Agenzia Nazionale di Valutazione del sistema Universitario e della Ricerca

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The effect of research collaborations on citation impact: a dynamic panel data analysis

Tindaro Cicero, Marco Malgarini

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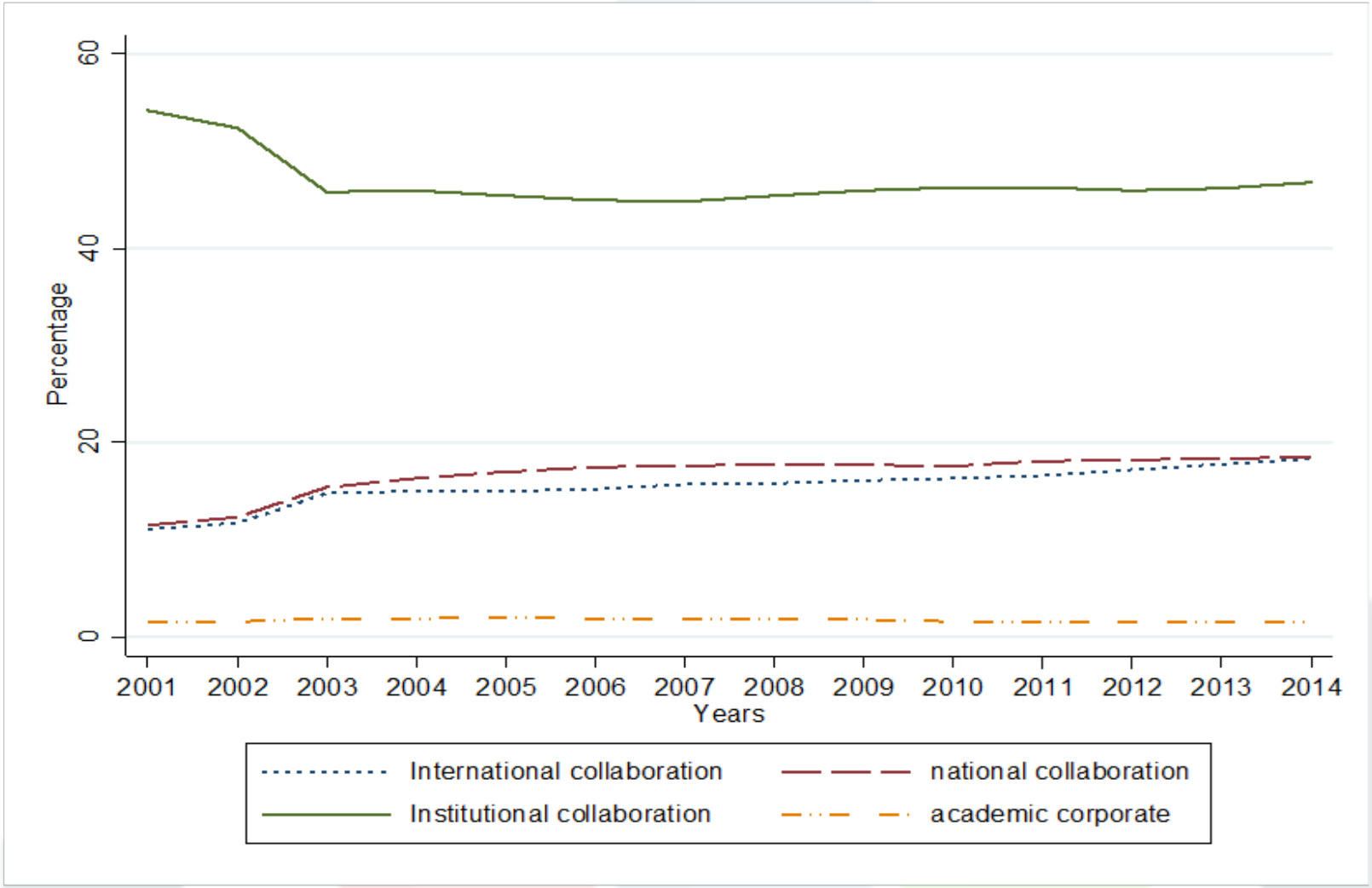
Aims and scope

- Modern science is characterized by growing collaboration among researchers involved in scientific activities
- Collaborations may be classified in terms of geographical proximity, distinguishing among institutional, national and international collaborations
- We also further identify inter-sectoral collaborations, i.e. those between academics and other professionals working in the industry sector
- Our aim is to evaluate the effects of different kind of research collaborations on scientific impact during the period 2001-2014
- We innovate with respect to previous studies in using a dynamic panel data approach, allowing to control for the general growing trend of citations over time

