People & Patents in Italian Universities: characteristics of academic inventors and link with research quality

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Focus

- Research quality is positively or negatively associated with patenting activity of Italian academic inventors?
- How strong is the influence of individual characteristics such as disciplinary and gender issues, academic role and university's features?

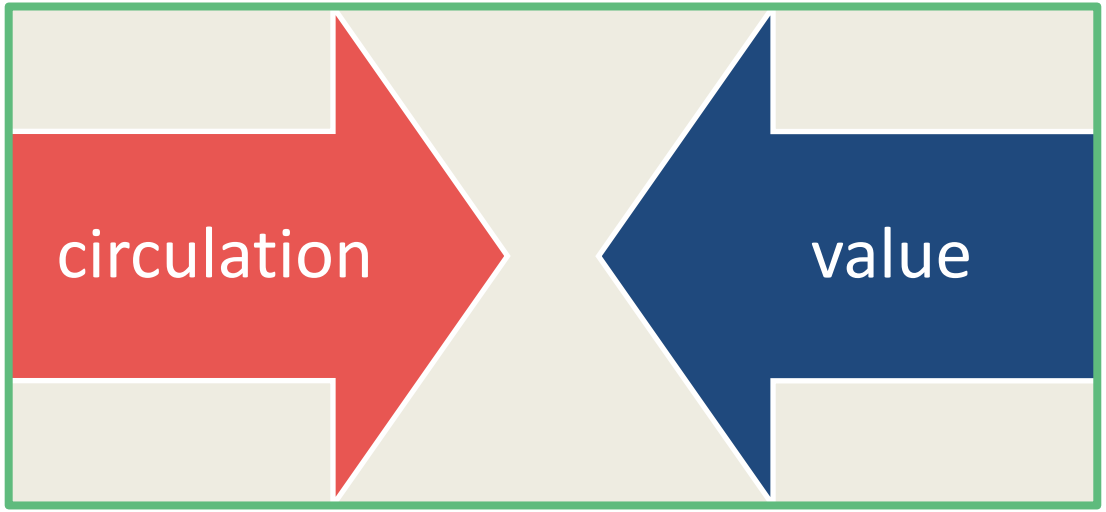
Third mission and impact on society

- increasing emphasis on interacting externally and engaging in new relationships with non-academic domains (Etzkowitz 2003; Slaughter and Leslie 1997)
- worldwide academic institutions and policymakers' incentives:
- propensity towards patenting (Mowery and Nelson 2004; Nelson 2004; Stiglitz and Wallsten 1999)
  - university researchers engaging in academic entrepreneurship (Shane 2004)
  - diffusion of TTOs, industry collaboration support offices and science parks (Siegel et al. 2003)

Research quality and Third Mission

- Production of knowledge and valorisation of research are driven by different characteristics, motivations and incentives
- *Substitute or complement*? A 'classical' problem (Merton 1968; Mitroff 1974; Mulkay 1976; Dasgupta and David 1994)
- E.g.: patenting activity is inspired by commercial and financial objectives and the monopoly constituted by patents can delay or even interrupt the disclosure of results, while knowledge production is based on openness, i.e. publication and discussion of results within the academic community (Florida and Cohen 1999; Hane 1999; Nelson 2004; Lissoni and Montobbio 2006; Lissoni at al., 2012)

Substitute or complement?



Positive

- Research quality benefits from the collaboration with the business sector: (D'Este and Perkmann, 2011)
  - access to new funding channels
  - use of equipment and infrastructure
  - opportunities of verification and refinement of theories and discoveries in concrete situations
  - capacity to support research lines and to generate broader impact
- especially in the fields of Medicine and Engineering: (Bonaccorsi et al. 2013)
  - scientific productivity of teams
  - training of students
  - career paths of young researchers

