0049)	(0.0075)
Observations	163,385	163,385	163,385	163,385	163,385
Nonmobile scientists	13,100	13,100	13,100	13,100	13,100

Event study: Yearly publications (by # of co-authors)



Event study: Sum of average citations (by # of co-authors)

Co-authors: 1 2 3 ≥ 4

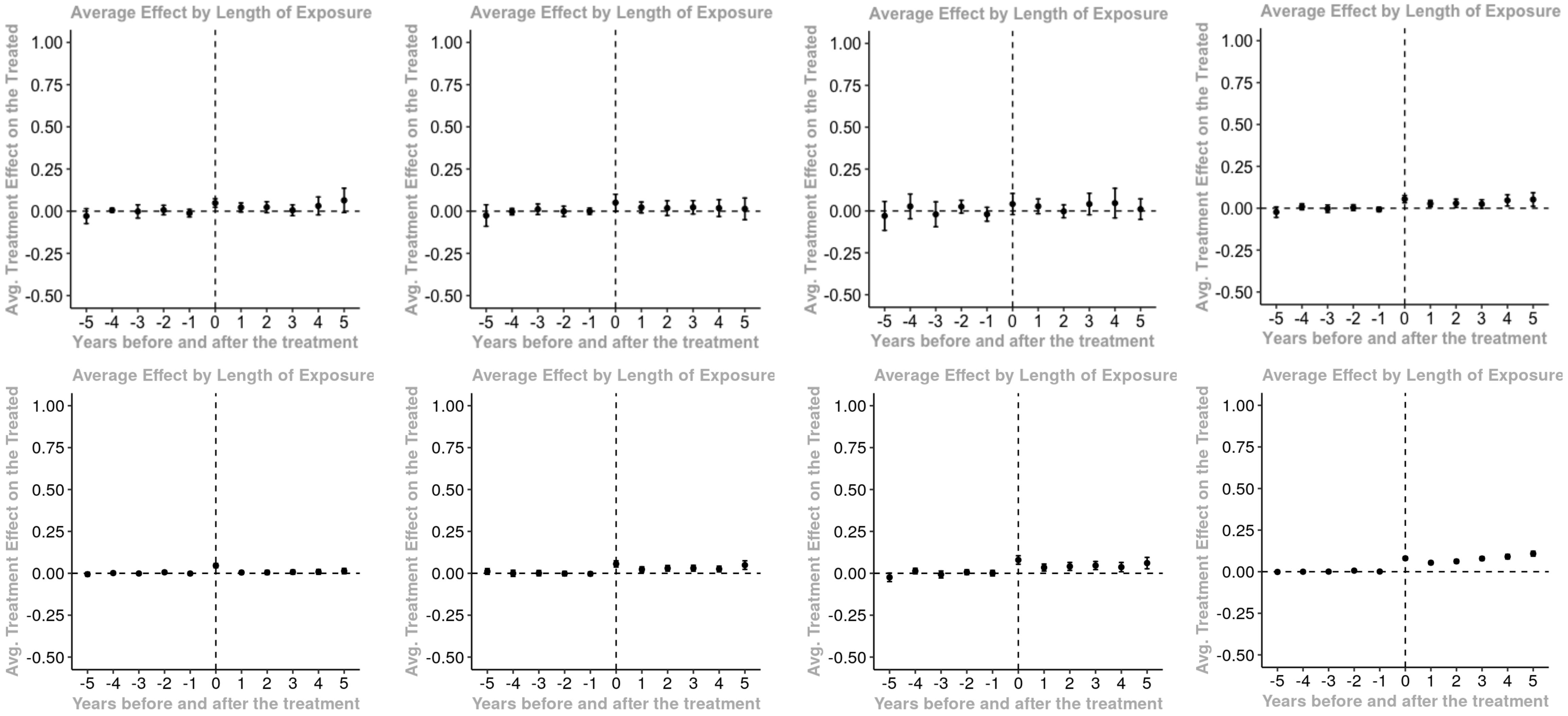


Event study: top journal publications (by # of co-authors)

