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Can policy design help organizations improve their networking capabilities? An empirical analysis on a regional policy

Federica Rossi*
Annalisa Caloffi**
Margherita Russo***

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* School of Business, Economics and Informatics, Birkbeck, University of London, Malet Street, London WC1E 7HX, UK; tel. 0044 207 0790685; email: f.rossi@bbk.ac.uk (corresponding author)

** Department of Economics and Business, Università di Padova, email: annalisa.caloffi@unipd.it

*** Department of Economics, Università di Modena e Reggio Emilia, email: margherita.russo@unimore.it

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Dipartimento di Economia Marco Biagi
Università degli studi di Modena e Reggio Emilia
Via Berengario 51 | 41121 Modena
tel. 059 2056711 | fax. 059 2056937
info.economia@unimore.it | www.economia.unimore.it

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* School of Business, Economics and Informatics, Birkbeck, University of London, Malet Street, London WC1E 7HX, UK; tel. 0044 207 0790685; email: f.rossi@bbk.ac.uk (corresponding author)
** Department of Economics and Business, Università di Padova, email: annalisa.caloffi@unipd.it
***: Department of Economics, Università di Modena e Reggio Emilia, email: margherita.russo@unimore.it

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Abstract

In parallel with the interest in networks of innovation on the part of the academic literature, policymakers are increasingly recognizing the important systemic nature of innovation processes, involving many agents often engaged in networks of relationships (OECD, 1997; Mytelka and Smith, 2002; European Commission, 2003; Nauwelaers and Wintjes, 2008), and they are increasingly supporting the creation of networks among firms and other types of organizations.
Policies for innovation networks usually aim to support joint R&D, technological development or technology transfer projects or even, sometimes, networking per se (with a view to create a "critical mass" of experts or users in a certain technology). At the same time, these policy interventions may also help the participants improve their ability to perform collaborative innovation, by allowing them to gain experience in working with external partners on a specific activity. Such behavioural outcomes, while not generally considered the main objective of these policies, have the potential to generate long-lasting beneficial changes in the participants' competences and abilities (Gök and Edler, 2012). An important question for policy design is what kind of networks should be supported, if the objective of the policy is not just to fund "successful" innovation projects, but also to increase the participants' ability to engage in collaborative innovation. Should policies simply provide funding to innovation networks on the basis of an assessment of the project they intend to realize, or should they promote the setup of networks with specific features, in order to increase the agents' innovative potential through networking?

Keywords: regional policy on innovation networks, design of network of innovators

JEL: D85, H43, L14, L52, O32, R1

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Introduction

In parallel with the interest in networks of innovation on the part of the academic literature, policymakers are increasingly recognizing the important systemic nature of innovation processes, involving many agents often engaged in networks of relationships (OECD, 1997; Mytelka and Smith, 2002; European Commission, 2003; Nauwelaers and Wintjes, 2008), and they are increasingly supporting the creation of networks among firms and other types of organizations. Examples are the EU Framework Programmes (Breschi and Malerba, 2009; Tindemans, 2009) as well as the many national and regional policies launched in the past decade or so (Branstetter and Sakakibara, 2002; Caloghirou et al, 2004; Russo and Rossi, 2009; Bellandi and Caloffi, 2010; Cunningham and Ramlogan, 2012).

Policies for innovation networks usually aim to support joint R&D, technological development or technology transfer projects or even, sometimes, networking per se (with a view to create a "critical mass" of experts or users in a certain technology). At the same time, these policy interventions may also help the participants improve their ability to perform collaborative innovation, by allowing them to gain experience in working with external partners on a specific activity. Such behavioural outcomes, while not generally considered the main objective of these policies, have the potential to generate long-lasting beneficial changes in the participants' competences and abilities (Gök and Edler, 2012).

An important question for policy design is what kind of networks should be supported, if the objective of the policy is not just to fund "successful" innovation projects, but also to increase the participants' ability to engage in collaborative innovation. Should policies simply provide funding to innovation networks on the basis of an assessment of the project they intend to realize, or should they promote the setup of networks with specific features, in order to increase the agents' innovative potential through networking?

