French research performance in context

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Actors and Objectives

CURIF: an association of French research-intensive institutions
SIRIS: a hybrid consultancy / research centre

Aim: contribute to the ongoing **policy reflection on the French research system**

Principles:

- **evidence-based**
- **explorative** (the results were unexpected)

Structure of the report

- Introduction
  - Discussion of Methodology
  - Critical assumptions

- Part 1: Description/evidence of the performance of the French system
  - Global indicators
  - Excellence indicators

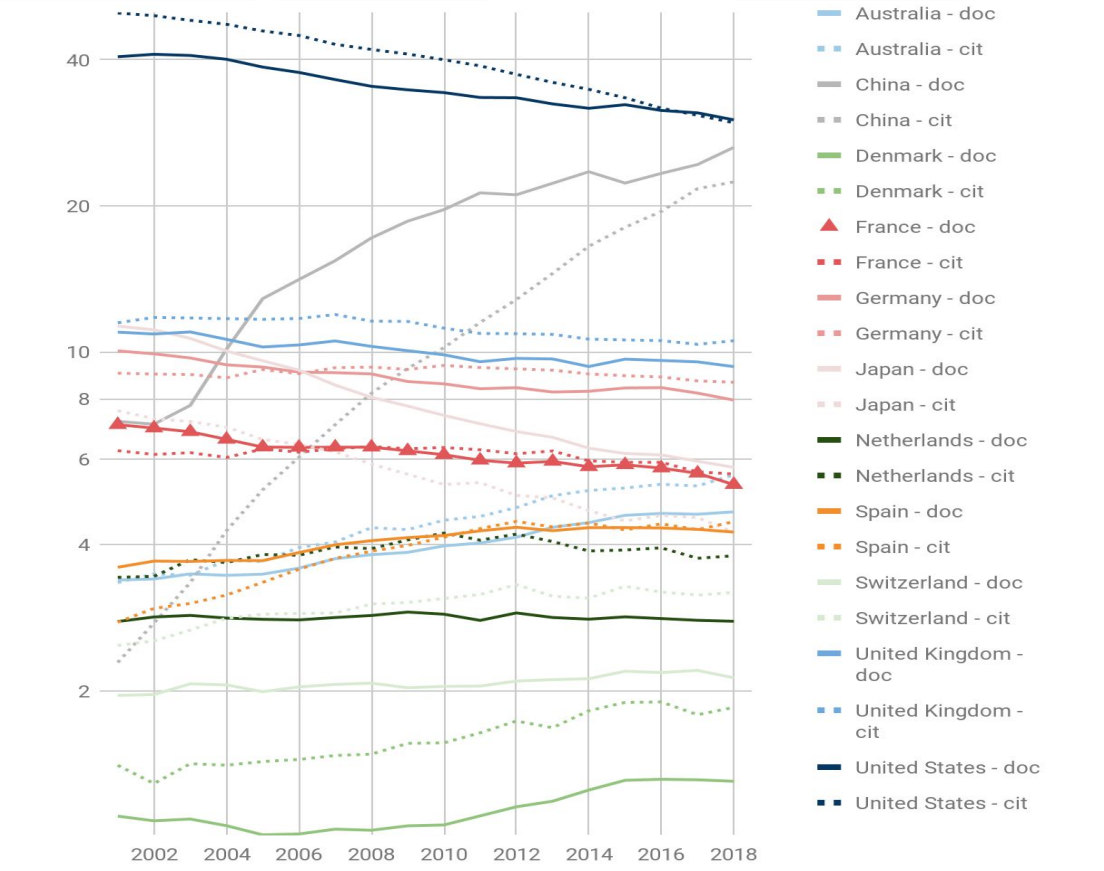
- Part 2: Discussion of explanatory hypotheses
  - Funding
  - Connection to hubs
  - Structure of the system
  - HR model
  - Autonomy, Accountability, Governance

Key limits and assumptions

- Methodological problems (bibliometry)
- Making key assumptions explicit even if they are not easy to prove or disprove
- One-sided perspective
  - “Highly-performant research”, measured by citations, prestigious awards and highly cited researchers;
  - But this is how research works: it is a filtering system based on a peer-criticism;
  - And **highly performing research system** (Denmark, Netherlands) can be **compatible with greater social equity**

Part 1: research performance

Total scientific production



Share of documents and citations - World Total (data source: Scimago Country Ranking 2018)

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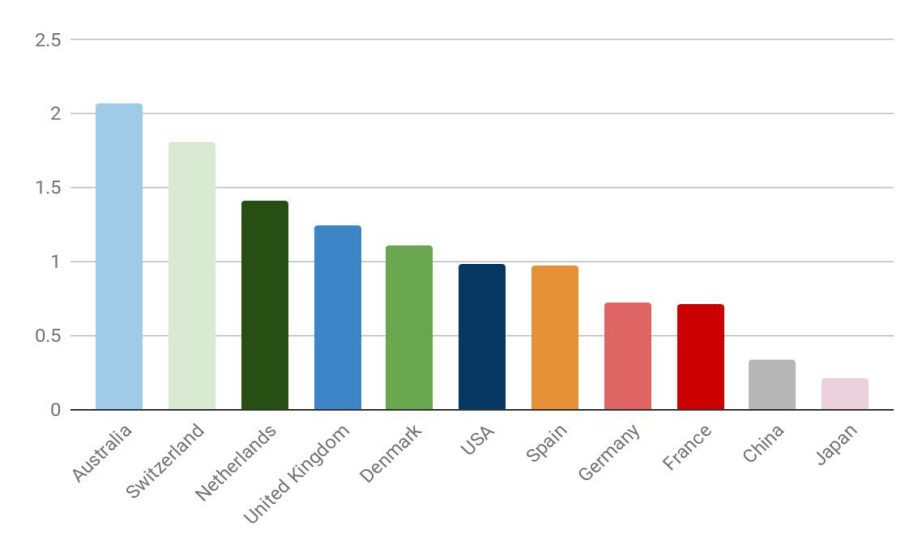
Evolution of scientific production (2001-2018)

Country	Evolution in share of Documents	Evolution in share of Citations
Australia	+38.19%	+66.81%
China	+267.27%	+878.91%
Denmark	+18.02%	+31.63%
France	**-24.74%**	**-10.49%**
Germany	-20.82%	-4.21%
Japan	-48.86%	-43.90%
Netherlands	+0.11%	+10.77%
Spain	+18.19%	+61.12%
Switzerland	+8.71%	+28.60%
United Kingdom	-15.09%	-8.16%
United States	-25.90%	-40.59%

