Networked by design

Can policy constraints support the development of capabilities for collaborative innovation?

Annalisa Caloffi
Federica Rossi
Margherita Russo

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- **Network innovation policies**
  - *issues and questions, our approach*
- **Case study**
  - *context, policy objectives, policy pogramme*
  - *Data*
- **Effects of constraints:**
  - *Descriptive statistics, statistical models*
- **Remarks**
- **Further research**

Public policies
in support of innovation networks:

– increasingly popular

– usually aimed at promotion of R&D collaborations, technology transfer, innovation diffusion BUT ALSO at **improving networking**

– Involvement of firms, particularly SMEs, is often a key objective

– Some policies require participants to comply with **relational features** that are seen as conducive to successful collaborative innovation

– E.g. **minimum size** of the network, minimum number of small firms and universities (**heterogeneity**), etc.

Main research question

Do policy constraints on the composition of networks increase participants' ability to engage in collaborative innovation?

Effects of policy constraints

- **Positive:**
  - Creating connections between organizations that would not have otherwise collaborated
  - Promoting diffusion of knowledge and technology to weaker partners
  - Inducing established networks to open up their partnerships to new organizations
- **Negative:**
  - Additional layer of rules that may be misaligned with the participants' needs
  - Increased transaction costs in network formation and management
  - Unnecessary/opportunistic partners may hamper performance and learning
  - Congestion, slower/more difficult communication

Context

- Tuscany government's policies supporting innovation networks from 2000 to 2006
- Regional economic context
  - Prevalence of SMEs with no R&D activity, many in low or medium technology sectors affected by harsh international competition
  - Networking among local firms was limited to firms active in some specific sectors and territories of the region (industrial districts specialized in textiles, leather, jewellery)
  - Networking among firms and universities or research centres also weak

Policy objectives

- To support the realisation of innovation projects in several target sectors
  - ICT and multimedia (48.2% of the total funds),
  - opto-electronics (16.4%),
  - mechanics (7.5%) and others (among which biotechnologies, new materials, nanotechnologies)
- To support diffusion of innovation towards SMEs and micro enterprises
- To support the upgrading of the innovation skills of regional firms
- **Non-written goal**: re-balancing regional disparities (sectors, places, agents), opening local networks, promoting the formation of a stable nucleus of a regional innovation system

Policy programme's description

- **4 programs** (RPIA1 and RPIA2, SPD line 171 and 172)
- **9 waves**
- **168 funded R&D projects/networks**
- **1,127 participating organizations**: 765 firms + 362 other organizations (innovation centres & other KIBS; Universities and research centres; Business associations, Chamber of commerce; Others...)
- **Funds assigned: almost € 37 million** (around 40% of the total funds spent on innovation policies)
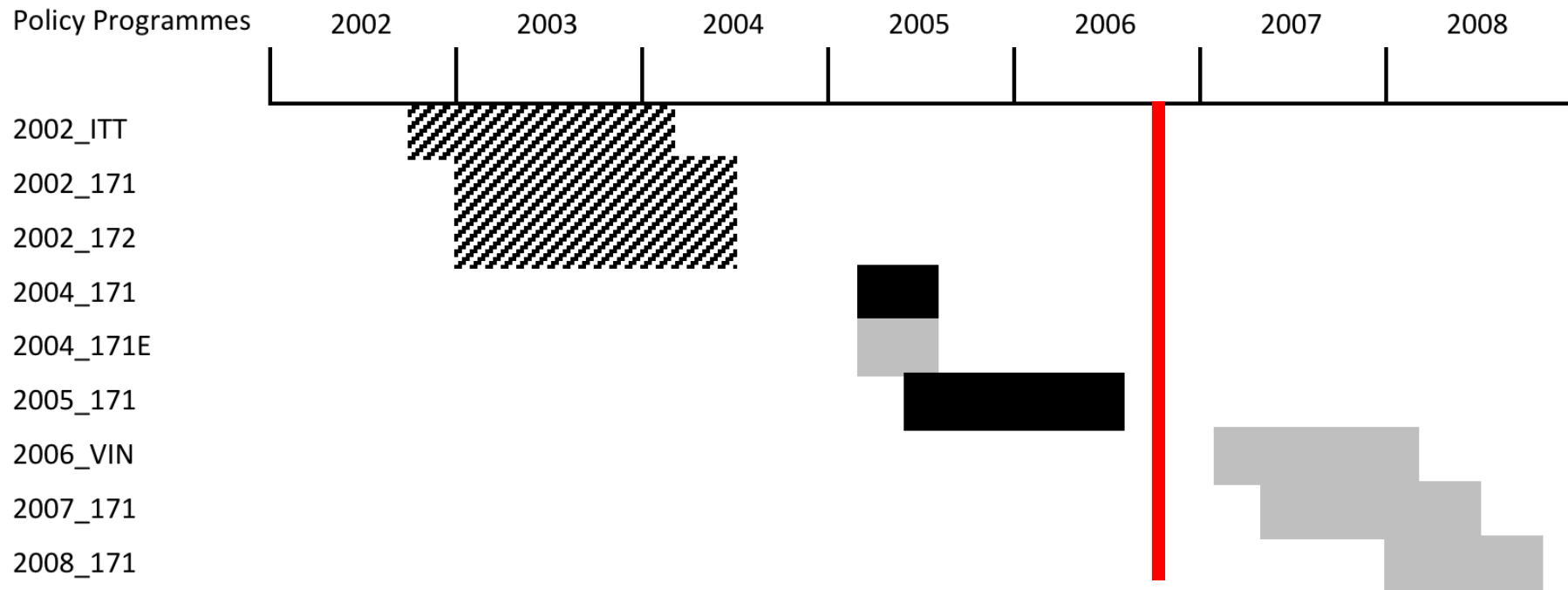- **Strong learning potential**, favoured by frequent meetings