Policy constraints and collaborative innovation

In order to investigate this question, we use a rich dataset on all the organizations participating in a set of regional policy programmes implemented in Tuscany (Ita-

ly) between 2002 and 2008. Some of these programmes imposed certain compulsory requirements on the composition of the innovation networks to be funded (in terms of the size of the partnerships and of the types of organizations that they should include), while other programmes left the participants free to organize their partnerships according to their needs. In comparing the two different groups of programmes, we analyse the effects of such constraints upon the participants' ability to engage in subsequent collaborative innovation.

We can expect constraints to have both negative and positive effects on learning. Constraints impose an additional layer of rules that may be misaligned with the participants' actual needs. If such rules are irrelevant, they may increase the transaction costs in the process of network formation. But such rules may even be detrimental, if they hamper the networks' innovative performance and learning processes. For example, networks may be required to involve a type of organization that is not necessary for the success of the project, and which may even have an adverse impact on it, or a large number of partners that create congestion and hamper communication, thus reducing performance.

Conversely, constraints may be instrumental in enhancing the participants' ability to engage in further collaborative innovation. By participating in relatively large and heterogeneous networks, organizations may become acquainted with a variety of partners (who can provide them with further networking opportunities) and they may gain experience in interacting with agents characterized by different competencies, cognitive frames and modes of operation. We analyse whether policy constraints have had an impact on the participants' collaborative innovation capabilities by focusing precisely on these aspects – the ability to form new networks and the ability to form more heterogeneous and larger networks – as evidenced by the participants' involvement in subsequent policy-supported innovation networks.

The regional policy programmes

Tuscany's regional government has been one of the most active promoters of innovation network policies in Italy. In the programming period 2000-2006 it promoted nine consecutive waves of four policy programmes, supported by European Regional Development funds (ERDF), funding innovative projects carried out by networks of organizations. Overall, the nine waves were assigned almost € 37 million, representing around 40% of the total funds spent on innovation policies in that programming period. 168 projects were funded, and carried out in the years 2002-2008.

In our analysis we shall consider only the funded projects[1]. While the overall number of participations amounted to 2,006, many organizations (348) had taken part in more than one project, so that the different organizations involved in the nine waves were 1,127. Table 1 shows the numbers and shares of participations and organizations involved in the programmes, classified into nine categories according to their nature: firms, business service providers (generally private companies); private research companies; local (business) associations; universities (and other public research providers); innovation centres (generally publicly funded or funded via public-private partnerships); chambers of commerce; local governments; and other public bodies. The largest share of participating enterprises were manufacturing companies (68%): of these, 21.8% were micro and small firms in the traditional industries of the region (marble production and carving, textiles, mechanics, jewellery). Micro firms in the service sector were an active group, with 1.8 projects each on average. Not all types of organizations were permitted to receive funding: large companies and organizations based outside the region could enter the projects only with their own resources.

[1] See Russo and Rossi (2009) for a comparative analysis of funded and not funded project applications submitted to the RPIA_ITT programme.

Table 1. Participants, agents and funding by type of organization

Type of organization	Participations		Participating organizations		Total funding		Average funding per organization
	n.	%	n.	%	€	%	€
Firm	914	45.6	680	60.3	13,348,181	36.3	19,630
University	261	13.0	93	8.3	73,55,106	20.0	79,087
Private research company	32	1.6	22	2.0	537,613	1.5	24,437
Innovation centre	150	7.5	34	3.0	6,208,052	16.9	182,590
Business service provider	153	7.6	86	7.6	4,015,642	10.9	46,694
Local government	176	8.8	77	6.8	691,654	1.9	8,983
Local association	209	10.4	85	7.5	3,016,694	8.2	35,491
Chamber of commerce	49	2.4	11	1.0	802,151	2.2	72,923
Other public body	62	3.1	39	3.5	815,448	2.2	20,909
Total	2,006	100.0	1,127	100.0	36,790,543	100.0	32,645

The various programmes addressed a set of technology/industry targets. A large share of funds was committed to widening the adoption of ICT and multimedia in traditional industries and SMEs (48.2%). Projects in opto-electronics, an important competence network in the region, received 16.4% of funds, while projects in mechanics received 7.5%. The remaining areas included organic chemistry (5%), biotech (4%), and others (new materials, nanotechnologies and combinations of the previously mentioned technologies).