Evolution in share of documents and citations (data source: Scimago Country ranking 2001-2018)

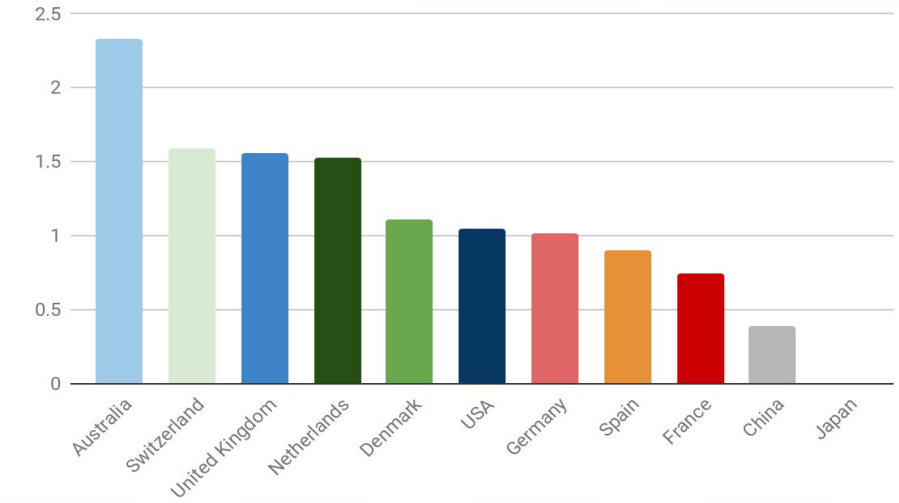
Universities in the top 500 per 10 000 researchers

Shanghai



ARWU Top-500 univ. per 10,000 researchers (data source: ARWU, UNESCO STI)

CWTS Leiden



CWTS Leiden PPTop 10% Top-500 universities per 10,000 researchers (data source: CWTS Leiden, UNESCO STI indicators)

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Cutting-edge fields: Biotechnology

	Top 100		Total ranked (300)	
	Number	Per 10,000 researchers	Number	Per 10,000 researchers
Australia	3	0.27	12	1.07
China	18	0.11	81	0.47
Denmark	2	0.44	5	1.10
France		0.00	17	0.57
Germany	6	0.14	37	0.89
Japan	2	0.03	16	0.24
Netherlands	2	0.23	10	1.17
Spain	3	0.22	17	1.27
Switzerland	1	0.23	7	1.58
United Kingdom	6	0.21	20	0.69
United States	39	0.28	96	0.69

ARWU Subject Ranking "Biotechnology" 2018 (data source: ARWU)

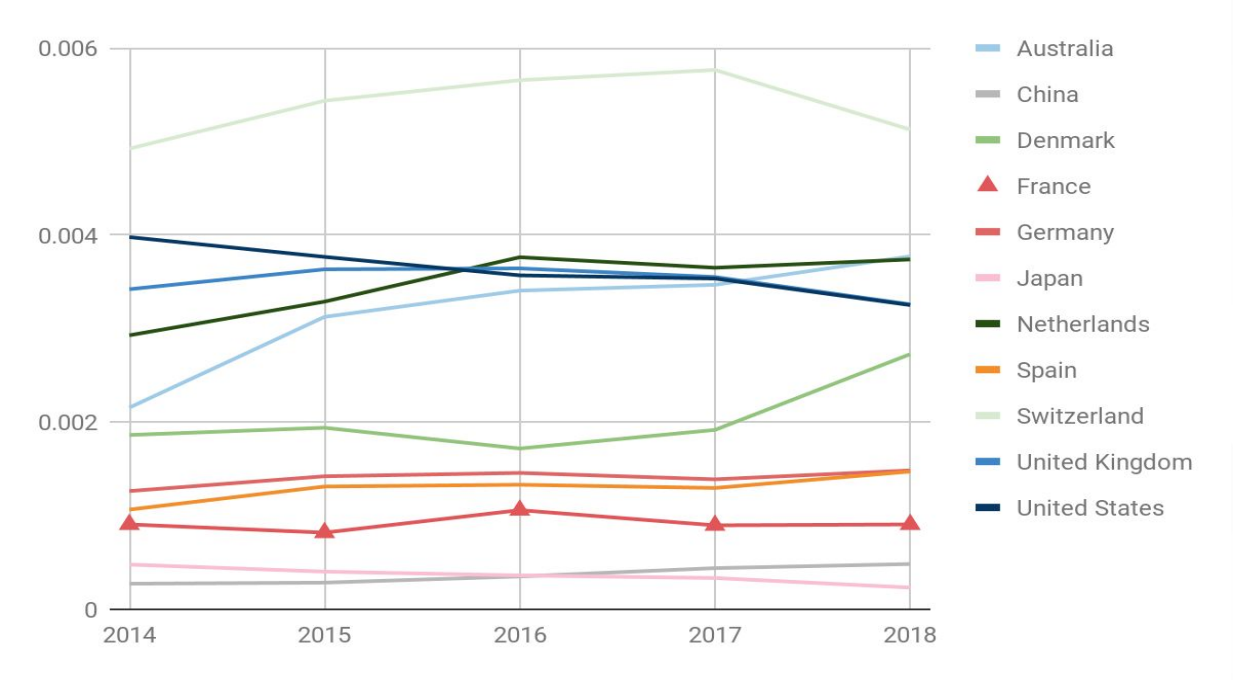
Cutting-edge fields: fast emerging technology fields (nanosciences, graphene, etc.)