Co-authors: 1 2 3 ≥ 4

COLOMBIA

BRAZIL

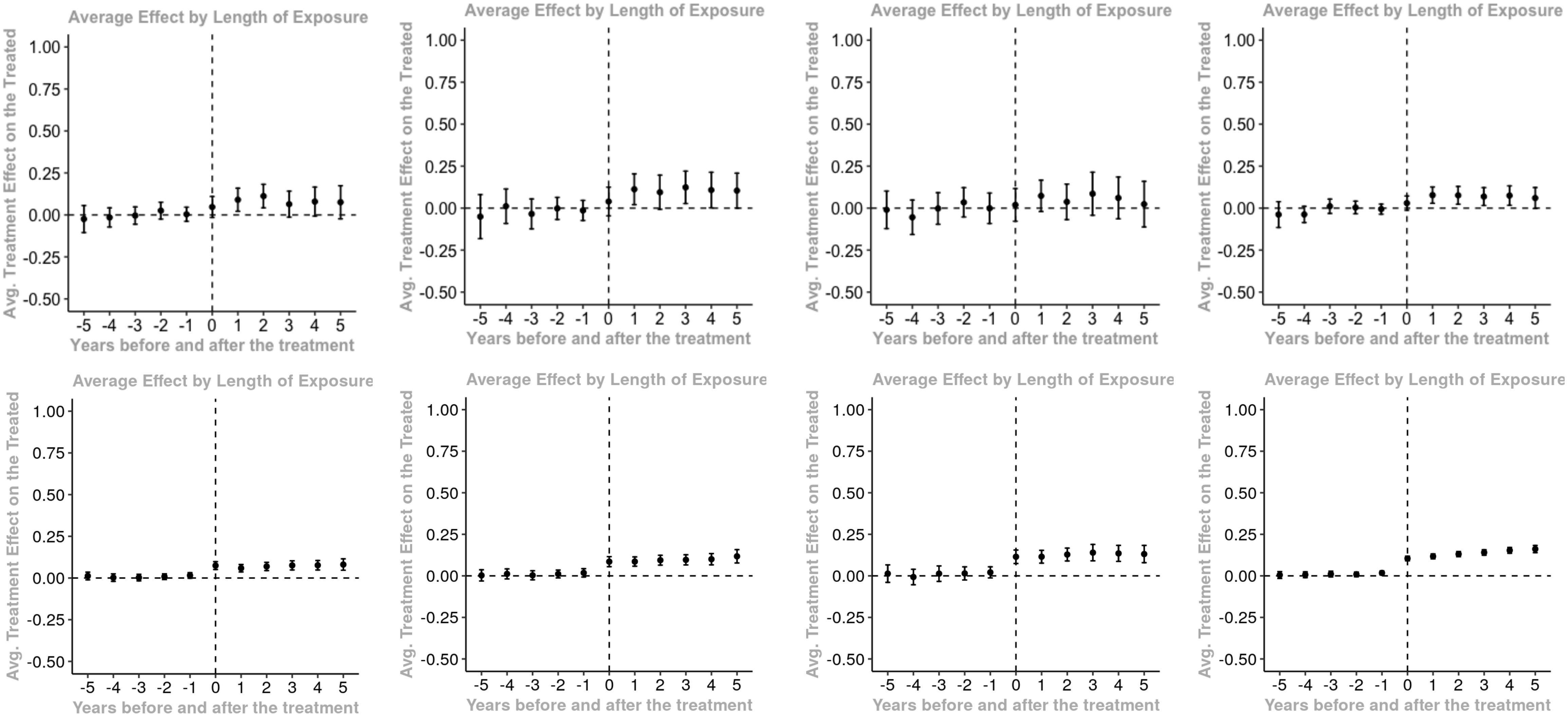


Event study: % of English publications (by # of co-authors)