Types of participants in both periods and sub-periods
(total number of participants: 1,127)

Type of organization	Both periods		Only 2002-5		Only 2006-8	
	n.	%	n.	%	n.	%
Firm	73	35.6%	417	64.1%	190	70.1%
University	28	13.7%	44	6.8%	21	7.7%
Private research company	4	2.0%	12	1.8%	6	2.2%
Service centre	18	8.8%	14	2.2%	3	1.1%
Business service provider	21	10.2%	42	6.5%	23	8.5%
Local government	18	8.8%	49	7.5%	10	3.7%
Local association	24	11.7%	51	7.8%	10	3.7%
Chamber of commerce	10	4.9%	0	0.0%	1	0.4%
Other public body	9	4.4%	22	3.4%	7	2.6%
Total	205	100.0%	651	100.0%	271	100.0%

Two periods: network formation (2002-05) vs. network consolidation (2006-08)

Constraints on partnership composition only imposed in first period

Policy Programmes	2002	2003	2004	2005	2006	2007	2008

2002_ITT

2002_171

2002_172

2004_171

2004_171E

2005_171

2006_VIN

2007_171

2008_171

Key

Minumum size constraint	Heterogeneity constraint	
	Present	Absent
Present	■	
Absent	▨	▦

Relationship between policy constraints and key dimensions they were designed to impact

	Minimum heterogeneity	No minimum heterogeneity	Minimum size	No minimum size
Programmes	2002_ITT, 2002_171, 2002_172, 2005_171	2004_171E, 2006_VIN, 2007_171, 2008_171	2002_ITT, 2002_171, 2002_172, 2004_171 2005_171	2004_171E, 2006_VIN, 2007_171, 2008_171
N. organizations	805	322	822	305
Average network heterogeneity	3.29	2.43	3.27	2.42
t (p-value)	-12.73	(0.00)	-12.32	(0.00)
Average network size	20.44	7.9	20.17	7.94
t (p-value)	-30.69	(0.00)	-28.46	(0.00)

Size and heterogeneity of project networks

Remarks

- Programmes having both minimum size and minimum heterogeneity constraints produced networks that were, **on average**, larger and more heterogeneous than those in programmes without such constraints
- However, the networks formed in programmes without constraints exhibited greater variability in terms of heterogeneity: the **constraint reduced the variability in the compositions of the partnerships**
- Moreover, the constraints had **different intensity** in different programmes: in the following models we separate the effect of the two constraints

Model 1

- Were organization that participated in policy programmes characterized by policy constraints in the first period more likely to participate also in the second period?
- Focusing on the 856 organizations that participated in the first period, we check whether their likelihood to participate in the second period (dummy 1 = participated in second period, 0 = no) was affected by the average size and heterogeneity of the networks they had participated in during the first period (which in turn depended on the policy constraints)
- two-step instrumental variables probit regression

Variables used in Model 1

Number of observations: 856

Variabile name	Variable description	Mean	σ	Min	Max
T_20068 (dependent variable)	1 if organization participated in at least one project in period 2006-9, 0 otherwise	0.24	0.43	0.00	1.00
avgminhet	Average minimum heterogeneity of projects as mandated by policy constraints	1.64	0.38	0.00	2.00
avgminsize	Average minimum size of projects as mandated by policy constraints	7.91	2.72	0.00	10.00
avgdiversity_20025	Average heterogeneity of networks the organization participated in during 2002-2005	3.37	1.01	1.18	5.95
avgp_20025	Average size of networks the organization participated in during 2002-2005	21.02	7.48	3.00	36.00
avgfunding_20025	Average funding per project obtained by the organization in 2002-2005	7738	16358	0	266425
Nprojects20025	Overall number of projects the organization participated in during 2002-2005	1.53	1.34	1.00	14.00

Plus controls on type of organization and share of projects in each technology area