Country	Number of papers	Fractional counts[b]		Domestic counts	
		e_p index	$P'_{top\ 0.01\%}$	e_p index	$P'_{top\ 0.01\%}$
Netherlands	1499	0.118	0.250	0.111	0.141
Ireland	497	0.087	0.026	0.095	0.029
Austria	774	0.068	0.012	0.077	0.013
Germany	7480	0.078	0.259	0.076	0.13
Finland	781	0.077	0.022	0.076	0.015
Denmark	804	0.076	0.027	0.073	0.017
Sweden	1402	0.072	0.034	0.069	0.019
Belgium	1227	0.061	0.017	0.060	0.01
Spain	4061	0.060	0.051	0.057	0.032
Portugal	968	0.067	0.018	0.052	0.005
Greece	735	0.058	0.007	0.049	0.003
Italy	4320	0.051	0.037	0.048	0.024
France	5373	0.054	0.042	0.048	0.022
Czech Republic	909	0.047	0.003	0.046	0.002
Hungary	388	0.008	1.3E-06	0.007	5.6E-07
Singapore	3066	–	–	0.196	2.19
Switzerland	960	–	–	0.151	0.49
UK	3114	–	–	0.107	0.45

FETT performance for selected countries in 2014; fractional counts only took into account EU countries (reproduced from (Rodríguez-Navarro and Brito 2018))

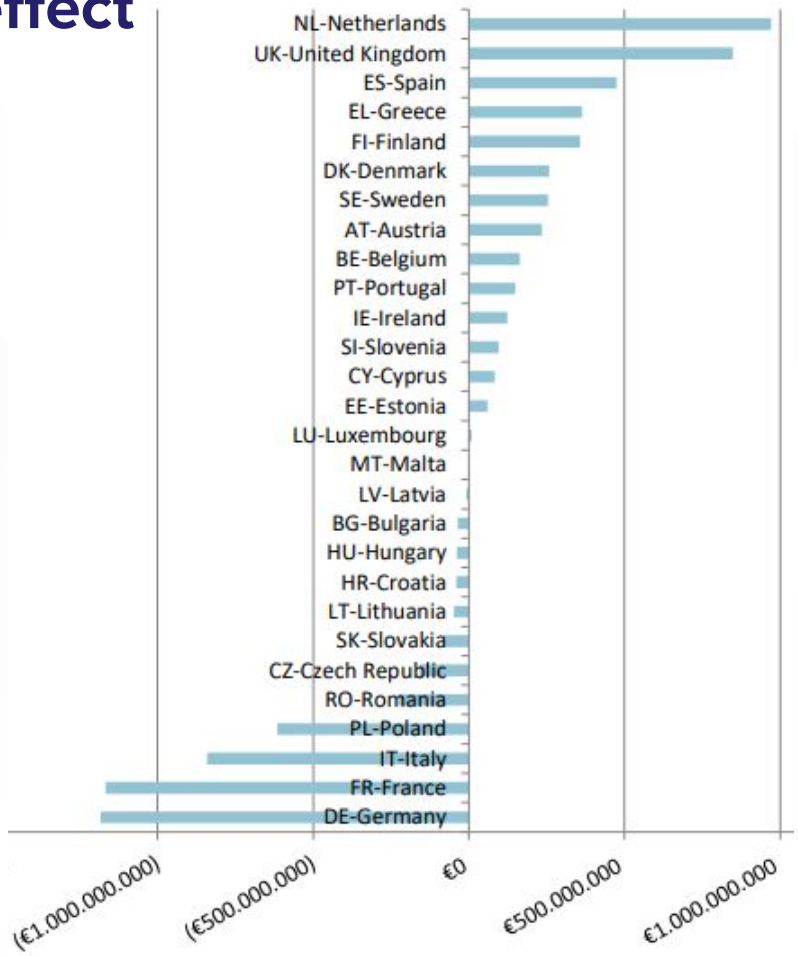
Highly-Cited Researchers per researcher

Ratio of HCR by researcher (data source: Clarivate Highly Cited Researchers 2018)



Horizon 2020 - net distribution effect

H2020 (up to mid-2018), Net distribution effect (reproduced from Fisch (2019))



Conclusions

- France and Germany are being caught by emerging scientific powerhouses such as China but also Australia or Spain

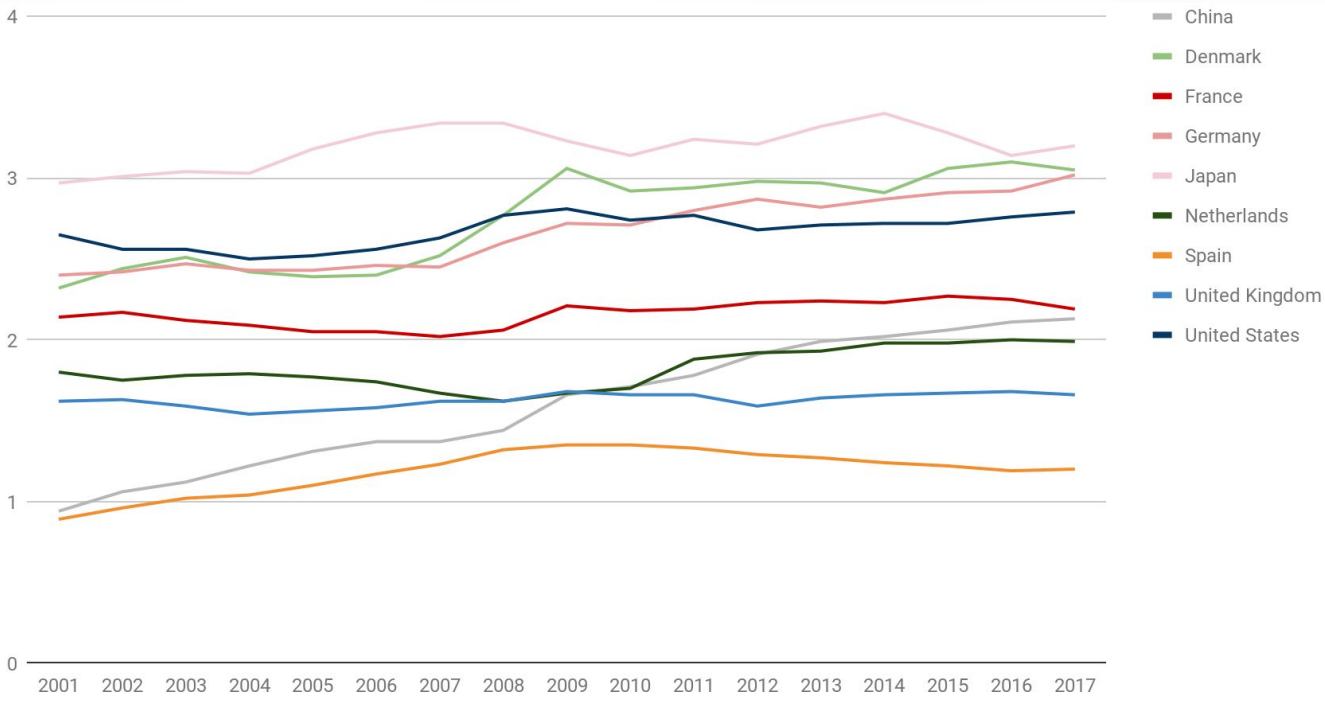
- They are continuing to lose ground to strong performers such as Denmark, the Netherlands or Switzerland