The set of policy programmes can be divided into two major periods. The first, which included the majority of waves and participants, ran from 2002 to 2005, and absorbed 45% of the resources for the network policies. It included three programmes, divided into six waves. The second period started in 2006, and ended with the last intervention implemented in 2008. It included two programmes, divided into three waves. Out of the six waves launched in the first period (2002-2005), five were characterized by the imposition of several constraints which were not present in any of the waves in the second period (2006-2008). Table 2 shows the types of constraint characterizing the different waves: whether the programme demanded a certain composition of the partnership in terms of types of organizations involved (henceforth “minimum heterogeneity constraint”), and whether the programme demanded a minimum number of partners, greater than

that implied by the heterogeneity constraint (henceforth "minimum size constraint").

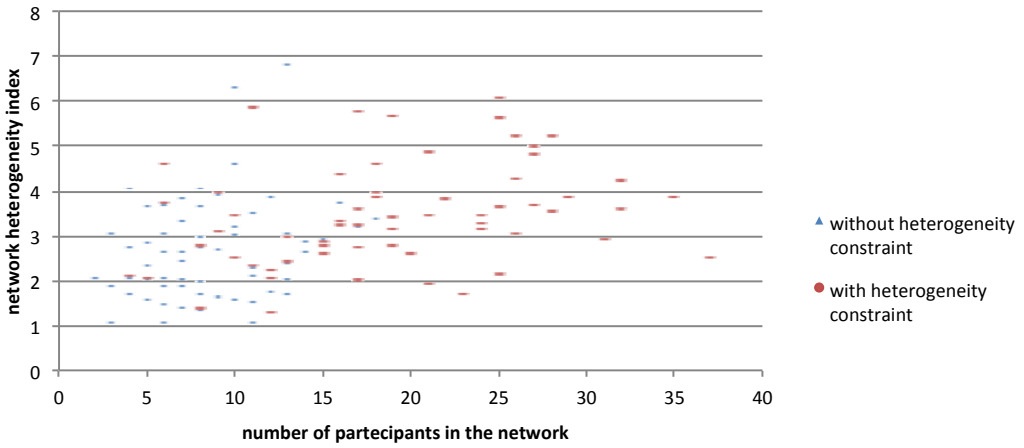
Table 2. Types of constraints in the different waves

Wave	Policy programme	Type of constraints:				
		Minimum size of the partnership	Minimum number of:			
			SMEs	Research org.	Innovation centres	Local governments
2002_ITT	RPIA 2002	6	4	1		
2002_171	SPD line 171		4		1	
2002_172	SPD line 172		4		1	
2004_171	SPD line 171	4	1			
2004_171E	SPD line 171					
2005_171	SPD line 171	10	5	1		1
2006_VIN	RPIA 2006					
2007_171	SPD line 171					
2008_171	SPD line 171					

The effects of policy constraints

The following figure 1 shows the heterogeneity and size of networks in a scatter diagram that distinguishes between programmes with and without constraints. To compute the heterogeneity of each network we have used the reciprocal of the Herfindahl index on the shares of participants belonging to the different categories of agents, while the network size is defined in terms of number of participants. The average size and heterogeneity of networks were greater when constraints were present. In programmes without constraints, network size was generally smaller and, although network heterogeneity was on average lower, its variability was greater.

Figure 1. Size and heterogeneity of project networks, grouped according to presence or absence of constraints



Obviously, these comparisons do not tell us what are the effect of constraints: the features of networks in each programme may be influenced by many other elements (the amount of funds available, the technology area that the policy was designed to implement, the duration of the programme, and so on). Moreover, this approach does not allow us to distinguish between the effects of each constraint. While the constraints were strongly overlapping, they had different intensities in different programmes, and they were only loosely related: the programmes that imposed a highest minimum size were not necessarily those that imposed the highest heterogeneity, and vice versa programmes with low minimum size requirements may have had more strict heterogeneity constraints.

In what follows, we try to explore the effects of policy constraints on the behaviour of each organization rather than on the behaviour of the networks of organizations. For each organization, we average the heterogeneity indexes and the size of all the networks in which it took part, in either the first or the second period. The impact of constraints is also measured at the level of each organization: we compute the minimum heterogeneity requirements and the minimum size requirements of all the networks an organization participated in (where present), and we average these across all such networks.

