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Promoting successful innovation networks: a methodological contribution to regional policy evaluation and design. The case of Tuscany's innovation policies 2000-2006

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Promoting successful innovation networks: a methodological contribution to regional policy evaluation and design.
The case of Tuscany's innovation policies 2000-2006

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Abstract

In line with the growing consensus around the important role of networks of heterogeneous organizations as drivers of innovation processes, in the last ten years regional policymakers have increasingly promoted interventions in support of such networks. The adoption of policy instruments of this kind still calls for the development of appropriate tools for their evaluation. While some progress in this direction has been made thanks to some experiments that try to assess the individual gains stemming from the development of R&D networks (Branstetter and Sakakibara, 2002; Benfratello and Sembenelli, 2002), more research is needed into the theoretical frameworks and the methodological tools that can enable us to improve the assessment of the ability of innovation networks to meet policy objectives. Our approach differs from the existing studies in that it tries to keep the network at the core of the evaluation exercise. Building on previous contributions (Russo and Rossi, 2005, 2009a, 2009b; Bellandi and Caloffi, 2010; Rossi et al. 2010), we try to explore in some depth the application of a range of social network analysis tools to the evaluation of a set of regional policies supporting the development of innovation networks among heterogeneous agents. In particular, we aim to assess to what extent the networks of collaborative relations that emerge in response to the policy display the potential to generate innovations and support the production and absorption of spillovers, in line with the policy objectives. To do so, we combine the analysis of the network participants with a study of the features of the networks activated by the policy programmes, in both a static and a dynamic perspective (Palla et al, 2007; Vedres and Stark, 2008). Some implications for policy design are drawn from the analysis.

Keywords: evaluation, innovation networks, intercohesion, social network analysis, industrial policy

JEL classification: L14, D85, L52, H43

1. Introduction

The view that networks of heterogeneous organizations foster the development of innovations is increasingly shared within the scientific community. Some contributions (Nooteboom, 2000; Powell and Grodal, 2004) stress that the creative recombination of competences and knowledge promoted by heterogeneity are important drivers of innovation processes; others (Lane and Maxfield 1997; Lane 2009) focus on the emergence of innovation processes fostered by generative relationships characterized by heterogenous competences, mutual and aligned directedness in contexts of joint action; while others (Spence, 1984; Katz, 1986) suggest that networks foster innovation through the production and the internalisation of spillovers within the group of participants. In line with this growing consensus, policymakers are increasingly promoting interventions in support of networks among either small and large firms, or firms and universities, explicitly aimed at supporting innovation, along the main dimensions which are targeted by policy - R&D, knowledge transfer, innovation diffusion.

The emergence of policy instruments of this kind calls for the development of appropriate tools for their evaluation. Although this field of investigation has attracted some interest, the existing literature does not provide us with a single evaluation framework. The main difficulty here consists in explicitly considering the interactions among agents in a network in order to assess their effects. Under these circumstances, several approaches are co-existing, each one based on peculiar theoretical premises, and consequent methodological options[1].

The present paper tries to make an original contribution towards framing a methodology based on Social Network Analysis (hereafter: SNA). These tools are applied both to the level of the individual network and to the level of the policy programme.

[1] For large-scale analysis of policies promoting R&D collaborations, see, for instance, Branstetter and Sakakibara and Branstetter (2002) and Odagiri et al (1997) on Japanese policies promoting research consortia; Benfratello and Sembenelli (2002) on the European-funded projects Eureka and the 3rd and 4th Framework Programs for Science and Technology (FPST); Barber et al (2005) on the research collaboration networks that have emerged in the European Union’s first four successive four-year Framework Programs (FPs) on Research and Technological Development.

Although the application of SNA to the evaluation of innovation policies is a recent field of research (Russo and Rossi, 2005, 2009a, 2009b; Bellandi and Caloffi, 2010; Capuano and Del Monte, 2011), it can benefit from many contributions that have tried to detect the basic features of the most performing network architectures, mostly outside of a policy context. Drawing on this literature, the paper adds to the previous contributions by identifying a set of features that can boost the innovative capacity of a network, and applies them to an evaluation perspective.