- French and German research performance is
  - stronger in mainstream fields and according to generic indicators (total number of publications)
  - weaker in cutting-edge fields and on excellence indicators

Possible explanations: Part 2

Hypothesis 1: Funding - average within OECD / EU

- For example, GERD is lower in the Netherlands

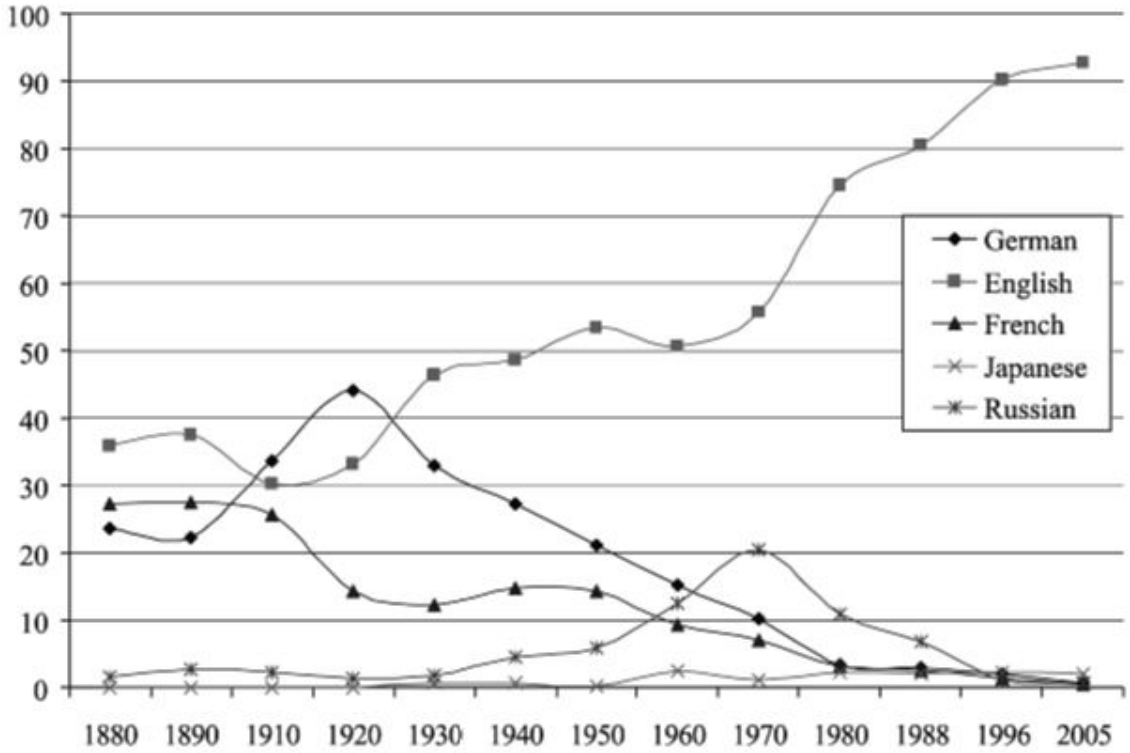


GERD in % of GDP (data source: Eurostat)

Hypothesis 1: Funding - two major differences

- Research funding goes primarily to national research organisations
- State funding to universities
    - Does not distinguish a Research stream from a Teaching stream;
    - Depends far less on performance indicators;
    - Allocates only limited amounts on a competitive project-based basis

Hypothesis 2: Globalisation - language of publication



Publishing languages in global scientific literature (Carli and Ammon 2007)

Hypothesis 2: Globalisation - language of interaction

- English as lingua-franca

Switching language in research intensive universities is not just a question of publication, it is a question of **teaching**, **administration** and **daily communication**.

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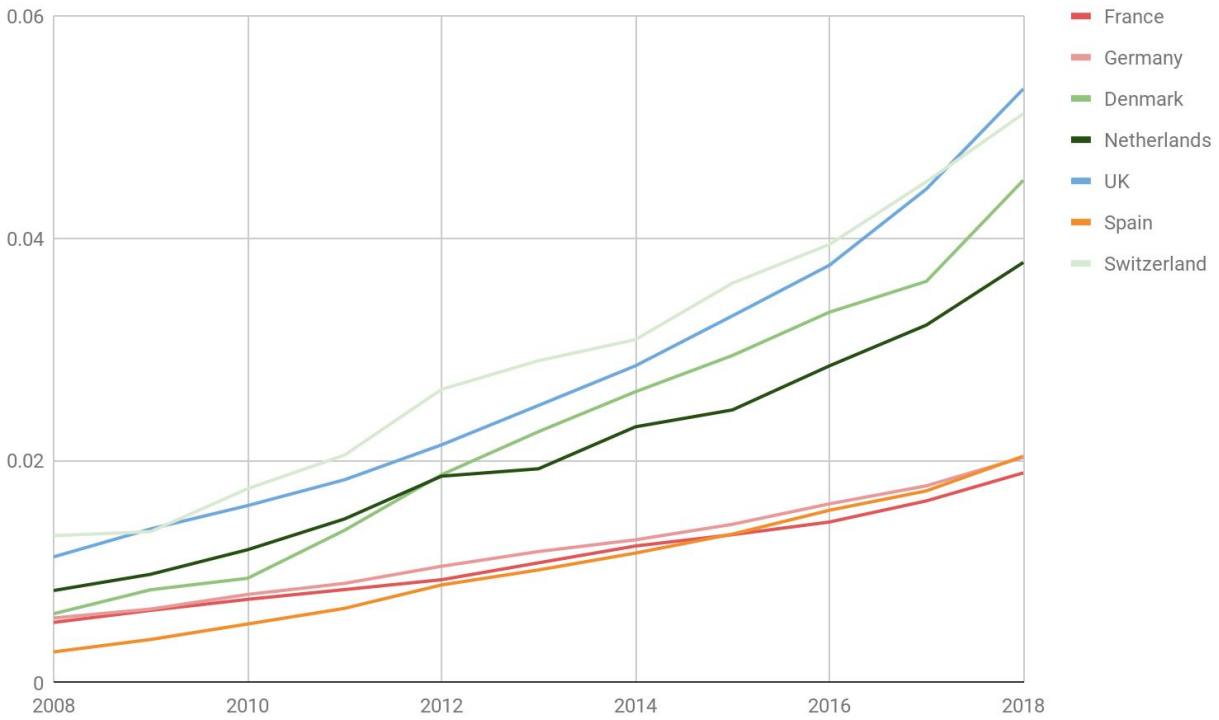
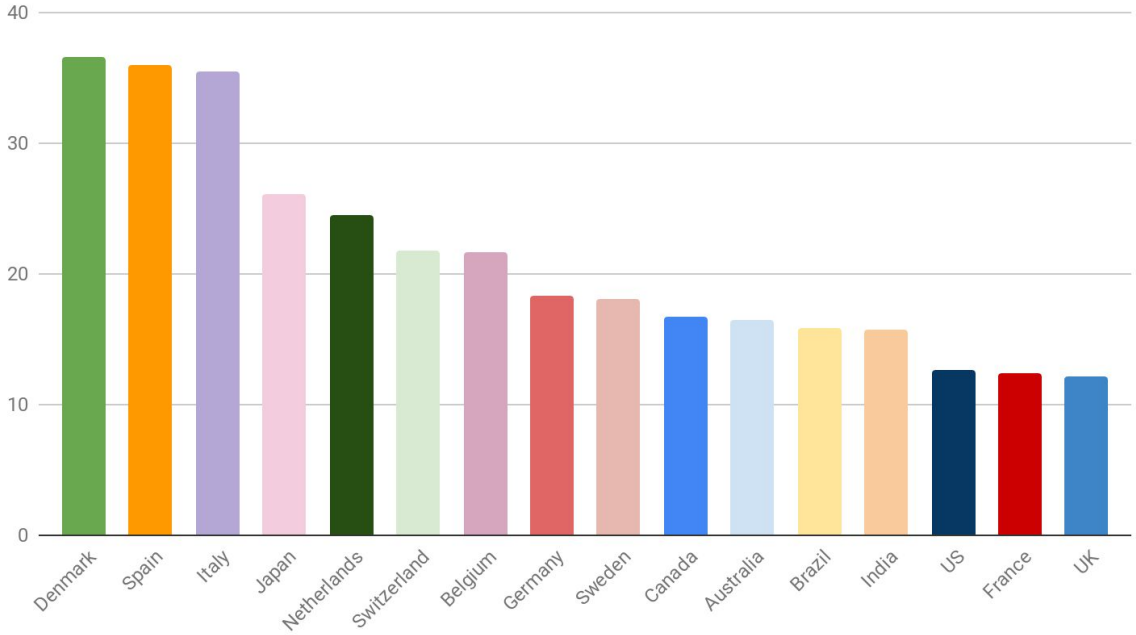
Hypothesis 2: Globalisation - co-publication networks