First, we consider the 856 organizations that participated in programmes in the first period, and we assess whether policy constraints influenced the likelihood to participate also in the second period (Model 1). The dependent variable

(*T_20068*) takes value 1 if the organization has participated in at least one project in the second period, and zero otherwise. Our hypothesis is that the policy constraints are likely to impact the actual heterogeneity and size of the networks the organization participated in during the first period, and these in turn are likely to affect the probability of its participation in the second period. To test this hypothesis we run a two-step instrumental variables probit regression (ivprobit) where the average heterogeneity and average size of networks in the first period (*avghet_20025* and *avgsize_20025*) are instrumented by the average minimum heterogeneity (*avgminhet_20025*) and the average minimum size (*avgminsize_20025*) constraints of the projects the organization participated in. We also include some variables capturing the organization's pre-existing capabilities for collaborative innovation (the number of projects the organization participated in during the first period, *Nprojects_20025*, and the average funding per project the organization was able to procure, *avgfunding_20025*), and we control for the organization's type and technological specialization (share of projects in each technology area).

Table 3 reports the signs of significant coefficients found for Model 1. The first-stage regressions on the variables *avghet_20025* and *avgsize_20025* show that policy constraints significantly influence the heterogeneity and size of the networks each organization participates in: the variable *avgminsize_20025* has a positive and significant coefficient in both cases, indicating that participating in networks that, on average, have higher minimum size requirements leads organizations to form larger and more heterogeneous networks. Instead, the variable *avgminhet_20025* has a significant but negative coefficient in both cases, indicating that participating in networks that, on average, have higher minimum heterogeneity requirements leads organizations to form smaller and less heterogeneous networks.

Firms are involved in less heterogeneous networks, while several technological areas are positively associated with heterogeneity. Organizations that capture larger funds, on average, are involved in larger networks, and so are various types of organizations and several technological areas.

Concerning the main equation, neither greater heterogeneity nor greater size are associated with greater likelihood to participate in projects in the second period. Subsequent participation is more likely if organizations have obtained more funds and have participated in more projects in the first period, variables that can indicate the presence of stronger pre-existing collaborative innovation capabilities. The participation in a large number of projects in the first period may have further increased their collaborative innovation capabilities by providing them with more contacts and greater reputation as successful collaboration partners.

Table 3. Signs of significant coefficients in Model 1

Dependent Variable	**First stage avghet_20025**	**First stage avgsize_20025**	**Main equation T_20068**
avghet_20025			
avgsize_20025			
avgminhet_20025	-	-	
avgminsize_20025	+	+	
avgfunding_20025		+	+
Nprojects_20025	-		+
Ent	-	+	
Opub		+	
LA		+	
SC		+	
LG		+	
Uni		+	
SP			
shareICT	+	+	-
shareOpto		+	-
shareMEch	+		
shareOrgChem		-	
shareBiotech	+		
shareNew	+		-
shareMulti	+		
shareNano		+	-
shareGeo	+	-	
shareOther		-	
constant	+	+	+
N. observations	856	856	856

Wald test of exogeneity: chi2(2) = 5.59 Prob > chi2 = 0.0612

The result that participation in programmes with tighter minimum heterogeneity constraints had a negative effect on the heterogeneity and size of the networks presented, can appear counterintuitive. A possible explanation is that the specification of more stringent constraint may have discouraged participants from including in their networks organizations that were different from the types recom-

mended by the policymaker; that is, when confronted with very specific requirements, participants followed the guidelines for network composition quite closely and did not involve other types of organizations. This, paradoxically, led them to form networks that were less heterogeneous and smaller than those they may have formed had the constraint been looser (or absent). This interpretation is consistent with the observation that in programmes where heterogeneity constraints were present there was less variability in the project networks' heterogeneity indexes (see Figure 1) leading us to suggest that one of the effects of the heterogeneity constraints might have been to reduce the variety in the compositions of the different networks.

Secondly, we consider the set of 476 organizations that participated in the second period (2006-2008) and we examine whether having participated in projects in the first period that mandated constraints influenced three different characteristics of an organization's networks in the second period: the number of projects, *Nprojects_20068* (Model 2), the average heterogeneity of project networks, *avghet_20068* (Model 3), and their average size, *avgsize_20068* (Model 4)[2]. Due to some missing data, the models are run on 460 observations.