First, the paper investigates whether one of the ways in which the performance of these initiatives can be evaluated ex post is in terms of the heterogeneity and breadth of the networks that the policymaker has been able to mobilize.

Second, the paper explores another important issue in evaluating policy effectiveness: the extent to which firms (and other organizations) have been able to progressively develop the ability to organize and engage in collaborative interactions. With reference to this second issue, the paper considers the presence of organizations (which we call "bridging actors") acting as intermediaries within networks. The involvement of such actors in innovation networks suggests that the production of knowledge spillovers which is encouraged by the policy is not necessarily a spontaneous process, nor their absorption is automatic. This is particularly true when micro and small firms are the ultimate target of the innovation network policies. In these cases (for instance, when the networks include either small firms and universities, or small and large firms), the presence of some kinds of bridging actors may be useful in order to facilitate the exchange of knowledge and competencies among agents which differ in languages, decision-making horizons, systems of incentives and objectives, etc (Howells, 2006). This point is investigated by analyzing brokers, brokering positions and intercohesive agents. These concepts, elaborated in the SNA literature, help us analyse the diffusion of such kind of bridging actors as well as the results of their activity.

Third, another important aspect that may facilitate the production and the absorption of spillovers is constituted by the time profile of the policy-supported networks. Following some authors, in order to acquire and manipulate existing knowledge, as well as to produce new pieces of knowledge, the networked organizations should develop specific standards, skills and competencies, whose creation, in turn, require non-episodic forms of collaboration (Powell et al., 1996; Dyer and Singh, 1998; Nooteboom, 2000). However, such collaborations should not become too stable, in order to avoid the risk of lock-ins (Lane and Maxfield, 1997): therefore, there is a trade off between stability and continuous novelty in network membership configuration. In order to take these issues into account, we explore the particular tension between stable and temporary networks for innovation. Through a dynamic analysis of the collaborations in innovation network projects, we try to assess if – and to what extent – the policies induce the formation of communities emerging from temporary networks.

These analyses are applied to a set of policies aimed at supporting innovation networks among heterogeneous economic actors, which have been implemented by the Italian region of Tuscany between 2002 and 2008 (programming period 2000-2006)[2]. The interest in this region stems from the fact that Tuscany's regional government has been one of the most active promoters of innovation network policies in Italy (Bellandi and Caloffi, 2006), having engaged in the support of innovation networks since the early 2000s with a succession of tenders in the context of ERDF funds (Russo and Rossi, 2005; Bellandi and Caloffi, 2009).

The paper is organized as follows. Section 2 summarizes the rationale for policies promoting network of innovators, and suggests a methodological framework for their evaluation. In section 3, we describe the policy interventions in support of innovation networks implemented by Tuscany's regional government in the programming period 2000-2006, and we summarize the methodology we have used for the analysis. Sections 4-6 present the results of the empirical analysis of the policy interventions. In particular, in section 4, we discuss the extent to which the policy programmes have been able to mobilize heterogeneous networks; in section 5 we analyze the importance and nature of bridging actors within the programmes; and in section 6 we explore the extent to which the participants in each programme were already engaged in previous programmes or were new to participation in such interventions. Finally, section 7 summarizes our findings and their implication for the evaluation of innovation network policies and for the design of such policies.

[2] These policies have been implemented through the regional Single Programming Document 2000-2006 (hereafter: SPD).