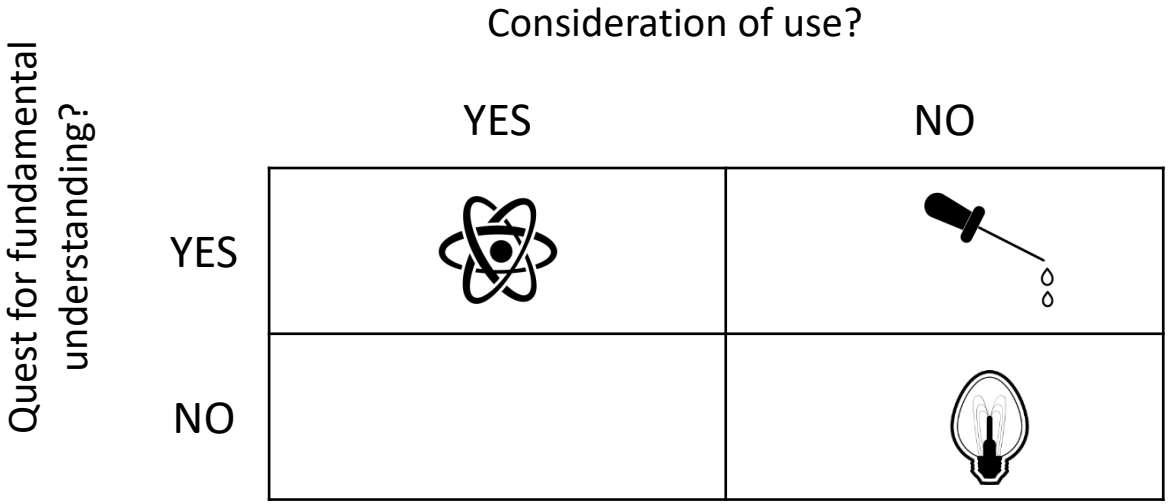
Positive

- researchers with higher productivity and scientific impact are generally more engaged in technology transfer activities (D'Este and Perkmann, 2011; Van Looy et al. 2011; Gulbrandsen and Smeby 2005)
- the international scientific visibility acts as a lever for reputation and it raises business's interest for partnerships (Bruno and Orsenigo 2003)
- SMEs *versus* large firms

Negative

- valorisation of research and commercialization divert resources (time and equipment) from ‘blue-skies’, fundamental and long term research (and teaching activity) (Clark 1998; Shane 2004; Etzkowitz 2003; Jensen and Thursby, 2002; Dasgupta and David 1994)
- potentially detrimental effects of ‘entrepreneurial science’ (instrumental use and manipulation by industry) (Noble 1977; Slaughter and Leslie 1997; Krimsky 2003; Kenney 1986)
- academic norms and values contaminated by profit and efficiency principles (Merton, 1968), impact on academic freedom (Blumenthal et al. 1986; Behrens and Gray 2001), lowering of research productivity (Agrawal and Henderson 2002) and slowing down of open knowledge diffusion (Nelson 2004; Rosell and Agrawal 2009; Murray and Stern 2007)

Discipline matters



(Stokes, 1997)

- Ambidexterity and positive feedback loops (Ambos et al. 2008)

At individual level

- the rate of patenting is expected to decline with the age, similarly to publishing activity (Stephan et al., 2004)
- patenting activity is negatively associated to age and positively to career stage (Agrawal and Henderson, 2002)
- patent production curve over the life cycle (similar to publication production) is an inverse U shape (Wallmark, 1997)
- patents are probably more concentrated in those communities where there are more opportunities, but also where this cost-opportunity is low and where patent communication and publication are not too far each other (Potì and Reale, 2005)
- a strong motivation is represented by the attractiveness of market resources to research activity which come with patenting

Data on patents

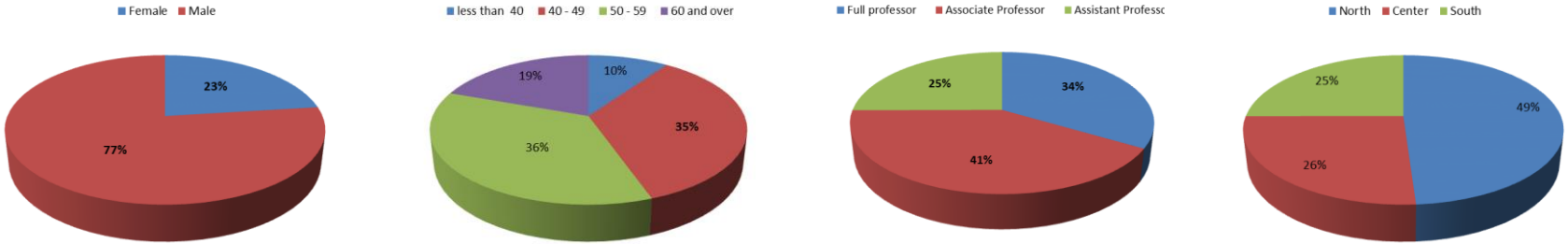
- Microdata on individual characteristics, patenting activity and quality of scientific production of inventors are drawn from Evaluation of Research Quality (VQR) 2011-2014, the second round of the Italian research assessment exercise
- Data on patents are taken from the European Patent Office (Worldwide Patent Statistical Database) and subsequently validated and integrated by researchers in the submission phase of the VQR.