The signs of significant coefficients found for Models 2, 3 and 4 are reported in Table 4. Model 2 suggests that having participated in projects with minimum heterogeneity and size constraints (*avgminhet_20025* and *avgminsize_20025*) did not influence the number of projects that the organization participated in during the second period. Rather, pre-exisiting collaborative innovation capabilities (*Nprojects_20025*) significantly and positively influenced the number of projects an organization participates in: having participated in more projects in the first period increased not only the likelihood to participate in projects in the second period (as shown by Model 1) but also the number of projects an organization participated in.

Model 3 suggest that having participated in projects with minimum heterogeneity and/or minimum size constraints did not influence the average heterogeneity of

[2] Because of the different types of dependent variables, Model 2 is estimated with a Poisson model while Models 3 and 4 use OLS.

projects in the second period. Having participated in a greater number of projects in the first period had a significantly negative effect on the heterogeneity of networks in the second period: more experienced organizations ended up joining or forming less heterogeneous networks. Organizations may not consider heterogeneity per se as a valuable attribute of project networks, but rather only value when it is indeed necessary for the project's success: this is supported by the fact that in the programmes implemented in the second period, where no constraints were imposed, the networks' composition was more variable (as shown in Figure 1).

Model 4 suggests that having participated in programmes with heterogeneity and size constraints in the first period did not influence the size of an organization's project networks in the second period. From the previous Figure 1, we know that project networks in the second period were on average much smaller than in the first period, indicating that the minimum size constraints had indeed been effective in forcing organizations to form larger partnerships than they would have formed otherwise.

Table 4. Estimates for Models 2, 3 and 4

Dependent variables:	**Model 2 Nprojects_20068**	**Model 3 avghet_20068**	**Model 4 avgsize_20068**
avgminhet_20025			
avgminsize_20025			
avgfunding_20068	+		
Nprojects_20025	+	-	
Ent			+
Opub			
LA	-	+	
SC		+	
LG	-	+	
Uni		+	
SP		+	
shareICT			
shareOpto	+	-	+
shareMEch			
shareOrgChem		-	-
shareBiotech	-	+	+
shareNew		+	
shareMulti		-	-
shareNano			
shareGeo			-
shareOther		-	-
constant	+	+	+
N. observations	460	460	460

Conclusions

These findings suggest several remarks on the effectiveness of constraints in supporting learning processes on the part of organizations involved in policy initiatives. Some constraints – especially less restrictive ones like the imposition of a minimum size – encourage organizations to interact with a larger number of organizations than they would not otherwise have partnered with. Although this does not necessarily translate in greater participation to subsequent programmes or in the formation of more diverse or larger networks in the second period, these contacts may provide useful in other contexts and at future points in time. Instead, a more restrictive constraint like the minimum heterogeneity constraint appears to have had more controversial effects: having participated in programmes with tighter heterogeneity constraints led organizations to form less heterogeneous and smaller networks. The argument here is that very specific constraints were interpreted by participants as being akin to "guidelines" that should be followed in order to bid successfully; hence, in programmes with strict heterogeneity constraints the compositions of projects networks were more similar to each other, and reflected quite closely the minimum composition required by the policymaker. Instead, looser (or even absent) heterogeneity constraints led participants to include the variety of organizations that they actually needed to realize their projects, producing greater variability in network composition and, on average, greater heterogeneity.

The problem with the *ex ante* definition of very specific heterogeneity constraints is that, while there is a general consensus on the benefits of heterogeneous networks, the nature of the agents that may best contribute to the partnership very much depends on the content of the project that the network intends to realize. Hence, the definition of specific constraints may force participants to include organizations whose involvement is not needed for the purposes of the project, creating unnecessary complications. Rigid rules may even discourage participants from experimenting with more varied approaches.

Together, these findings suggest that collaborative innovation capabilities are gained over a longer time span than the duration of individual programmes, and

that the imposition of simple constraints on network structure is not sufficient to ensure the acquisition of such skills. This is particularly true for projects that have small scale and short duration such as the ones we have analysed. In order to support organizations' capabilities to engage in collaborative innovation, strategies other than the imposition of constraints on network structure may be more productive: for example, implementing outreach actions in order to encourage organizations to participate in more policy supported innovation networks, and designing additional measures in order to increase the organizations' learning opportunities (providing opportunities to meet other organizations, facilitating meetings between different types of organizations, providing opportunities for joint action, and so on).

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