2. Policies in support of innovation networks: how to evaluate their impact?

2.1. The rationales for policies in support of innovation networks

Economic and organization theories have progressively moved beyond the traditional linear view[3] of innovation - which conceptualizes innovation as a sequence of well defined, temporally and conceptually distinct, stages - in favour of systemic approaches that view innovation as an interactive, non-linear process resulting from the interplay of numerous organisations (e.g. firms, research institutes, customers, authorities, financial organisations) and institutions (e.g. IPR, regulations, behavioural norms, cultural specificities). This complex process, characterised by reciprocity and feedback mechanisms, determines the innovation's success (e.g. Freeman, 1987, 1988; Lundvall, 1992; Nelson, 1993; Edquist, 1997). The influential literature on national systems of innovation, which emerged at the beginning of the 1990s with contributions by Lundvall (1988; 1992), Freeman (1988) and Nelson (1988; 1993), has highlighted the interplay of a wide range of factors, organizations and policies influencing the capabilities of a nation's firms to innovate (Nelson, 1993). At the same time, the focus on the cognitive aspects of innovation has fostered interest in interactions among agents as sources of new knowledge: it has been increasingly acknowledged that direct interactions among people are the main modes of transmission and creation of tacit knowledge, thought to be a key source of innovation[4]. Researchers have begun to study various forms of cooperation between firms directed at developing innovations (Freeman, 1991; Mowery and Teece, 1996), including user-producer interactions (Rosenberg, 1963; Von Hippel, 1978; Lundvall, 1985; Russo, 1985). The role of heterogenity has been analyzed as a condition to develop generative relationships in agent-artifact space (Lane and Maxfield, 1997; Russo, 2000; Bonifati, 2010) and to foster interpretative space (Lester and Piore 2004). Other researchers have focused on the role of proximity - cognitive, technological, social or geographic - in fostering

[3] Although rarely codified in the economic literature, the linear model has for a long time been widely shared, often implicitly, in the academic discourse. For a comprehensive reconstruction of its historical development, see Godin, 2006.

[4] This issue was first raised in the literature by Hägerstrand (1965, 1970) and Polanyi (1969).

innovation processes (Audretsch and Feldman, 1996; Jaffe, 1986; Nooteboom, 1999; Lundvall, 1992; Balconi, Breschi and Lissoni, 2004).

Paralleling the evolution of the academic discourse on innovation, the policymakers' theoretical understanding of innovation processes has also evolved, particularly in Europe (Mytelka and Smith, 2002). In line with a systemic approach to innovation, it has increasingly been acknowledged that innovation policies must be implemented through interventions that involve not only the activities of basic scientific research, development and commercialization of research outcomes, but also the productive activities of firms and the social and institutional contexts in which they operate (EC, 2003). Interest in social interactions as a locus for innovation has led policymakers to assign particular importance to supporting clusters and networks of organizations (Audretsch, 2002; EC, 2003; European Council, 2000).

Rationales for interventions in support of innovation policy can be linked to either mainstream "market failure" arguments or to the more recent "system failure" approach (Woolthuis et al, 2005).

According to Abramovsky et al (2004), most potential and actual economic rationales for intervention in innovation on the basis of market failure fall within three broad categories. The first category is based upon the idea that innovators may find it difficult to appropriate all the returns from their innovations; as a result, they have sub-optimal incentives to innovate. This can be called the "spillover" rationale for intervention. The second category stems from the difficulties that groups of individuals or firms encounter in acting collectively towards some common goal. These "coordination failures" may result in otherwise productive projects not being undertaken. Finally, the third category ("information failures") arises when differences in the information available to different parties prevent transactions from taking place.

System failures as a rationale for policy, instead, arise when at least some of the elements in an innovation system are misaligned or fail to exploit the full innovation potential of their interactions. Woolthuis et al (2005), on the basis of a thorough literature review, present the following list of systemic imperfections[5]:

[5] These have been identified by various authors, including Carlsson and Jacobsson (1997), Smith (1997), Malerba (2002), Johnson and Gregersen (1994), and Edquist et al. (1998).

1. Infrastructural failures, being problems with the physical infrastructure that actors need to function (such as IT, telecom, and roads) and the science and technology infrastructure.
2. Transition failures, being the inability of firms to adapt to new technological developments.
3. Lock-in/path dependency failures, being the inability of complete (social) systems to adapt to new technological paradigms.
4. Hard institutional failures, being failures in the formal institutions supporting an innovation system, such as the framework of regulation and the general legal system.
5. Soft institutional failures, being failures in the informal institutions supporting an innovation system, such as political culture and social values.
6. Strong network failures, being the "blindness" that develops if actors have close links and as a result miss out on external developments.
7. Weak network failures, being the lack of linkages between actors as a result of which insufficient use is made of complementarities, interactive learning, and the potential to create new ideas.
8. Capabilities' failure: Smith (1999) and Malerba (2002) both refer to the phenomenon that firms, especially small firms, may lack the capabilities to learn rapidly and effectively and hence may be locked into existing technologies, thus being unable to jump to new technologies.