Co-publications with China normalized per n° of researchers (data source: Scopus)

Hypothesis 2: Globalisation - researcher mobility

Share of nonmobile natives that had temporary visits abroad for at least 6 months (data source: [GlobSci 2015 study](#))



Hypothesis 3: Structure - 3 key models

- **Denmark, Netherlands, UK: “differentiated” model** (no large independent national research organisations, few research-intensive universities, more teaching universities, some independent research institutions);
- **Germany, Japan: “dual” model**, (research universities, teaching universities, and relatively large national research organisations independent from universities);
- **France: “hybrid” model** (large national research organisations partly integrated within large research and teaching universities).

Warning !!!

The next slides are not an attack on National Research Organisations but on the way the French system works. The key problem is the mission that the French state gives to generalist NROs such as the CNRS.

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Hypothesis 3: Structure - Vertical segmentation

		50+ locomotives		500+ locomotives		500+/50+
Country	R&D units	HEI	HEI/total units	HEI	HEI/total units	%
Denmark	2,331	11	0.47%	5	0.21%	45.5%
France	8,485	96	1.13%	9	0.11%	9.4%
Germany	13,652	96	0.70%	34	0.25%	35.4%
Netherlands	5,702	24	0.42%	18	0.32%	75.0%
Spain	11,233	57	0.51%	18	0.16%	31.6%
Switzerland	2,495	22	0.88%	7	0.28%	31.8%
UK	12,400	108	0.87%	46	0.37%	42.6%

* This includes all institutions in a country that have applied for FP7 or H2020 funds.

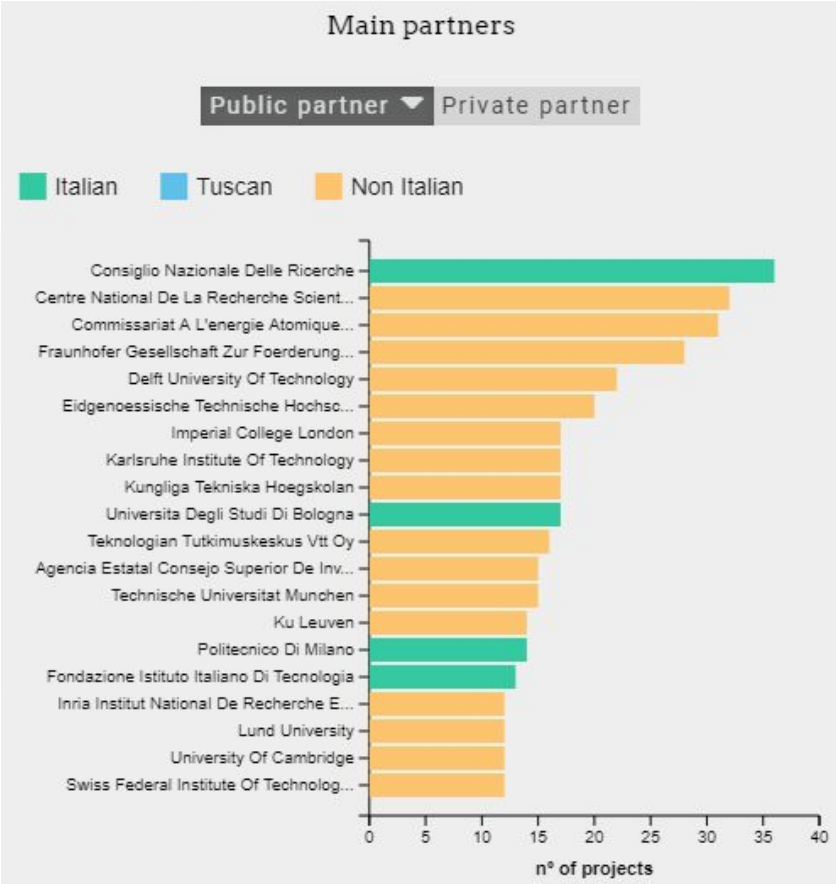
Fig. 58: Number of project-submitting "locomotive" Higher Education Institutions (Piro 2019)