Co-authors: 1 | 2 | 3 | ≥ 4

COLOMBIA

BRAZIL

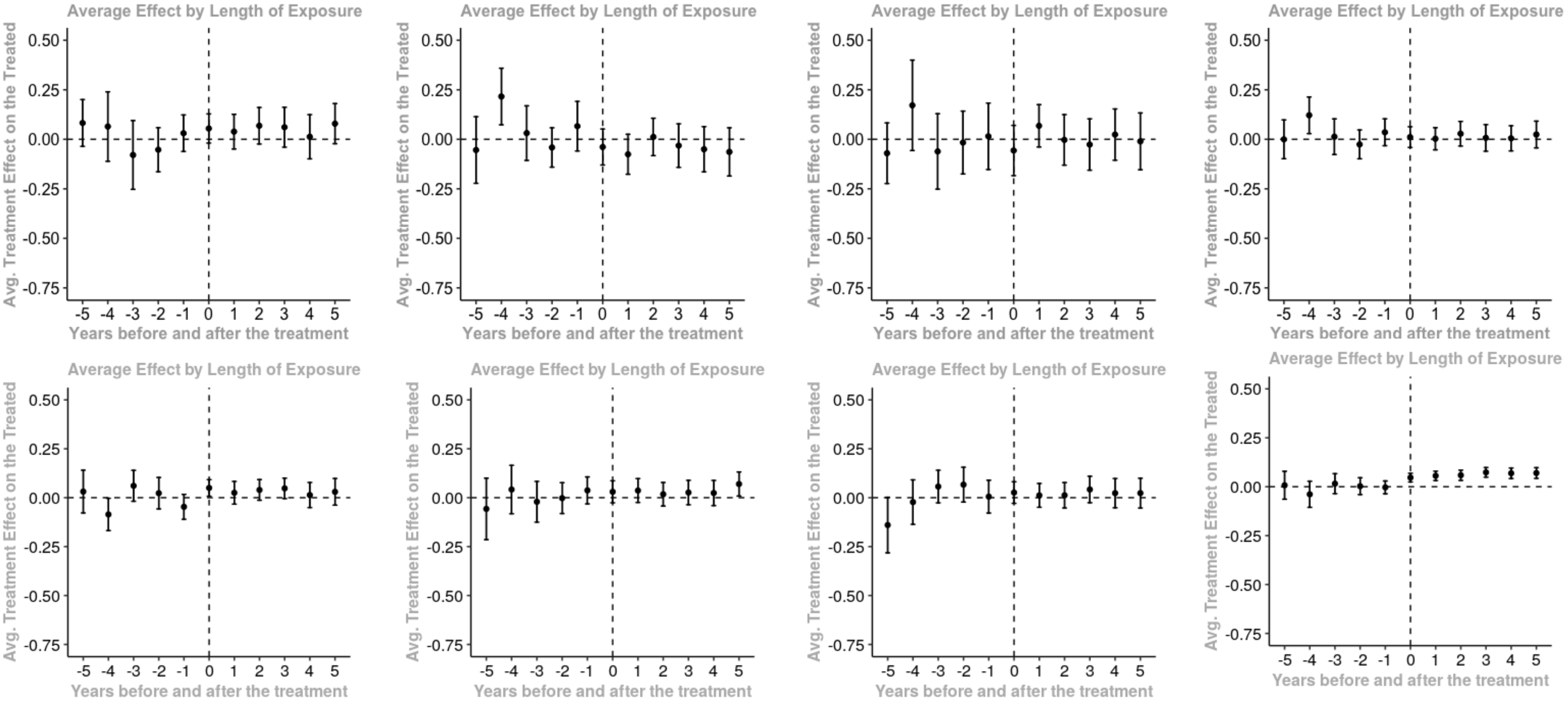


Event study: Average novelty (by # of co-authors)

Co-authors: 1 2 3 ≥ 4

COLOMBIA

BRAZIL



Overall ATT (any #): non-mobile researcher performance by macro field

Fields	# publications	Citations per publication	# publications in top journals	% of English publications
	(1)	(2)	(3)	(4)
Panel A: Colombia				
STEM	0.22***	**0.2563*** **	**0.0609*** **	**0.0913*** **
	(0.0359)	(0.0259)	(0.0115)	(0.0228)
SSH	0.2287***	0.1295***	0.0218*	0.035
	(0.0312)	(0.0203)	(0.0089)	(0.0202)
Panel B: Brazil				
STEM	0.2781***	**0.3695*** **	**0.1608*** **	**0.2105*** **
	(0.0128)	(0.0091)	(0.0064)	(0.0099)
SSH	**0.3171*** **	0.1148***	0.0226***	0.0606***
	(0.0103)	(0.005)	(0.0018)	(0.0046)

