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Comparing measures of higher education size: Academic personnel versus Scientific Talent Pool

Benedetto Lepori, Lutz Bornmann and Félix de Moya Anegón

Institute of Communication and Public Policy, Università della Svizzera italiana, Lugano, Switzerland
Science Policy and Strategy Department, Administrative Headquarters of the Max Planck Society, Munich, Germany
CSIC/CCHS/IPP, SCImago Group, Communication and Information Science Faculty, University of Granada, Granada, Spain

Measuring size of Higher Education Institutions

- HEIs have widely different organizational sizes
  - From few employees to several thousands
  - Many small and few very large organizations

- Reliable measures of size are required for sensible comparisons
  - Scale-free bibliometric indicators are size-dependent (Abramo and D'Angelo 2016)
  - Evidence of non-linear scaling (Lepori, Geuna and Mira 2019)
  - Efficiency should be measured against some measure of input (Bornmann et al. 2020)

- Yet measures of size/input are generally considered as problematic
  - Particularly by the bibliometric community (Glänzel, Thijs and Debackere)
  - In terms of availability *and* comparability

Yet, the situation seems to have improved in the last decade (Lepori, Borden and Coates 2022), particularly thanks to the development of institutional data systems.

This paper

We compare two widely available measures of organizational size

- Academic Personnel (AP) as defined by international educational statistics (UOE 2013)
- Scientific Talent Pool (STP) as the number of authors affiliated to an institution in Scopus (Bornmann et al. 2020)

Using a large population of HEIs from the European Tertiary Education Register (www-eter-project.com),

we aim at understanding the sources of differences between these two indicators

- As related to their definition and sources
- Identifying complementarities and understanding their strengths and weakness for different types of analyses

Outline

Comparing indicators and methodological issues

- AP
- STP
- Deriving expectations on their relationships

Data and methods

Empirical results

- Overall relationships
- Outliers
- Regression results
- Predictive ability

Discussion and conclusions

AP

Personnel employed by an HEI and involved in research and/or teaching

- Reference to contracts
- Excludes admin as well as research and teaching assistants
- No division between research and teaching

Issues affecting comparability

- HEI perimeter and linkages: hospitals and research institutes
- Coverage of PhD students
- Counting of personnel:
  - Headcounts vs. Full-Time Equivalents
  - Employment thresholds and reference dates

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STP

Number of author identifiers in Scopus affiliated with an institution

Available for all institutions covered by bibliometric databases worldwide.

Methodological issues

- Homonyms
- Guest scientists with no contractual relationships
- Changes in author names
- Personnel non-publishing in Scopus is excluded.

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AP vs. STP

Baseline: they are correlated as they both measure HEI's personnel

Sources of differences

- STP counts only publishing personnel: AP >> STP for low research intensity, STP ≥ AP for high research intensity
- Scopus coverage is better for sciences: for HEIs oriented towards social sciences AP > STP
- Presence of university hospitals: STP > AP
- Presence of associated centers: STP > AP

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Data

HEI list from the European Tertiary Education Register (www.eter-project.com)

- Matched with SCImago Institutions Ranking (SIR)
- 1,510 matched entities over 1,648 SIR entities
- Matched entities comprise 88%% of bachelor/master students and 94% of PhD students in ETER

Variables (year 2018)

- AP personnel in HC
- STP
- Research intensity: ISCED8/ISCED5-7 students
- Legal status (public/private)
- PhD awarding (yes/no)
- University hospital

Methods

Descriptive statistics based on AP/STP ratio (N=1,191)

- By country
- Outliers with STP >> AP

Regression model

$$\ln(STP) = \alpha + \beta \ln(AP) + \gamma\, sqrt(research\ intensity) + \delta\, stemorientation + \varepsilon\, i.legalstatus + \theta\, i.phdawarding + \pi\, i.universityhospital + \mu_j\, country_j$$