Hypothesis 3: Structure - the weight of NROs

	50+ locomotives			500+ locomotives			500+/50+ locomotives		
Country	HEI	PRI	Share HEI	HEI	PRI	Share HEI	HEI	PRI	Share HEI
Denmark	11	10	52.4%	5	0	100.0%	45.5%	0.0%	100.0%
France	96	49	66.2%	9	9	50.0%	9.4%	18.4%	33.8%
Germany	96	98	49.5%	34	8	81.0%	35.4%	8.2%	81.3%
Netherlands	24	30	44.4%	18	5	78.3%	75.0%	16.7%	81.8%
Spain	57	128	30.8%	18	6	75.0%	31.6%	4.7%	87.1%
Switzerland	22	12	64.7%	7	4	63.6%	31.8%	33.3%	48.8%
UK	108	39	73.5%	46	3	93.9%	42.6%	7.7%	84.7%

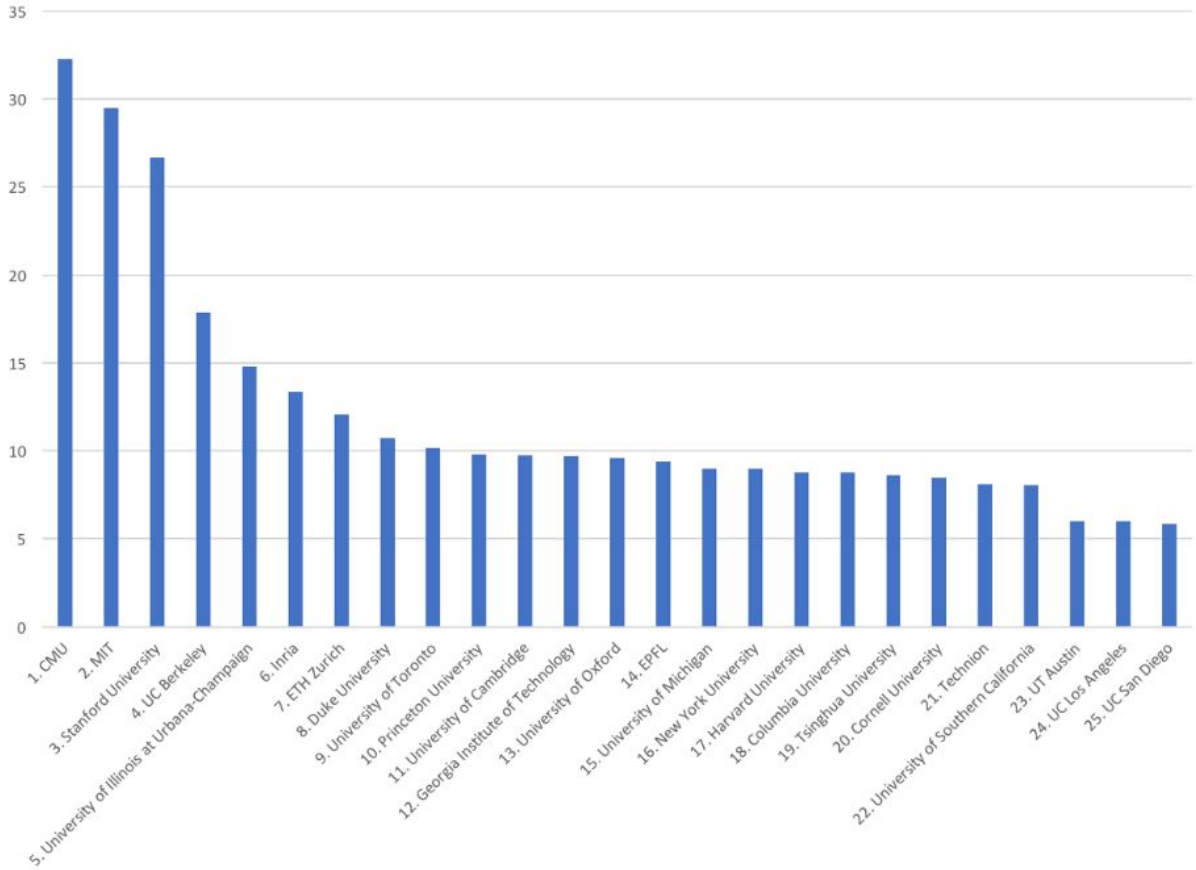
Fig. 60: project-submitting "locomotive" Higher Education Institutions and Public Research Institutions (PRI) (adapted from Piro (2019))

Hypothesis 3: The impact of NROs - visibility



H2020 partners of Tuscan universities (data source: CORDIS)

Hypothesis 3: The impact of NROs - visibility



World-top 25 universities in AI research at NIPS 2017 publication index (reproduced from Chuvpilo (2018)

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Hypothesis 3: The impact of NROs - performance

EXCELLENCE INDICATORS

Best Paper Rate | Best Journal Rate

SIGNIFICANCE

Show statistically significant results only

YOUR SELECTION

CLEAR

Institution	Country	Papers	Indicator value
Universite Denis Diderot, Paris 7	FRA	23420	22.4%
Ecole Normale Superieure de Paris	FRA	8951	22.0%
Universite Rene Descartes, Paris 5	FRA	16094	21.8%
Universite Pierre et Marie Curie, Paris 6	FRA	42225	21.2%
Universite Paris-Sud 11	FRA	23738	20.8%
Centre National de la Recherche	FRA	231759	16.8%

Screenshot of the Mapping Scientific Excellence tool, showing six selected institutions and their score on the percent of papers in the top 10%

Hypothesis 3: The impact of NROs - transaction cost + HR

- Multi-affiliated institutions result in weak decision-making capacity and systemic loss of resources
  - information asymmetry (between the *tutelles*)
  - internal asymmetry (HR)
  - strategic misalignment between NROs and university