Data on research quality

- Microdata on research quality are drawn from VQR 2011-2014, where academics were asked to submit two research outputs published in that assessment period.
- Quality of research outputs was assessed using an informed peer review methodology
- For each academic inventor we computed the mean of the two outputs submitted and normalized it by disciplinary area means (to account for different evaluation parameters in different areas)

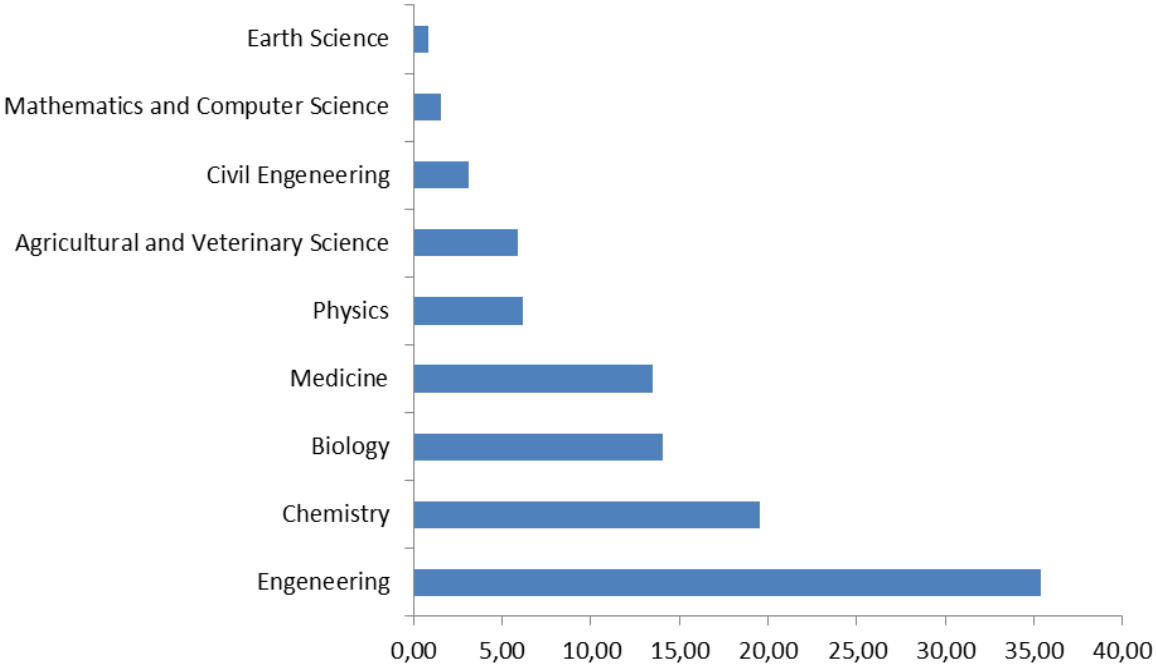
Descriptive Statistics

- 2.363 inventors out of roughly 55.000 academics in Italian universities



Gender, age, academic position and university location of professor-inventors, years 2011-2014

Descriptive Statistics



Disciplinary area of professor-inventor, 2011-2014

Model

- Estimation of an empirical regression model to explore the correlation between research quality and patenting.
- Endogeneity problems due to reverse causality
- The dependent variable is the number of patents produced in the VQR period by the individual researchers and the explanatory variables are:
  - research quality indicators (normalized by area)
  - characteristics of the researcher (gender, age, academic position, disciplinary area)
  - characteristics of the university (geographical area, university specialization, funding, legal status state/non state, Polytechnic/School for Advanced Study/Online)