Overall ATT (any #): non-mobile researcher performance by type of co-author

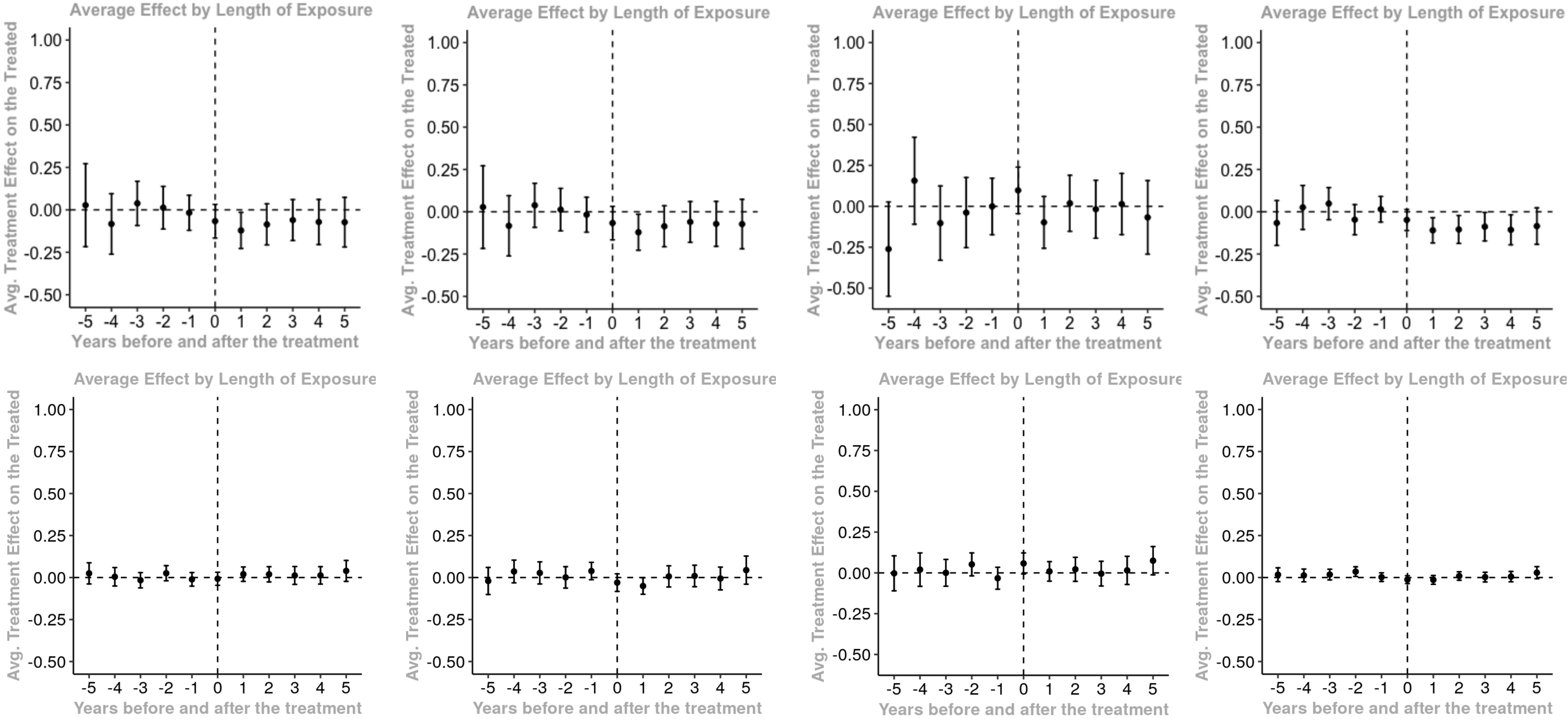
Co-author	# publications	Citations per publication	# publications in top journals	% of English publications	Novelty
	(1)	(2)	(3)	(4)	(5)
			Panel A: Colombia		
Diaspora/ Intermittent	0.2045***	0.1842***	0.0315**	0.0691**	0.0147
	(0.0385)	(0.0328)	(0.0106)	(0.0273)	(0.0305)
Returnee	0.1633***	0.1632***	0.0308**	0.0802**	0.058
	(0.0385)	(0.0258)	(0.0116)	(0.0291)	(0.0364)
			Panel B: Brazil		
Diaspora/ Intermittent	**0.2852*** **	**0.2335*** **	**0.0807*** **	**0.1403*** **	**0.0547*** **
	(0.0087)	(0.0059)	(0.0033)	(0.0056)	(0.0087)
Returnee	0.1662***	0.1008***	0.0159***	0.0699***	0.0452
	(0.021)	(0.0122)	(0.0047)	(0.0134)	(0.0294)