The dataset

- Data are extracted from the Scival-Scopus database, concerning articles, reviews and conference papers of 7 countries (France, Germany, Italy, Netherlands, UK, US, China) published in the period 2001-2014
- We focus on ten STEM scientific areas, as defined by the Italian National University council:
  - Mathematics and computer science
  - Physics
  - Chemistry
  - Earth Sciences
  - Biology
  - Medicine
  - Agricultural and veterinary sciences
  - Civil engineering
  - Industrial and information engineering
  - Psychology
- For every country, area and year we consider the citation impact, as measured by the Field-Weighted Citation impact (FWCI), which takes into account differences in citation patterns across disciplines

Share of collaborative papers, 2001-2014



FWCI, 2001-2014

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
China	0.47	0.55	0.61	0.61	0.56	0.6	0.64	0.67	0.65	0.69	0.73	0.79	0.8	0.84
France	1.19	1.18	1.18	1.18	1.23	1.25	1.3	1.31	1.31	1.34	1.38	1.34	1.35	1.34
Germany	1.27	1.26	1.26	1.28	1.3	1.32	1.38	1.39	1.39	1.42	1.46	1.41	1.44	1.44
Italy	1.15	1.18	1.16	1.21	1.27	1.27	1.33	1.34	1.34	1.43	1.45	1.5	1.47	1.51
Netherlands	1.53	1.53	1.6	1.58	1.6	1.67	1.72	1.74	1.75	1.82	1.81	1.81	1.77	1.73
United Kingdom	1.36	1.38	1.4	1.41	1.42	1.45	1.5	1.51	1.52	1.53	1.57	1.57	1.56	1.57
United States	1.52	1.49	1.49	1.46	1.45	1.47	1.49	1.49	1.51	1.51	1.5	1.49	1.49	1.49
EU - 27	1.15	1.15	1.16	1.16	1.18	1.2	1.23	1.22	1.22	1.24	1.26	1.25	1.25	1.26
OECD	1.21	1.2	1.2	1.19	1.19	1.2	1.22	1.22	1.23	1.23	1.23	1.22	1.22	1.23

The effect of research collaborations on scientific impact

- In order to assess the relevance of the effect of research collaboration on scientific impact we estimate a model relating the FWCI to the four different kind of collaborations identified above

- We also consider the possible role of lags of the dependent variable in order to take into consideration the recent growth observed in the FWCI for most of the countries considered in the analysis.

- In doing so, we use the Arellano-Bond dynamic panel model specified as follows:

$$fwci_{ijt} = fwci_{ij(t-1)} * \beta 1 + collaborations_{ijt} * \beta 2 + \alpha_{ij} + \varepsilon_{ij}$$

Estimation results

- The Arellano Bond test for zero autocorrelation in first differences errors allows to check for the correct specification of the model
- The test is performed on the first differences of the error term – since first differences of a white noise process are necessarily autocorrelated, we concentrate on second and higher autocorrelations

- Test results confirm that the model has been correctly specified with respect to the autocorrelation structure of the residuals

Arellano Bond test for zero autocorrelation in first differenced errors		
Order	Z	Prob.>z
1	-4.062	0.000
2	1.694	0.090
3	-0.461	0.644

Estimation results

- The coefficient associated with the dependent variable is highly significant, showing that FCWI is strongly auto-correlated
- We conclude that the dynamic panel model is a data-congruent representation of the dataset:

Variables	Coeff.	Robust St. Err.	z	P>|z|	[95% Conf. interval]	
FWCI						
L1.	0.54595	0.50080	10.90	0.000	0.44780	0.64410
Collaboration type:						
Institutional	0.00276	0.00417	0.66	0.507	-0.00540	0.01093
National	0.00420	00.447	0.94	0.348	-0.00457	0.01296
Corporate	0.02077	0.01446	1.44	0.151	-0.00757	0.04912
International	0.00804	0.00346	2.32	0.020	0.00126	0.01481
Constant	0.07038	0.30280	0.23	0.816	-0.52310	0.66385

Estimation results

- Collaborations with international co-authors have a significant positive effect on scientific impact
- No effect is found at the aggregate level for the other forms of collaboration