With country dummies

Model using AP in FTE and with random intercepts provide very similar results

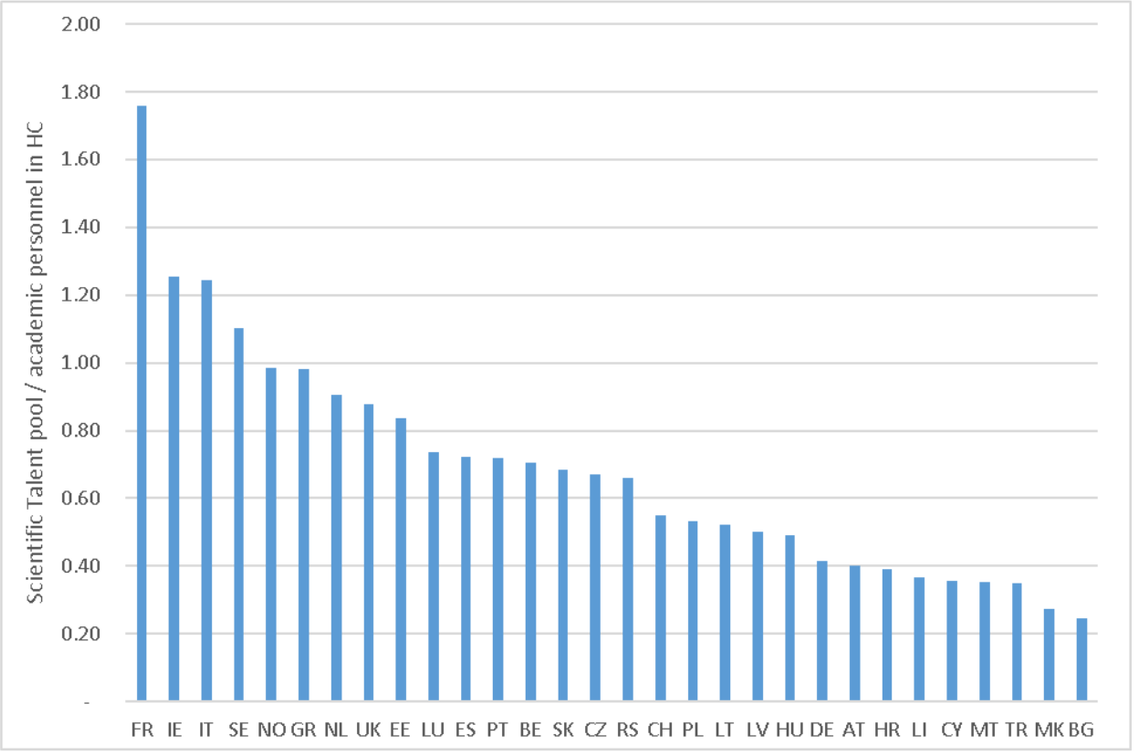
Descriptive statistics

For the whole sample:

- Sum of STP is 76% of sum of AP
- High correlations (Spearman), but significant differences at the same time

Variable	Scientific Talent Pool	Academic Personnel HC	Academic Personnel FTE	Research Intensity	STEM orientation (students)
Scientific Talent Pool	1				
Academic Personnel HC	0.7822***	1			
Academic Personnel FTE	0.8372***	0.9578***	1		
Research Intensity	0.7249***	0.5023***	0.5523***	1	
STEM orientation (students)	0.2659***	0.3258***	0.3267***	0.0592	1
***p<0.001					

Country patterns



Country differences

France because of joint units with PROs where AP includes only personnel employed by HEIs, STP all personnel in the joint unit

IT: AP includes only structured staff

Some evidence – as expected – that STP is low in countries with a less strong scientific profile

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Outliers

Name	Country	AP	STP	Ratio	Explanation
Sorbonne University	FR	2784	12987	4.66	The figure is highly inflated by hospitals and by UMR with CNRS
Erasmus University Rotterdam	NL	1640	5284	3.22	Erasmus medical center accounts for most of the authors
Trinity College Dublin	IE	743	3129	4.21	Figure highly inflated by hospitals
Grenoble Institute of Technology (INP)	FR	393	2555	6.50	STP seems to be inflated, in Scopus less than 1,000 authors,
University of Liège	BE	697	2357	3.38	ETER figures underestimated
National Polytechnic Institute of Toulouse	FR	310	1863	6.01	some large associated research institutes
West Pomeranian University of Technology, Szczecin	PL	41	743	18.12	mistaken year in ETER
Campus Bio-Medico University	IT	199	662	3.33	Associated with a large hospital
École nationale supérieure de chimie de Montpellier	FR	47	718	15.28	some large associated research institutes
Gran Sasso Science Institute	IT	29	258	8.90	Research Infrastructure of the National Institute of Physics
Scuola Normale Superiore, PISA	IT	103	464	4.50	Graduate School
University Centre in Svalbard	NO	31	111	3.58	Artic research center, mostly external authors

80 HEIs STP/AP>2

39 in France, 14 in Italy

Most can be explained by specific conditions: universities with very large hospitals; HEIs with associated centers, research facilities and graduate schools