Number of publications without mobiles (by # of co-authors)

Co-authors: 1 2 3 ≥ 4

COLOMBIA

BRAZIL



Research agenda: Empirical strategy

- DiD with multiple treatment periods (Callaway and Sant'Anna, 2021)

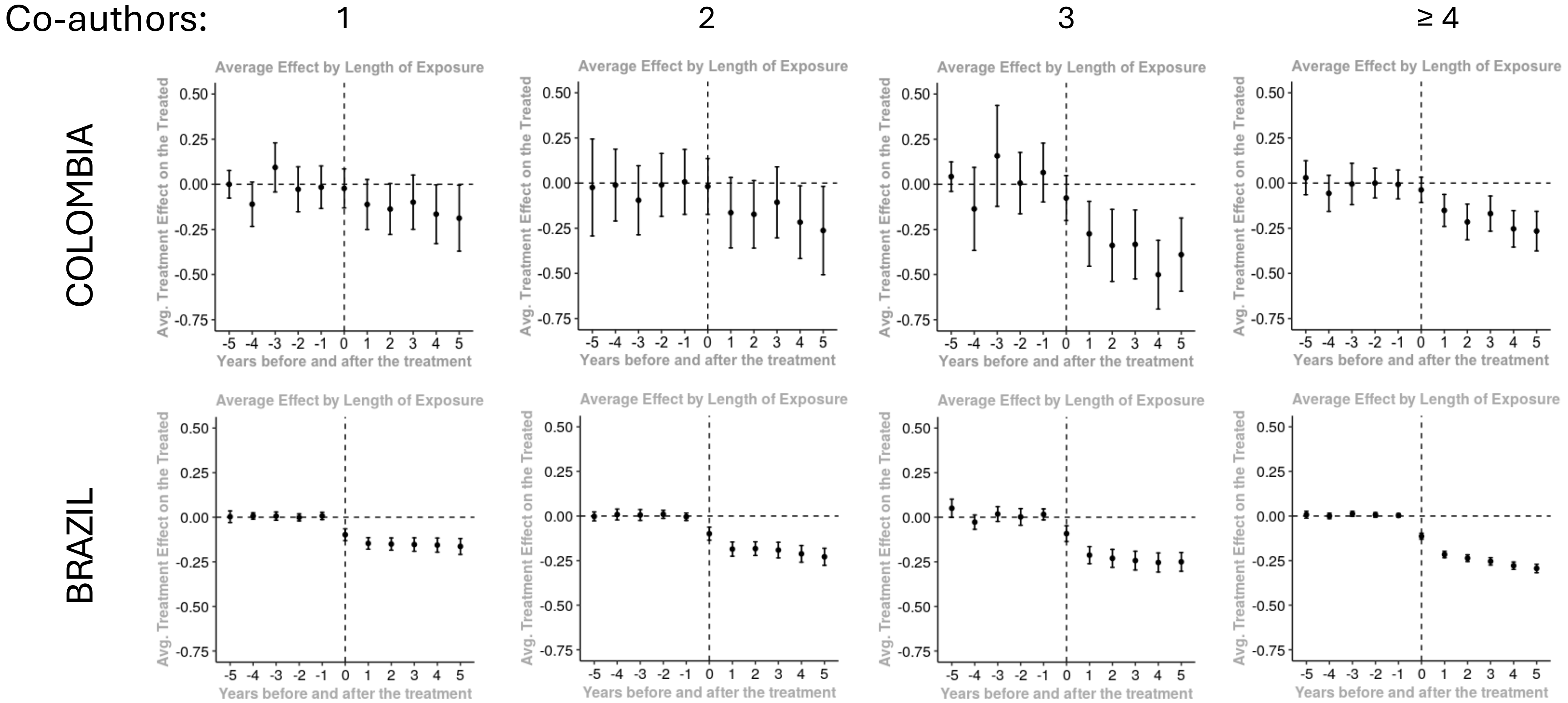
$$ATT(g,t) = E[\, Y_1(g,t) - Y_0(g,t) \mid \; G = g, T \geq g \,]$$