Model 1: results

Dependent Variable	First stage avghet_20025		First stage avgsize_20025		Main equation T_20068	
	Coefficient (SE)	Significance level	Coefficient (SE)	Significance level	Coefficient (SE)	Significance level
avghet_20025					-1.931 (1.809)	
avgsize_20025					0.352 (0.276)	
avgminhet	-0.886 (0.139)	***	-3.838 (0.970)	***		
avgminsize	0.257 (0.019)	***	1.567 (0.133)	***		
avgfunding_20025	0.000 (0.000)		0.000 (0.000)	**	0.000 (0.000)	*
Nprojects20025	-0.001 (0.022)		-0.248 (0.153)		0.552 (0.111)	***
constant	2.485 (0.328)	***	10.623 (2.280)	***	3.779 (1.741)	**
	N. obs.	856	N. obs.	856	N. obs.	856
	F	29.46	F	38.67	Chi2	77.81
	Prob > F	0.000	Prob > F	0.000	Prob > Chi2	0.000
	R-squared	0.425	R-squared	0.493	R-squared	
	Adj R-squared	0.411	Adj R-squared	0.48		

*** $p<0.01$, ** $p<0.05$, * $p<0.1$; Wald test of exogeneity: chi2(2) =   5.59   Prob > chi2 = 0.0612

Controls: types of organizations and share of projects in each technology area: some significant

Remarks

- Minimum size and minimum heterogeneity constraints influenced the size and heterogeneity of the networks funded in the first period
  - Larger minimum size constraints led organizations to form larger and more heterogeneous networks
  - Greater heterogeneity constraints led organizations to form smaller and less heterogeneous networks
    - strict heterogeneity constraint interpreted as a guideline that stifled variety?
- However they did not impact the organization's likelihood to participate in projects in the second period
- Pre-existing collaborative innovation capabilities matter

Models 2, 3, 4

- In the second period, were organizations able to participate in more networks, and/or in larger and more heterogeneous networks,
- as a consequence of their earlier participation in networks with certain policy constraints?
- Focusing on the 476 organizations that participated in the second period, we check whether the number, average heterogeneity and average size of projects they participated in were influenced by the policy constraints in the first period

Variables used in Models 2, 3, 4

		Number of observations: 460			
Variabile name	Variable description	Mean	σ	Min	Max
Nprojects20068 *(dependent variable in Model 2)*	Number of projects the organization participated in 2006-2008	1.46	0.94	1.00	8.00
avghet_20068 *(dependent variable in Model 3)*	Average minimum heterogeneity of projects as mandated by policy constraints	2.65	1.10	1.00	6.76
avgsize_20068 *(dependent variable in Model 4)*	Average size of networks the organization participated in during 2006-2008	9.04	3.34	2.00	18.00
avgminhet	Average minimum heterogeneity of projects as mandated by policy constraints	0.74	0.87	0.00	2.00
avgminsize	Average minimum size of projects as mandated by policy constraints	3.67	4.45	0.00	10.00
Nprojects20025	Overall number of projects the organization participated in during 2002-2005	1.08	1.89	0.00	14.00
avgfunding_20068	Average funding per project obtained by the organization in 2006-2008	29791	72245	0	1411738

Plus controls on type of organization and share of projects in each technology area

Models 2, 3, 4: results

Dependent Variable:	Nprojects20068		avghet_20068		avgsize_20068	
	Coefficient (Robust S.E.)	Significance level	Coefficient (Robust S.E.)	Significance level	Coefficient (Robust S.E.)	Significance level
avgminhet	0.012		-0.313		0.036	
	0.142		0.296		0.922	
avgminsize	0.007		0.089		0.153	
	0.028		0.059		0.180	
avgfunding_20068	0.000	**	0.000		0.000	
	0.000		0.000		0.000	
Nprojects20025	0.127	***	-0.057	**	0.027	
	0.013		0.026		0.091	
constant	0.230	*	2.411	***	7.083	***
	0.136		0.283		0.613	
	N. obs.	460	N. obs.	460	N. obs.	460
	chi2	94.98	F	7.878	F	5.601
	Prob >Chi2	0.00	Prob >F	0.00	Prob >F	0.00
	R-squared	0.077	R-squared	0.263	R-squared	0.203

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Controls: types of organizations and share of projects in each technology area: some significant

Remarks

- Constraints had no impact on the number, the average size or the average heterogeneity of an organization's project in the second period
- Having strong pre-existing collaborative innovation capabilities
  - increased the organization's likelihood to participate in projects in the second period and the number of projects it participated in
  - Reduced the average heterogeneity of its projects (more expert at identifying "right" partners)
- "Loose" constraints like minimum size may help organizations to experiment with collaborating with new partners
- "Specific" constraints like heterogeneity may be counterproductive if forcing organizations to include types of partners they do not need (and may also be interpreted as rigid guidelines)

Further research

- Analysis of the ex-post results of the policy in terms of behavioural additionality (are relations still active?)

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- Counterfactual analysis

- Focus on the behaviour of specific agents (intermediaries)

- Studying the behaviour of agents over time