Few might be explained by data problems

Regression results

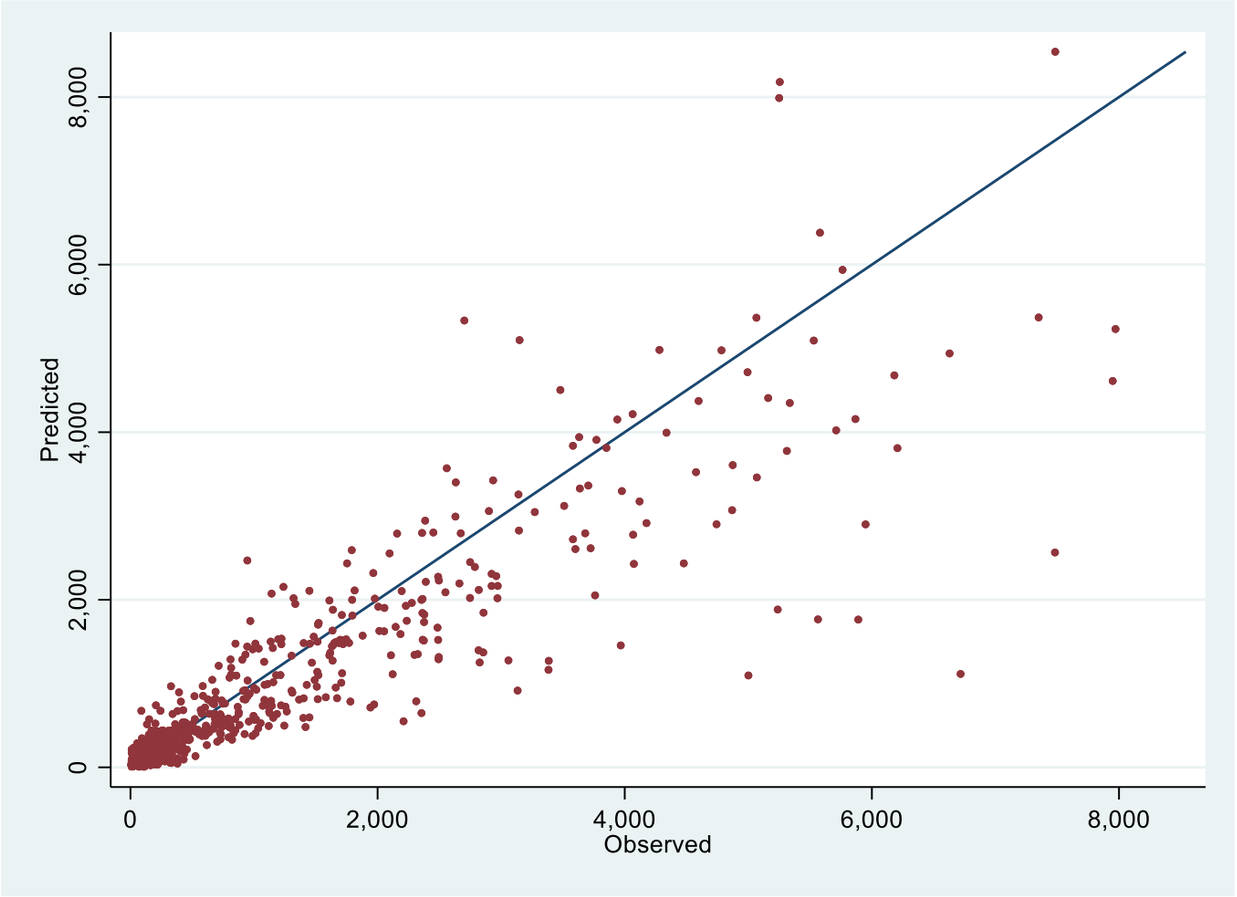
	Model 1			Model 2			Model 3		
	C	SE	Sig.	C	SE	Sig.	C	SE	Sig.
ln(Academic Personnel HC)	1.11	0.04	0.00	0.69	0.05	0.00	0.76	0.07	0.00
Sqrt(Research Intensity)				2.66	0.97	0.01	3.72	0.67	0.00
Legal status				-0.21	0.16	0.20	-0.19	0.19	0.31
STEM orientation (students)				0.76	0.19	0.00	0.86	0.15	0.00
PhD awarding				0.63	0.30	0.05	0.33	0.25	0.20
University Hospital				0.81	0.19	0.00	0.67	0.16	0.00
_cons	-1.50	0.30	0.00	-0.05	0.42	0.91	-0.40	0.41	0.34
Country-level fixed effects	no			no			yes		
Rsquare	0.60			0.74			0.80		
N	1102			743			743		

Outliers STP/AP > 3 excluded

Model fit increases with additional variables and with country dummies (slightly)

Additional variables have the expected sign and are statistically significant (except legal status and PhD awarding)

Predictive ability



STP observed vs. STP predicted by the model from AP and HEI covariates

Quite a good fit alongside the whole size range

Except perhaps the largest HEIs

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Discussion and conclusions

Reliable size measures are essential for institutional comparisons

- Comparing similar institutions in rankings avoiding size biases
- Analyzing efficiency

Results overall are reassuring

- No systematic bias as revealed by comparing AP vs. STP
- Beyond cases already known and related to structural reasons which should be controlled for

STP provides a better measure of the scientific potential of HEIs including associated units and hospitals

- But becomes problematic when considering efficiency in a multi-output setting including also education
- And when there is a strong focus on SSH

The availability of both indicators would allow for

- Cross-checking
- Comparing results of analyses
- Maybe constructing combined indicators

Thank you!