

The impact of knowledge diversity on inventive performance at European universities

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- Increased use of teams in scientific & technological research
- Teams are more creative and more productive
- Policies promoting teamwork in science: cross-disciplinary and cross-border collaborations
- Barriers to team potential - diversity

Q: How knowledge diversity contribute to effective teamwork?

Diversity in joint research experience

- cognitive diversity (Milliken et al., 2003)

H1: Teams with greater scope of cognitive diversity are more innovative

Diversity in disciplinary background

- variety and recombination process (Singh and Fleming, 2009)

H2: Teams with diverse disciplinary background are more innovative

Barriers

communication problems
coordination costs

Mitigation

working together (Katz, 1982)
prior working knowledge (Melero, 2011)

H3: There is an inverted U-shape between the scope of team joint research experience and its innovative potential

H4: Teams with overlap in their disciplinary background are more innovative



Cognitive diversity



Disciplinary diversity



- Knowledge domain overlap
- Joint research experience

Input based

- **Project** - Cummings & Kiesler (2007), Giuri et al. (2010)
- **Administrative unit** - Taylor & Greve (2006), Rey-Rocha et al. (2006)

Output based

- **Bibliometric** - Guimerà et al. (2005), Stvilia (2010)
- **Patents** - Singh & Fleming (2009), Morelo (2011), Bercovitz & Feldman (2011)

Research team: inventors on university patent application

- researchers who contributed in the form of idea conception (Lissoni & Montobbio, 2008; Haeussler & Sauermann, 2011)
- teams with scientists overrepresented among the most productive in science (Azoulay et al., 2007; Stephan et al., 2007; Lissoni & Montobbio, 2008)
- *applied* projects - commercially oriented projects

Performance: patent value (van Zeebroeck & van Pottelsberghe, 2011)

Knowledge background: scientific publications

- Countries with no or institutional IP ownership before 1995 - Geuna & Rossi (2011) - BE, CH, ES, FR, IE, IT, NL, UK
- University selection – Second Science and Technology Indicators Report (EC, 1997)
- EPO applications 1995-2002 in the field of Chemistry and Pharmaceuticals

Final sample: 785 patent families filed by 60 universities

- Publication records of inventors are collected in SCOPUS
Out of 1,774 distinct inventors publication record are found for 1,356

Team composition

Average team: 3.3 persons = 2.7 publishing + 0.6 non-publishing*

		No of inventors with scientific publications						
		1	2	3	4	5	6	6+
No of inventors	1	81						
	2	58	149					
	3	14	77	104				
	4	4	23	53	63			
	5		8	17	29	22		
	6	1	1	3	4	12	15	
	6+				3	6	4	15
		158	258	180	102	38	30	19

(*) Non-publishing inventors may include: (i) PhDs with no publications; (ii) technicians; (iii) industry researchers (approx 5% of teams Bercovitz & Feldman, 2011)

Diversity in knowledge background - propensity to collaborate
share of jointly co-authored publications in the total (distinct) output

$$ShareJoint_j = \frac{|\cup_{i=1}^n A_i| - \sum_{i=1}^n |A_i|}{|\cup_{i=1}^n A_i|}$$

Diversity in disciplinary background - based on Herfindal Index

$$DisDiv_j = \left(1 - \sum_{i=1}^{27} x_{ij}^2 \right) \frac{N}{N-1}$$

Disciplinary overlap measure - based on (Giuri et al., 2010)

$$Overlap_j = n - \beta = n - \frac{N_{pr}}{\frac{1}{n} \sum_i N_i} = n \left(1 - \frac{N_{pr}}{\sum_i N_i} \right)$$

Dependent variable

- 5Y forward patent citations made in EPO search reports (EPO-direct; EPO-PCT)
- Exclude self-citations
- (*) Weighted citations (Hall et al., 2001)

Poisson models

$$\mu_i = E[y_i|x_i] = \exp(x_i'\beta + z_i'\gamma)$$

Robustness checks

- Negative Binomial and Zero Inflated Negative Binomial

	(1)	(2)	(3)	(4)	(5)	(6)
Invent No	0.035 (0.032)					
Publn Inv No		0.140*** (0.037)	0.134*** (0.038)	0.116*** (0.040)	0.106*** (0.041)	
Non Publn Inv		-0.499*** (0.127)	-0.513*** (0.127)	-0.468*** (0.128)	-0.476*** (0.128)	-0.509*** (0.126)
Dis Div			0.979** (0.451)		1.094** (0.463)	0.992** (0.453)
Share Joint Publn				1.960** (0.959)	2.152** (0.952)	
Share Joint Publn sq				-3.213** (1.593)	-3.419** (1.569)	
Overlap						0.158*** (0.043)
Experience CV	0.153 (0.173)	0.131 (0.178)	0.103 (0.178)	0.104 (0.179)	0.071 (0.179)	0.123 (0.178)
L.Pat	0.336*** (0.117)	0.310*** (0.118)	0.271** (0.119)	0.306*** (0.118)	0.264** (0.119)	0.261** (0.119)
Univ Equiv	0.007 (0.005)	0.006 (0.005)	0.007 (0.005)	0.006 (0.005)	0.007 (0.005)	0.007 (0.005)
Constant	-0.588*** (0.214)	-0.696*** (0.218)	-1.338*** (0.373)	-0.748*** (0.223)	-1.473*** (0.385)	-1.184*** (0.366)
# of obs	627	627	627	627	627	627
Pseudo LL	-629.01	-616.40	-613.97	-614.02	-611.11	-613.51
Wald test	77.672	102.884	107.749	107.649	113.468	108.662
BIC	1328.87	1310.1	1311.67	1318.21	1318.83	1310.76
Param.	12	13	14	15	16	14

Q: How knowledge diversity can contribute to effective teamwork?

Findings

- An inverted U-shape between diversity in joint research experience and inventive performance
- Joint research as a process of socialization & learning
- Multidisciplinary is favored
- Overlapping disciplinary background increases performance

Policy recommendations

- Disciplinary diversity has a potential
- Team member needs to work together to realize its potential

Future research:

- Joint research in inventing teams as complementary to non-patent and patent-paper pairs literatures
- What type of (joint) research is paving the way for discovering the technology?
- Is there a citation premium on output generated jointly by inventors?

Thank you for your attention

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