Sample statistics

	N	mean	sd	p10	p25	p50	p75	p90	p95	min	max
Number of patents per capita	32,616	0.120	0.567	0	0	0	0	0	1	0	21
Quality of research score	32,616	1.861	1.038	0.165	1.152	1.867	2.695	3.182	3.291	0	3.351
Female	32,616	0.329	0.470	0	0	0	1	1	1	0	1
Age	32,616	52.551	8.958	40	45	53	60	65	67	28	76
Full Professor	32,616	0.217	0.412	0	0	0	0	1	1	0	1
Associate Professor	32,616	0.358	0.479	0	0	0	1	1	1	0	1
Assistant Professor	32,616	0.357	0.479	0	0	0	1	1	1	0	1
Mathematics and Computer Science	32,616	0.101	0.301	0	0	0	0	1	1	0	1
Physics	32,616	0.065	0.246	0	0	0	0	0	1	0	1
Chemistry	32,616	0.085	0.280	0	0	0	0	0	1	0	1
Earth Science	32,616	0.031	0.174	0	0	0	0	0	0	0	1
Biology	32,616	0.143	0.350	0	0	0	0	1	1	0	1
Medicine	32,616	0.284	0.451	0	0	0	1	1	1	0	1
Agricultural and Veterinary Science	32,616	0.090	0.286	0	0	0	0	0	1	0	1
Civil Engineering	32,616	0.046	0.209	0	0	0	0	0	0	0	1
Engineering	32,616	0.155	0.362	0	0	0	0	1	1	0	1
heterogeneity index	32,616	0.931	0.069	0.849	0.921	0.955	0.974	0.978	0.982	0.363	0.982
North	32,616	0.434	0.496	0	0	0	1	1	1	0	1
Center	32,616	0.249	0.432	0	0	0	0	1	1	0	1
South	32,616	0.313	0.464	0	0	0	1	1	1	0	1
Online	32,616	0.005	0.068	0	0	0	0	0	0	0	1
Log per capita founding	32,557	10.744	0.551	10.133	10.478	10.841	11.044	11.188	11.636	5.8226	12.742
Polytechnic/School for Advenced Studies	32,616	0.060	0.238	0	0	0	0	0	1	0	1
State University	32,616	0.962	0.192	1	1	1	1	1	1	0	1

Sample statistics on research quality and individual and institutional characteristics, 2011-2014

	(1)	(2)	(3)	(4)
Quality of research score	0.0485***	0.0369***	0.0346***	0.0878**
	(0.00301)	(0.00313)	(0.00315)	(0.0342)
Female		-0.0393***	-0.0390***	-0.0697
		(0.00686)	(0.00686)	(0.0698)
Age		-0.00167***	-0.00170***	0.000654
		(0.000414)	(0.000416)	(0.00401)
Full Professor		0.0946***	0.0951***	0.311***
		(0.00882)	(0.00884)	(0.0743)
Mathematics and Computer Science		-0.280***	-0.267***	-0.437*
		(0.0125)	(0.0127)	(0.228)
Physics		-0.203***	-0.191***	-0.433***
		(0.0144)	(0.0146)	(0.121)
Chemistry		0.000165	0.0202	-0.0510
		(0.0132)	(0.0136)	(0.0833)
Earth Science		-0.271***	-0.248***	-0.650**
		(0.0191)	(0.0193)	(0.303)
Biology		-0.183***	-0.161***	-0.390***
		(0.0116)	(0.0120)	(0.0939)
Medicine		-0.241***	-0.220***	-0.476***
		(0.0101)	(0.0106)	(0.0964)
Agricultural and Veterinary Science		-0.233***	-0.211***	-0.508***
		(0.0130)	(0.0134)	(0.126)
Civil Engineering		-0.212***	-0.203***	-0.0752
		(0.0163)	(0.0164)	(0.165)
heterogeneity index			0.133*	2.005***
			(0.0784)	(0.690)
South			-0.0320***	-0.120*
			(0.00683)	(0.0665)

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			(0.0784)	(0.690)
South			-0.0320***	-0.120*
			(0.00683)	(0.0665)
Log per capita founding			0.0358***	0.211***
			(0.00615)	(0.0574)
Polytechnic/School for Advanced Studies			0.0900***	0.656***
			(0.0222)	(0.179)
State University			-0.0701***	-0.976***
			(0.0196)	(0.216)
Constant	0.0295***	0.307***	-0.140	-1.698**
	(0.00642)	(0.0232)	(0.0931)	(0.848)
Observations	32,616	32,616	32,557	2,359
R-squared	0.008	0.048	0.051	0.069

Main results

- The results of the regression model confirm the existence of a positive correlation between quality of research and inventive capacity
- The positive correlation persists in the presence of controls linked to individual characteristics
- We also found that patenting is an activity more frequent for men in mature stages of career, full and associate professors affiliated to Northern universities

Thanks for your attention!

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