Policies supporting innovation networks can be claimed to respond to several of these rationales. By providing funding to innovative firms, they contribute at least in part to their R&D costs, this way incentivizing the undertaking of innovation activities, especially more basic ones, which otherwise may not have taken place due to the spillover failure. They also provide incentives for organizations to exchange knowledge and to interact around development and production activities with other organizations, realizing transactions which otherwise would not have occurred, this way overcoming some coordination failures. The support for innovation networks allows local innovation systems to overcome "weak network failures" due to missing linkages between actors, which would prevent firms from learning from other actors in the system and from developing new ideas thanks to the creative recombination of knowledge residing within heterogeneous organizations, or to attributional shift of artifact functionalities or agents'identity. Moreover, through interactions with other organizations, each organization in the network can improve its ability to interact and to learn from interactions, thus increasing the likelihood that it will enter into further relationships once the policy intervention is over. The creation of these networks of relationships between organizations can result in improved communication networks in the system, which then allows the system as a whole to access knowledge from outside (thanks to the "weak ties" held by some of the organizations in the system, which, as Granovetter (1983) remarked, are particularly important in order to access unfamiliar knowledge and networks) and to diffuse knowledge rapidly within the system.

Policies aimed at supporting innovation networks within a local context are also examples of industrial policies which aim to identify scattered poles of knowledge, to include marginal actors, to foster linkages with non-local partners, stimulating joint actions able to define a "participated project" of industrial development (Bellandi and Di Tommaso, 2006).

2.2. The contribution of social network theory to policy evaluation

The emergence of policies aimed at supporting innovation networks calls for the development of appropriate tools for their evaluation. Some empirical contributions have explored this field of study, and have tried to assess the "systemic effect" stemming from the interactions of the agents in a network, by focusing on the effects of policies on individual firms (Branstetter and Sakakibara, 2002; Benfratello and Sembenelli, 2002). The objective of these contributions is to assess the individual benefits deriving from the participation in a network, or – in other terms – the extent of individual gains from spillover effects.

Our approach differs from these studies in that it tries to keep the network at the core of the evaluation exercise. Building on previous contributions, we try to explore in some depth the application of SNA tools to the analysis and evaluation of innovation policies. In particular, we aim to assess to what extent the networks of collaborative relations that emerge in response to the policy display the potential to generate innovations and support the production and absorption of spillovers, in line with the policy objectives. To do so, we combine the analysis of the single network / innovation project with the analysis of the whole set of networks / innovation projects that have been funded by the same policy programme.

Social network analysis (SNA) provides several analytical tools which can be used to attain these evaluation objectives. Moreover, the literature on innovation networks helps us to identify some basic ingredients of the relational architectures that display the greater potential to produce innovations. Analyses in this field show that such potential may be strongly influenced by the following architectural features of the network.

(i) *The interaction, within the same network, of actors having different nature, knowledge and competencies*.

Networks among heterogeneous actors lead to various benefits with respect to information diffusion, resource sharing, access to specialized assets, and inter-organizational learning (Lane and Maxfield 1997; Powell and Grodal, 2004). This is of particular importance in highly innovative and technology intensive industries, where agents need to complement their internal resources and competencies with specialized knowledge, technologies and know-how (Ahuja, 2000). Heterogeneity of network members (in members' nature, competencies, markets, innovative behaviour, etc.) may facilitate the production of spillovers. As highlighted by the literature on R&D JVs, a low degree of heterogeneity may see the emergence of competition among possible innovators instead of a collaborative effort, thereby reducing the incentives to invest in R&D (Katz, 1986; for an empirical application see Branstetter and Sakakibara, 2002). However, a high degree of heterogeneity (in activities, languages, …) may hamper mutual understanding and may lead to a progressive divergence of agents' interests and objectives.

(ii) *The involvement of bridging actors linking different parts of the network.*

The literature on innovation emphasizes the role played by bridging actors that operate as interfaces among heterogeneous organizations (and groups of organizations), which differ in language, decisionmaking processes and horizons, systems of incentives and objectives, etc. As network heterogeneity increases, their role becomes more important, since they may allow the network participants to enjoy the benefits of the heterogeneity in knowledge, competencies, etc.