- **Research agenda diversification**:
  - Share of publications with at least 75% of topics not present before treatment
  - Pivot index (Hill et al, 2024): $\Phi_i^j = 1 - \frac{R_j^i \cdot R_i}{\left\| R_j^i \right\| \|R_i\|}$
    - Where R_j^i is a vector containing the distribution of topics by researcher *i* in a focal paper *j,* after treatment*;* R_i is a vector with the frequency of topics in prior papers
- g: cohort: year of first co-authorship with mobile; *T*: treatment year
- **Treatment**: 1) at least one mobile co-author; 2) distinguish by number of mobile co-authors

Overall ATT (any #): non-mobile researcher share of publications with new topics (by type of collaboration)

	Share of publications with at least 75% new topics	Pivot Index
	(1)	(2)
	Panel A: Colombia	
Diaspora/Intermittent	-0.1149*	-0.0529
	(0.0455)	(0.0311)
Returnees	-0.1207**	**-0.0856***
	(0.0467)	(0.0355)
	Panel B: Brazil	
Diaspora/Intermittent	**-0.2385*** **	**-0.1548*** **
	(0.0074)	(0.009)
Returnees	-0.1312 ***	-0.1117***
	(0.0221)	(0.0258)

% of publications with ≥75% new topics (by # of co-authors)



Conclusions

- Combine rich data from CV, Scholarships, & Publications to estimate the impact of internationally mobile researchers on nonmobile researchers
- Collaborating with mobile researchers **increases the performance also of nonmobiles**.
  - **STEM non-mobile** researchers tend to benefit more.
  - Larger impact when collaborating with **diaspora or intermittent** in Brazil
- **Benefits of international mobility do not transfer** to nonmobile researchers
  - Need to collaborate with several mobile researchers (in Brazil, the effect is more long-lasting.
- Nonmobile researchers **diversify less into new topics** when collaborating with mobile researchers
- Results are largely **consistent for two rather different countries**

Policy implications and next steps

- Sponsoring mobility may have a postive impact on the national scientific system, even (or even more) when mobile researchers do not come back: **brain circulation**
- Better measurement of outcomes is needed to compare costs and returns
- Ongoing:
  - Exclude co-authored research from all measures (citations, top journals, novelty,)
  - Explore novelty measures
  - Improve the identification of Brazilian diaspora

Thank you

Comments? Questions?

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- **Backup slides**

Motivation

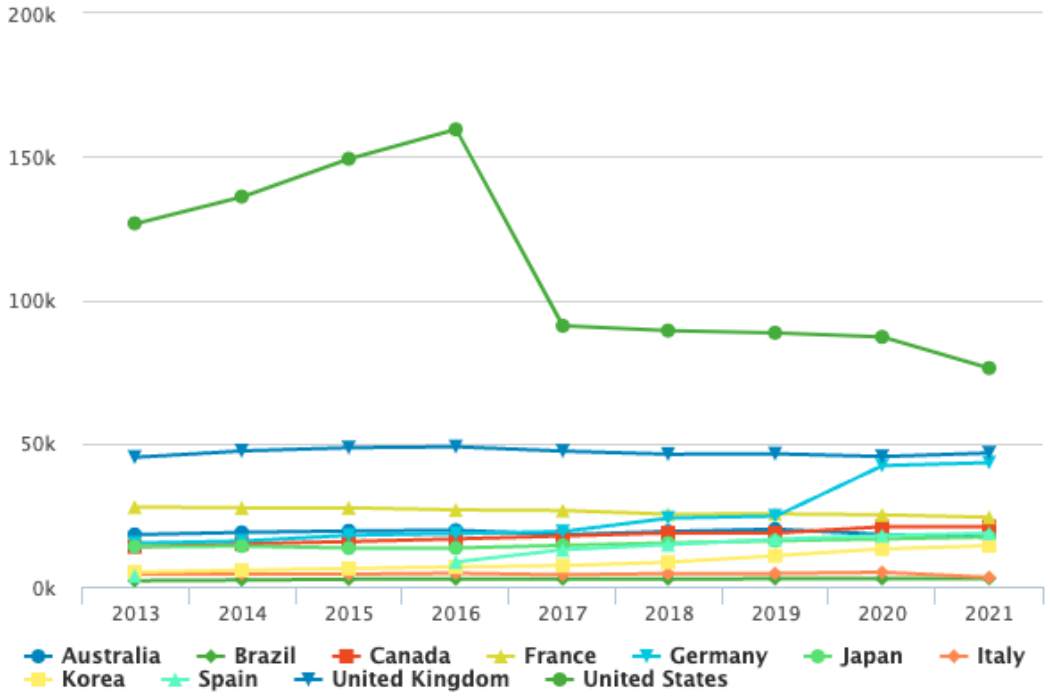


Figure: Number of international students at doctoral level (source: OECD STI Scoreboard).