Variables	Coeff.	Robust St. Err.	z	P>|z|	[95% Conf. interval]	
FWCI						
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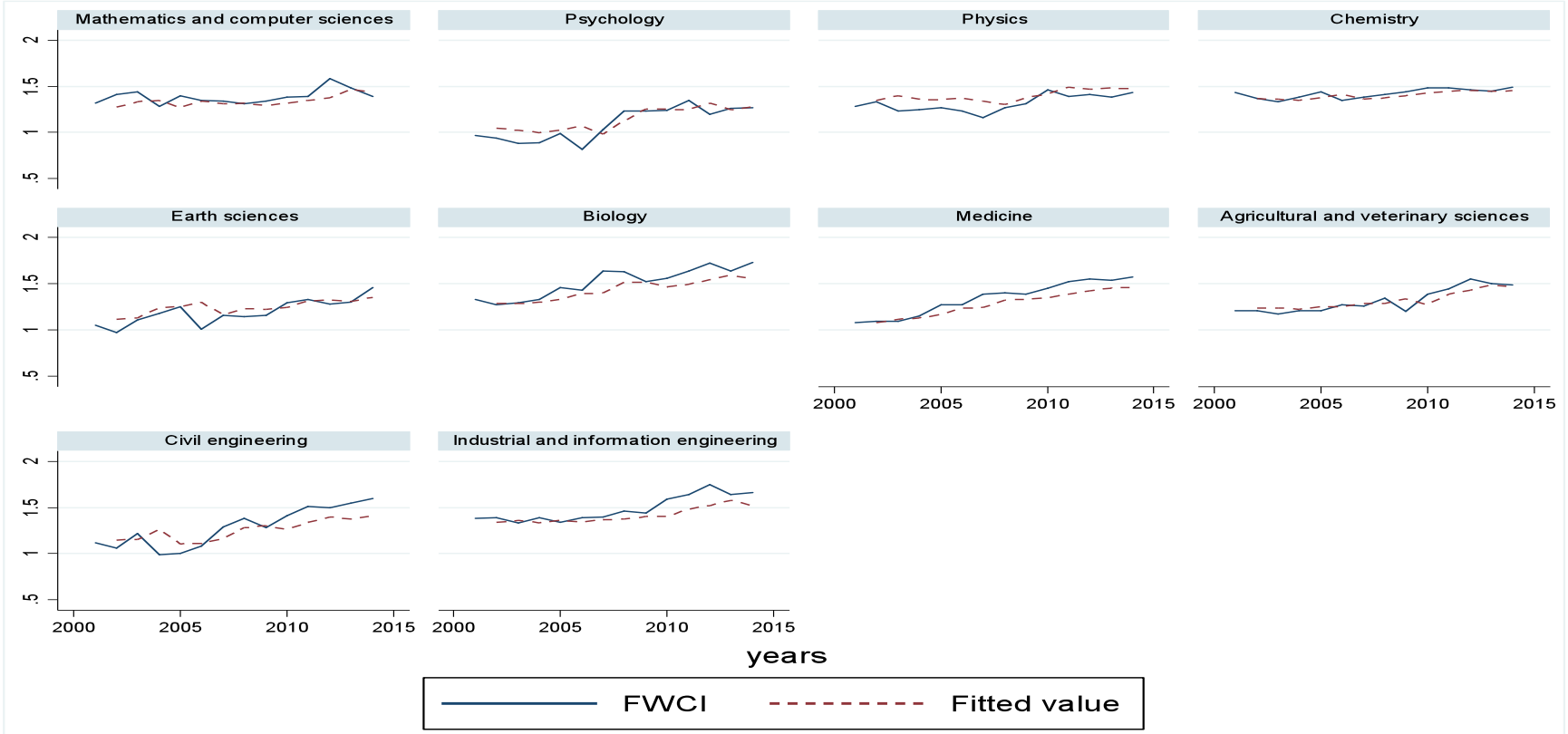
Estimation results at the area level

- The model provides an accurate representation of the indipendent variable also if estimated indipendently for the various scientific sectors
- Reported data are referred to Italy, but similar results are found for the other countries of the database



Estimation results at the area level

- However, the effect of different forms of collaboration varies at the area level:

Area	Institutional	National	Corporate	International
Mathematics and computer science	-0.00869*	-0.02108**	0.11469***	-0.00688***
Physics	0.00550	0.00120	0.00788	0.01206**
Chemistry	-0.01663**	-0.02101***	0.01504	-0.01143*
Earth sciences	0.01342	.028922*	-0.03594**	0.02120**
Biology	-0.00993	0.00023	0.01269	-0.00232
Medicine	-0.00587	0.00575	0.00641	-0.00153
Agricultural and vet. sciences	-0.00285	-0.00558	0.01900	0.00306
Civil engineering	0.00823	0.00913	-0.05872***	0.01896**
Industrial and inf. engineering	0.00682	-0.00536	0.01008	0.00750*
Psychology	-0.00617	0.02117*	-0.08431**	0.00114

*** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level

Estimation results

- International collaborations have a positive significant effect in civil and industrial engineering, physics and earth sciences; surprisingly, the effect appears to be negative in mathematics and computer science, with no or negligible effect in the remaining areas

- Corporate collaborations are found to positively influence scientific impact only in mathematics and computer sciences

- A negative effect of corporate collaborations is found in civil engineering, psychology and earth science (no effect in the remaining areas)
  - A possible explanation of this result is that corporate collaborations are generally more focussed on obtaining practioner-oriented results rather than high scientific impact

- National and institutional collaborations generally do not influence impact in a significant way

- However, in mathematics and chemistry, institutional and national collaborations are ultimately associated with lower scientific impact

THANK YOU FOR YOUR ATTENTION!