SNA can be used to identify different types of bridging roles in a network, such as brokers and intercohesive nodes. Brokers are agents operating as bridges for pairs of other actors that are not connected directly to one another. They may play a crucial role both in facilitating the expansion of the network and in creating/filling structural holes between the different areas of a network (Burt, 1992); in particular, through their (bridging) activity, such agents may modify the structure of the collaborations and create communities of innovators. While brokers create bridges, intercohesive nodes, in the definition provided by Stark and Vedres (2008), belong to more than one community, and hence belong to different social groups at the same time. Agents participating to more than one community – that is to more than one project network – can transfer their knowledge (about a particular artifact or technology, or about how to manage innovative projects) from one community to another. For this reason, we can consider the intercohesive nodes (as well as the brokers) as potential carriers of spillovers.

(iii) *The balance between stable and temporary networks.*

Another important aspect that may facilitate the production and the absorption of spillovers is the policy's time profile, which is strongly linked to the previous reflection on the formation of communities of innovators.

Several contributions have stressed that in order to acquire and manipulate existing knowledge, as well as to produce new pieces of knowledge, the networked organisations should develop specific standards, skills and competencies, whose creation, in turn, require non-episodic collaborations among the agents involved (Powell et al., 1996; Dyer and Singh, 1998; Nooteboom, 2000). At the same time, such collaborations should not become too stable, in order to avoid the risk of lock-ins (Lane and Maxfield, 1997). For this reason, some authors have stressed the relevance of temporary networks, such as those emerging from the realization of a collaborative research project, in bringing in new knowledge (Asheim, 2002; Grabher 2004).

In the policy practice, it can be very difficult to find a balance between fostering efficient and effective teamwork (time to create mutual understanding and routines) and favouring the creation of ruptures and novelty. However, the particular tension between temporary and stable network relations could be solved by considering the specific objectives of a policy. That is, policies that explicitly prioritize innovation diffusion processes or the absorption of spillover effects may be more oriented towards the promotion of relatively stable community of innovators that include either small and large firms or enterprises and universities; while policies aimed at supporting the production of radical innovations may give a prominent role to novelty-related aspects.

These issues may be a guide both for the analysis and the ex ante evaluation of single innovative projects and for the evaluation of a policy programme. In the following sections, we will apply them to the analysis of a set of policy programmes implemented by Tuscany's regional government.

3. Data and methodology

The empirical analysis focuses on a set of recent policies aimed at supporting joint innovation projects implemented by networks of heterogeneous economic actors. We have examined the whole set of programmes, financed by the European Funds, implemented by the Tuscany Region (Italy) in the programming period 2000-2006[6].

The different policy programmes explicitly refer both to the importance of the heterogeneity of the partnership and to the necessary presence of intermediaires facilitating the development of the innovation projects. At a more general level, the interventions were intended to support the upgrading of the innovation skills of SMEs, which constitute the large majority of enterprises of the region. Through the funding of network projects, the regional government intended to promote non-transitory forms of collaboration among the SMEs, the universities and the research centres localised in the region[7].

These policy goals were initially pursued through two measures (SPD measures 1.7.1 and 1.7.2) focusing, respectively, on research and development of new technologies and on the dissemination/diffusion of existing technologies in the regional economy. Another strand of policies was experimental in nature, drawing on the possibilities offered by the EU Regional Programme of Innovative Actions (RPIA)[8]. The nine

[6] The database includes a set of interventions implemented within the SPD 2000-2006 and the Regional Programmes of Innovative Actions 'Innovazione Tecnologica in Toscana' 2001-2004 (hereafter RPIA-ITT-2002) and 'Virtual Enterprises' 2006-2007 (hereafter RPIA-VINCI-2006), funded within the ERDF Innovative Actions framework. The empirical research was carried out over an extended time span, from 2004 to 2006, since the authors had participated in the monitoring and analysis of three specific regional programmes implemented during this period, namely the RPIA-ITT (see Russo and Rossi, 2009a), the RPIA-VINCI, and the SPD, line 1.7.1, 2005-2006 (see Bellandi and Caloffi, 2010).

