Relatedness, academic inventors and smart specialization in Italian NUTS3 regions

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The paper in a nutshell

What is the impact of academic inventors' involvement into local invention dynamics on relatedness for technological diversification? Does academic inventors' involvement into patenting activity constrain the role of relatedness?

- Outcome of interest: **entry of regions in new technological specialisations**
- Predictors of interest: **relatedness to existing specialisations**, **academic inventors' involvement** in patenting, interaction between the two

Motivation: increased policy and academic interest on the role of regional branching within the debate on smart specialisation strategies (S3)

Expected contribution: uncover knowledge dynamics behind smart specialisation, notably with respect to the role of academic knowledge

Literature: relatedness, and...

- The regional branching literature show that that regions will **stay close to their existing capabilities** when moving into new products and technologies (Boschma and Frenken, 2011): **relatedness** is a key pillar of the S3 approach (Boschma, 2014).
- However, the debate on regional diversification patterns has started questioning the desirability of relatedness-driven strategies, because of **path-dependence** and **lock-in** effect.
- The capacity to enter in new and **unrelated activities** might prove to be a key asset for regions willing to activate long-term development patterns.

Literature: ...unrelatedness

- **Unrelated diversification** is likely to ensure enduring economic growth and decreasing unemployment (Frenken et al., 2007; Davies and Tonts, 2010; Neffke et al., 2018).
- Understanding of the factors helping regions to develop the **capacity to diversify** in loosely related activities becomes of paramount importance
- The few existing investigations stress the role of **foreign firms** in engendering regional structural change and the specialization in cross-cutting technologies like **KETs** (DAmbrosio et al., 2017; Montresor and Quatraro, 2017; Neffke et al., 2018).

Literature: what mitigates relatedness?

- Novelty creation results from **recombination** of heterogeneous and dispersed **knowledge components** (Weitzman, 1996; Fleming and Sorenson, 2004, Saviotti, 2007): **inventors** are key actors in this process
- **Academic inventors** possess knowledge and skills that make them more receptive toward innovation and more likely to engage in **boundary-spanning research** (e.g. March and Simon, 1958; Hargadon, 2006)
- Academic inventors' involvement is a dimension of codified **local innovation capability** that is necessary to command wide areas of technological space

⇒ **Hp**: the involvement of **academic inventors** in local innovation dynamics **mitigates the impact of relatedness** on the entry of regions in new technological specializations

Data

- Patent data from OECD Regpat database: link patent-NUTS regions
- Academic inventor identification from database on Academic Patenting in Europe (APE-INV)
- NUTS 3 data from Cambridge Econometrics EU Regional Database
- NUTS 2 data from Italian Institute for National Statistics and Chamber of Commerce

⇒ Panel of 103 NUTS 3 ("provinces") over period 1998-2009 (N=1236)

Variables

Dependent variable

- **ma_entry**: 5 years moving average of **entry** = count of new specialisations in year-nuts3, based on patent tech. classes

Regressors of interest

- **ma_relatedness**: 5 years moving average of **relatedness** = proximity of new specialisations to old ones, based on patent tech. classes
- **acad_pat**: dummy indicating academic inventors' involvement into team of inventors, 1 if at least one academic inventor is involved
- **ma_relatedness*acad_pat:** interaction term capturing mitigation effect

Variables

Control variables

- **R&D**: research and development expenditure in year-nuts3
- **new firms**: new registered companies in year-nuts3
- **empl**: employment in year-nuts3
- **gdp**: gdp in year-nuts3

Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ma_entry	1,236	22.54078	18.33755	.2	87.4
ma_relatedness	1,236	.0116925	.0149436	.0000207	.0866874
acad_pat	1,236	.4757282	.4996311	0	1
R&D	1,236	147649.2	275369.2	3685.321	2417934
new_firms	1,224	4010.303	4457.97	536	33690
gdp	1,236	13.58036	18.96304	1.533	148.935
empl	1,236	231.4739	292.8336	31.116	2164.37

	ma_entry	ma_relatedness	acad_pat	R&D	New_firms	gdp	empl
ma_entry	1.0000						
ma_relatedness	0.9539*	1.0000					
acad_pat	0.4774*	0.4119*	1.0000				
R&D	0.5898*	0.6613*	0.2959*	1.0000			
new_firms	0.5783*	0.6515*	0.3555*	0.9187*	1.0000		
gdp	0.6511*	0.7378*	0.3381*	0.9521*	0.9621*	1.0000	
empl	0.6432*	0.7226*	0.3544*	0.9451*	0.9796*	0.9941*	1.0000