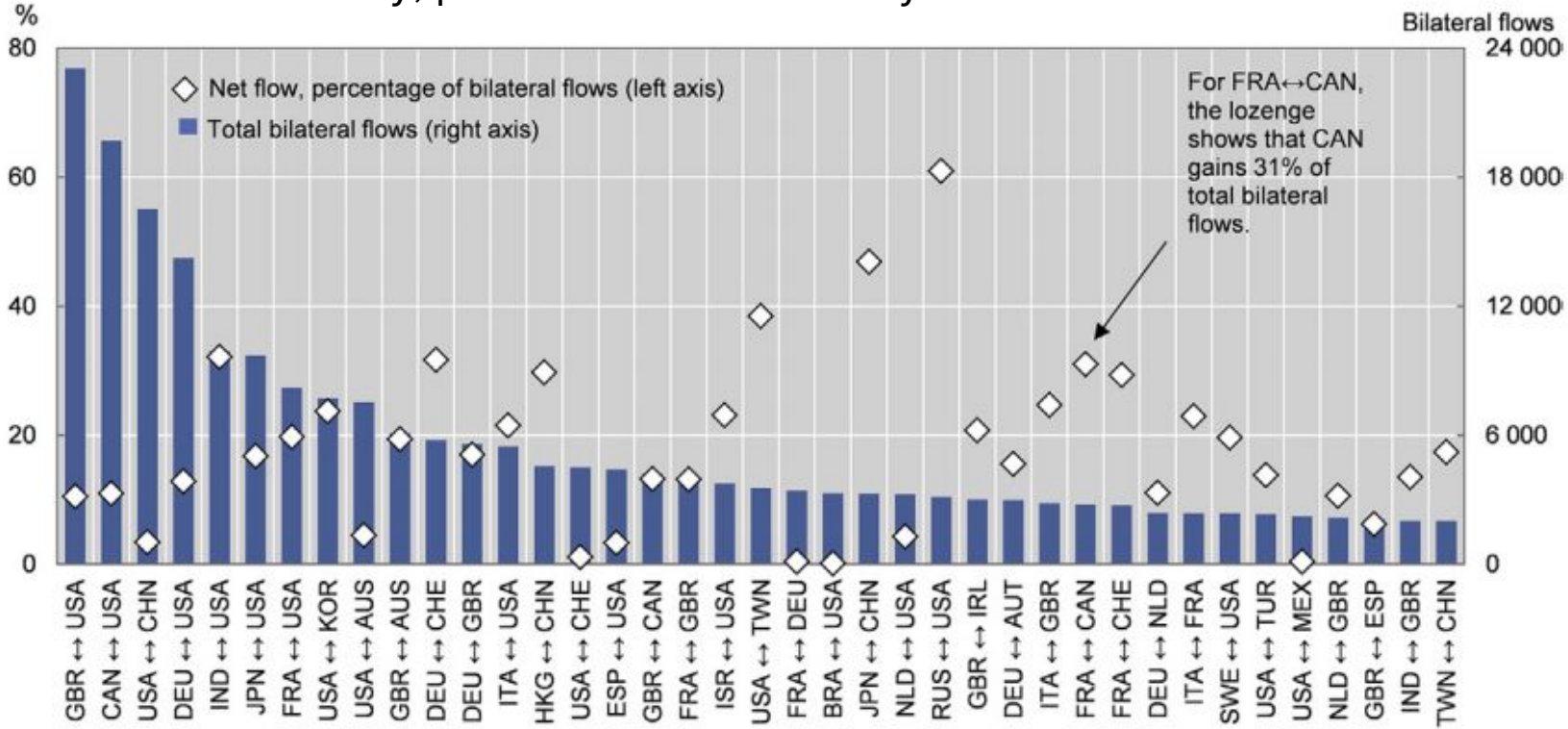
- Inefficient Hiring model
  - why hire either a researcher or a professor with 192 hours of teaching obligation rather than hiring two professors and being able to define teaching duties on a yearly basis?

Hypothesis 3: The impact of NROs - capacity at re-allocating positions

- Generalist NROs become conservative
  - balance between lobbying from different disciplinary fields makes it hard to allocate resources to new emerging areas
  - impossibility to benchmark oneself makes it hard to fix clear competitive objectives (i.e. become top 10 in a given field)

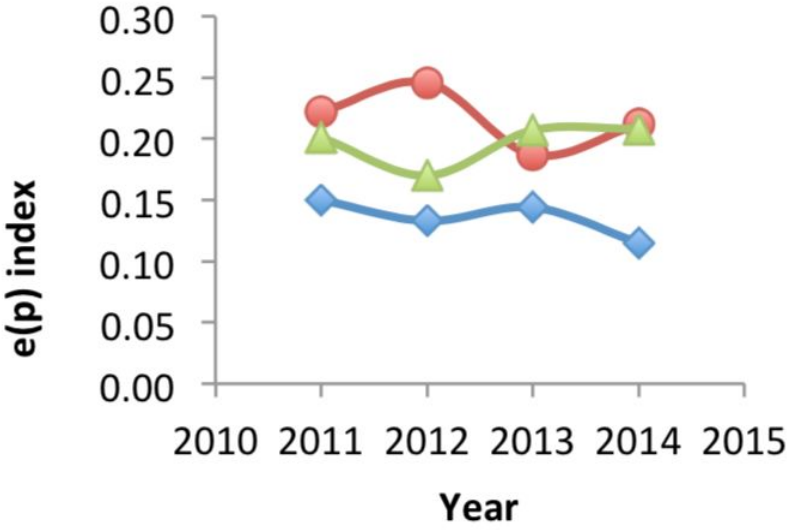
Hypothesis 4: Human Resources - mobility

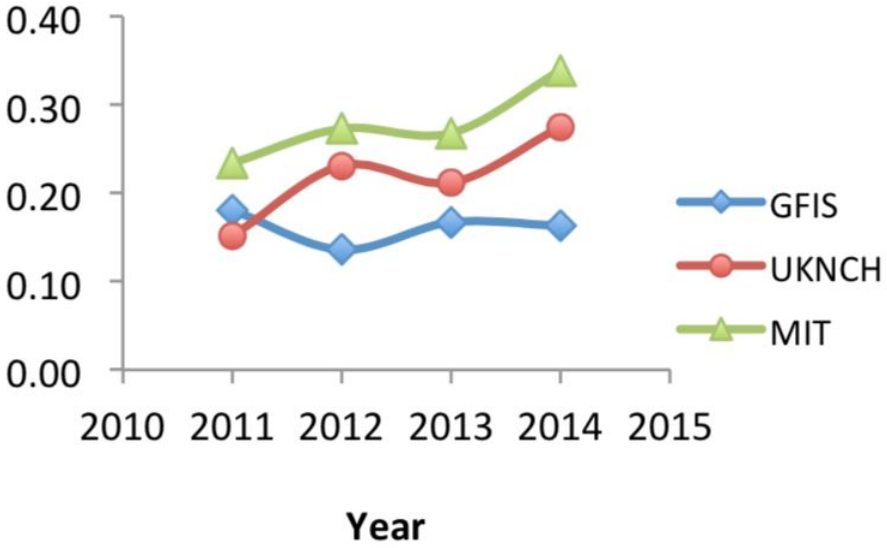
High negative brain drain towards Canada, Switzerland, the US and the UK; neutral brain circulation with Germany; positive inflow from Italy.