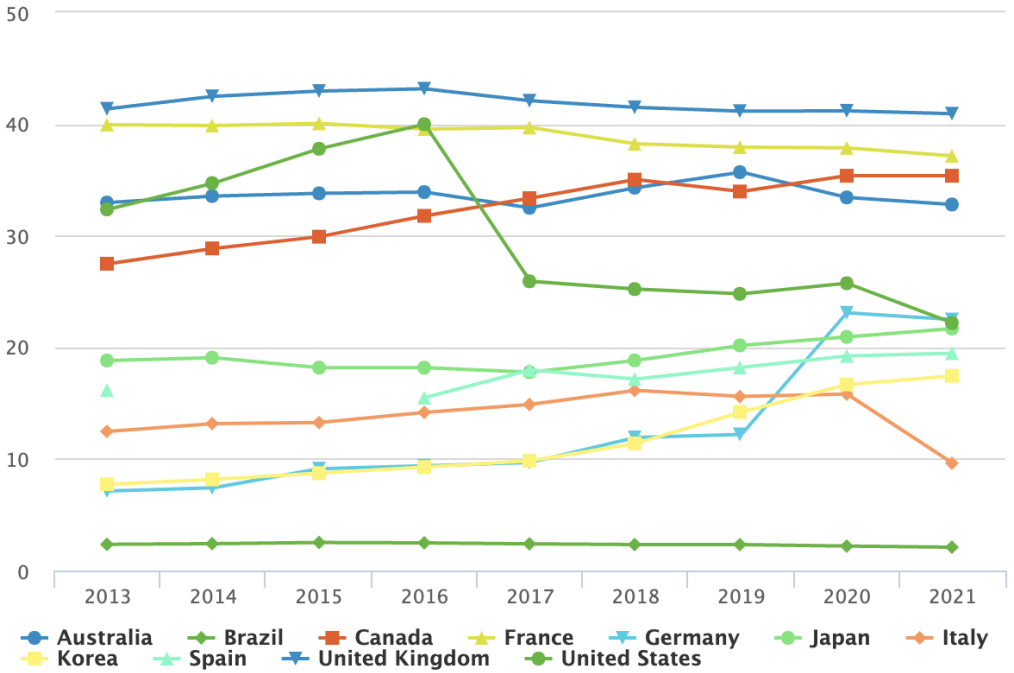


Figure: Share of international students at doctoral level (source: OECD STI Scoreboard).

Motivation

"Supporting high-level education is a fundamental strategy for Colombia **to increase its capabilities in Science, Technology, and Innovation (STI),** improve total productivity, contribute to economic growth, and promote social development."

Literature background: co-authorship and mobility

- Co-authorship increases scientists' performance and knowledge production: one way to adapt to the increasing burden of knowledge.
  - Division of labor (Bozeman and Corley, 2004; Katz and Martin, 1997), knowledge and skills acquisition (Laband and Tollison, 2000), and knowledge creation (Franzoni et al., 2018) lead scientists to co-author.

- International scientific mobility increases scientist's performance
  - International mobility affects researchers' individual performance (Jonkers and Cruz-Castro, 2018; Netz et al., 2020; Petersen, 2018; Velema, 2012)

- We do not know if co-authoring with mobile scientist also benefits the scientific productivity of non-mobile scientists