Methodology

- ma_entry=F(ma_relatedness, acad_pat, interaction, control variables)
- linear dep. var., balanced panel

$\Downarrow$

✓ **Fixed effects panel regressions**

✓ 1-year lagged regressors

✓ Inverse sine transformation[1] to ease interpretation of results

[1] $\text{inverse\_}y = \log(y_i + (y_i^2 + 1)^{1/2})$

Results: fixed effects regressions

Fixed effects	(1) ma_entry	(2) ma_entry	(3) ma_entry	(4) ma_entry
ma_relatedness	13.14***	12.35***	16.56***	15.29***
	(2.822)	(2.811)	(3.068)	(3.070)
acad_pat	0.0193	0.0167	0.0596***	0.0513**
	(0.0164)	(0.0164)	(0.0219)	(0.0220)
ma_relatedness*acad_pat			-3.829***	-3.236**
			(1.375)	(1.376)
R&D		0.179***		0.168***
		(0.0575)		(0.0576)
new_firms		-0.180**		-0.175**
		(0.0702)		(0.0701)
gdp		-0.307		-0.287
		(0.261)		(0.260)
empl		-0.183		-0.203
		(0.246)		(0.245)
Constant	3.372***	4.734***	3.345***	4.861***
	(0.0406)	(1.327)	(0.0416)	(1.325)
Observations	1,133	1,122	1,133	1,122
Adj. R-squared	0.280	0.291	0.284	0.295
ll	369.8	379.5	374.1	382.6
F	46.11	36.12	43.44	34.48
p	0	0	0	0

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Robustness check: mixed effects regressions

Mixed effects	(1) ma_entry	(2) ma_entry	(3) ma_entry	(4) ma_entry
ma_relatedness	20.40***	12.15***	24.69***	12.44***
	(2.354)	(2.462)	(2.619)	(2.806)
acad_pat	0.0279*	0.0311*	0.0780***	0.0646***
	(0.0165)	(0.0168)	(0.0220)	(0.0228)
ma_relatedness*acad_pat			-4.677***	-3.431**
			(1.377)	(1.442)
R&D		0.427***		0.220***
		(0.0352)		(0.0628)
new_firms		-0.166**		-0.102
		(0.0646)		(0.0676)
gdp		0.262		0.194
		(0.224)		(0.248)
empl		0.0534		0.265
		(0.219)		(0.242)
Constant	3.195***	-1.515*	3.162***	-0.578
	(0.159)	(0.845)	(0.156)	(0.994)
Observations	1,122	1,122	1,122	1,020
Number of groups	20	20	20	20
converged	1	1	1	1
ll	33.28	64.50	40.21	69.34
chi2	600.5	717.9	618.3	784.5
p	0	0	0	0

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusion

Findings:

- Results in line with the extant literature as for the **positive role of relatedness** for the entry in new technological areas
- Academic inventors' involvement significantly **reduces the impact of relatedness** on the entry of regions in new specialisations
- Academic knowledge contributes to local innovations capabilities, enabling **diversification patterns** across loosely technologically related domains

Contribution:

- These findings contribute to the growing literature on the importance of **unrelatedness** for regional development trajectories
- An initial step toward the identification of the factors upon which **regional development policies** could leverage to avoid lock-in effects
- Implications for smart specialisation strategies oriented at long-term economic development include the strengthening of **academia-business linkages**

Next steps

- Spatial regression model to check for spatial dependence
- Breakdown my macro geographical areas and by time span
- Probabilistic choice model by region-tech-year

Thank you!