"International flows of scientific authors, 1996-2011. Largest bilateral flows, by first and last affiliation (Appelt et al. 2015)

Hypothesis 4: Human Resources - ERC performance





"ERC publications in GFIS and UKNCH countries (TECH on the left and BIO-MED on the right). The e_p index is a coefficient based on impact percentiles (top 1%, 10% etc.). MIT publications are used as an external standard" (reproduced from (Rodríguez-Navarro and Brito 2019))

Hypothesis 4: Human Resources - Key factors

Item	Score
Opportunity to improve my future career prospects	4.30
Outstanding faculty, colleagues, or research team	4.25
Excellence/prestige of the foreign institution in my area of research	4.15
Opportunity to extend my network of international relationships	3.90
Better research infrastructures and facilities	3.80
Appeal of the life style or international experience	3.75
Opportunity to improve my future job prospects in the country where I lived when I was 18	3.65
Greater availability of research funds	3.60
Better quality of life	3.05
Better wage/monetary compensation	2.95
Few or poor job opportunities in the country where I lived when I was 18	2.60
Better working conditions (vacations, hours of work, …)	2.45
Family or personal reasons	2.40
Better fringe benefits (parental leaves, pension, insurance, …)	2.35

Description of factors in decision to work abroad - 1: Totally unimportant, 5, Extremely important (Franzoni, Scellato, and Stephan 2015))

Hypothesis 4: Human Resources - what science policy research says

[...] US research universities offer the most attractive jobs for early stage researchers. Behind the US is a group of well performing European countries, the Netherlands, Sweden, Switzerland and the UK. Austria and Germany are next, closely followed by ***France****, which in turn is followed by Italy.* (Jurgen Janger, Strauss, and Campbell 2013)

MIT and all other elite research institutions attract the brightest researchers because these institutions offer a superb research environment. Once in the institution, these researchers can freely apply for competitive research funding without any specific internal requirements. [...] No [German, ***French****, Italian or Spanish] university [provides] a research environment that is at the expected ERC level. (Rodríguez-Navarro and Brito 2019)*

Hypothesis 5: Autonomy, accountability, governance

- *[…] more money has much more impact when it is combined with budget autonomy. To be more precise: […] budget autonomy doubles the effect of additional money on university research performance.* (Aghion et al. 2008)

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Hypothesis 5: Autonomy, accountability, governance

European University Association

Autonomy scorecard:

France ranks 28th out of 28 overall

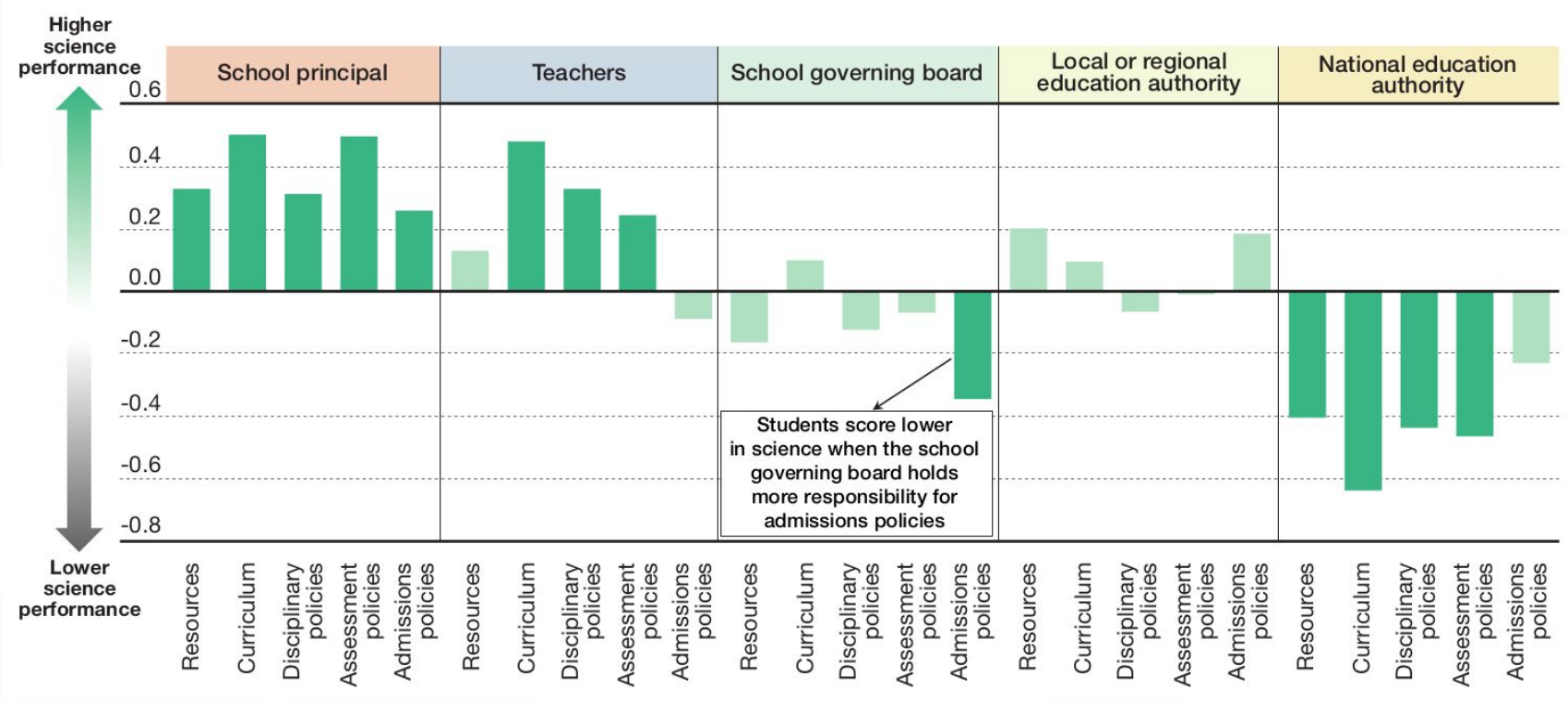
20th
in Organisational

24th
in Financial

27th
in Staffing

27th
in Academic

Hypothesis 5: Autonomy, accountability, governance



Correlations between the responsibilities for school governance and science performance (Reproduced from Pisa (OECD 2015b))

… the transformation of the French system of higher education and research has only just started…

Thanks!