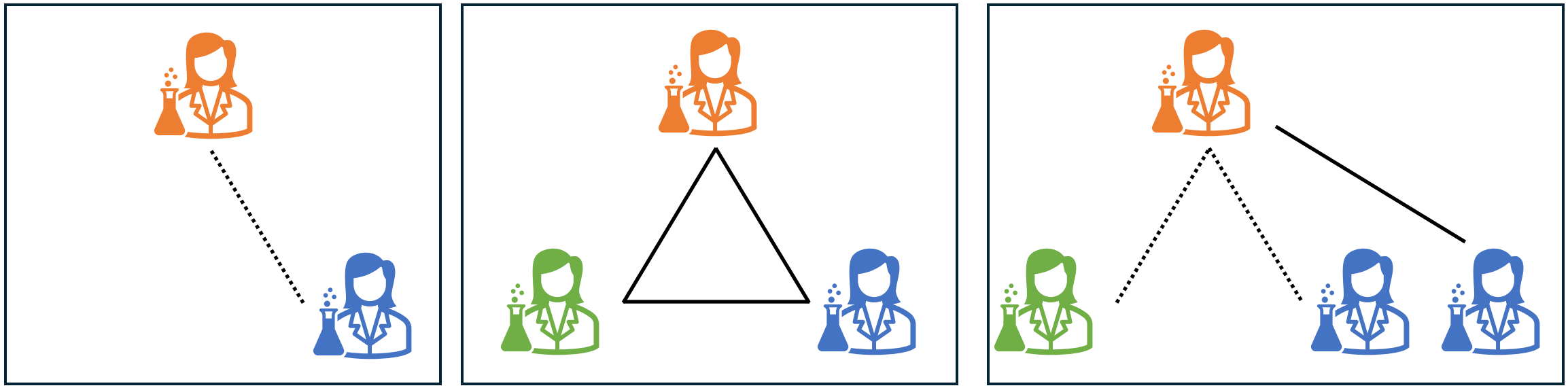
Literature background: novelty

- Novelty: knowledge that is significantly different from the existing stock
  - Scientist: engaging in new topics (Ayoubi et al., 2019; Azoulay et al., 2011; Borjas & Doran, 2015a, 2015b; Myers, 2020).
  - Discipline: production of radically different knowledge bits (Fontana et al., 2020; Shibayama et al., 2021; Wang et al., 2017).

- Collaboration can lead to the access and production of (novel) knowledge.
  - Small teams produce breakthrough science and large teams successful science (Wu et al, 2019)

- We do not know if co-authoring with mobile scientist also induces non-mobile scientists to produce more novel research

Empirical strategy



Scientists

Non-mobile | Mobile | Foreign

Descriptives

Covariate balance before and after matching (Col)(Back)

	Unmatched (1)			Matched (2)		
	Means Treated	Means Control	Var. Ratio	Means Treated	Means Control	Var. Ratio
Year of First Publication	2007.0948	2007.4986	1.0292	2009.1522	2009.1522	1
Education Level: Master	0.6619	0.8162	.	0.8418	0.8418	.
Education Level: Phd	0.3381	0.1838	.	0.1582	0.1582	.
Gender	0.5806	0.552	.	0.5519	0.5519	.
Stock of Co-authors	10.2840	6.7625	18.3616	**3.6196**	**3.0459**	**2.6727**
Stock of Publications	5.0735	5.3216	0.9528	3.1787	3.2959	0.8088
Stock of Citations	10.9139	8.3519	5.6755	1.6775	1.6002	0.345
Current Year	2012.2129	2012.8001	0.9267	2011.9275	2011.9275	1
Number of Researchers	2,532	1,301		828	828	

Covariate balance before and after matching (Br) (Back 👉)

	Unmatched (1)			Matched (2)		
	Means Treated	Means Control	Var. Ratio	Means Treated	Means Control	Var. Ratio
Year of First Publication	2004.4083	2006.3222	10.372	2009.1522	2009.1522	1
Stock of English Publications	2.2673	1.3166	1.5081	0.525	0.529	0.9844
Stock of Co-authors	15.4026	10.8934	3.2838	5.7826	5.4834	1.0025
Stock of Publications	6.5367	5.899	1.2866	3.0882	3.1423	0.9629
Stock of Citations	7.1142	4.8393	1.4909	1.1956	1.1832	0.685
Current Year	2010.1483	2012.917	1.0737	2011.4276	2011.4276	1
Number of Researchers	30,510	12,563		6,550	6,550	

Results: topic change and global novelty (Col)

	Share of publications with at least 75% new topics	Foster Measure
	(1)	(2)
Co-authoring with mobile scientists	-0.1821***	0.0131
	(0.0245)	(0.0175)
Observations	16,866	16,866
N non-mobile scientists	1,656	1,656

Results: topic change and global novelty (Br)

	Share of publications with at least 75% new topics	Foster Measure
	(1)	(2)
Co-authoring with mobile scientists	-0.232***	0.0622***
	(0.0058)	(0.0075)
Observations	163,385	163,385
N non-mobile scientists	13,100	13,100

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