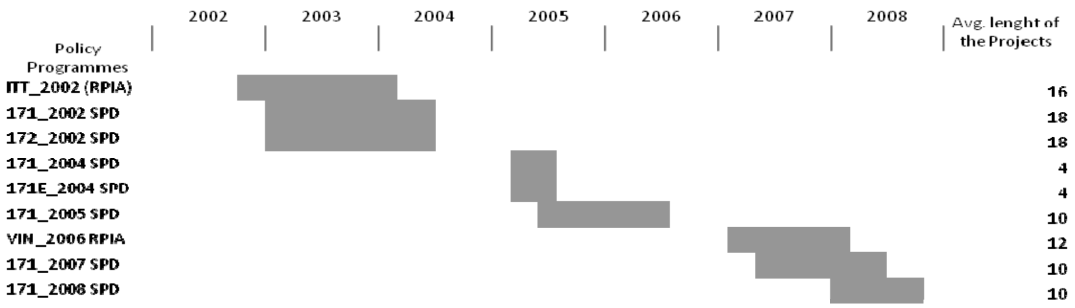
[7] As documented by the studies of Eickelpasch and Fritsch (2005), similar initiatives eliciting the growth of self-organised co-operation networks in research and development have been promoted in several European regions.

[8] The first set of network projects was funded by the regional government in 2002 as a response to the EU RPIA framework, which invited regions to implement innovative policy actions (see Russo and

programmes supporting innovation networks that were implemented in the programming period 2000-2006 funded a set of 168 projects realized between 2002 and 2008. The policy programmes under observation had short duration (figure 1), ranging from 4 months (programmes in 2004) to 18 months (in two programmes in 2002).

The whole set of programmes implemented by the region has lasted more than the other set of innovation policies at regional level (seven years of network policies versus five/six years of other policies). It was not planned in detail at the beginning of the programming period: resources were obtained over time and this explains leaps and overlaps in the time profile of the nine programmes. The effort involved in finding resources for network policies has led to a substantial amount of public funds devoted to the whole set of programmes supporting innovation networks (almost 37 million € overall), representing around 40% of the total funds devoted to innovation policies. The remaining part has consisted of incentives to individual firms[9].

Figure 1. The time framework of the different programmes



It is worth noting that half of the overall budget for the nine programmes considered was devoted to projects funded at 100% (no matching funds). The rest was administered in co-funding (with shares ranging from 75% to 85% of admittable costs).

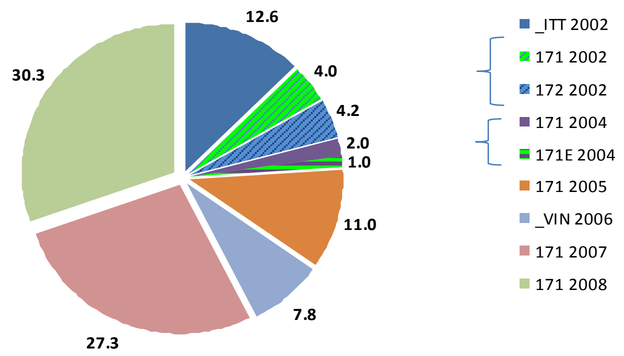
The distribution of funds across the various programmes is summarized in figure 2: 20.8% was spent in the programmes issued in 2002 which lasted almost throughout all of 2003 (no new programmes, were issued in that year); only 3% of funds were assigned

Rossi, 2009a). Tuscany extended this experimental intervention further, by including the promotion of innovative networks within some structural lines of intervention.

9 The innovation policy measures we have considered are included in the SPD 2000-2006, and they refer to measures 1.1 and 1.8, funded in 2002, 2003, 2004, 2006 (for an evaluation of these policies see Mealli et al., 2011).

to the two small programmes of 2004; 11% was assigned to the 2005 programme, on production technologies. The biggest shares of funds were assigned to the last two programmes (27.3 % and 30.3%, respectively). On average, the funds and the number of participants per project range from slighty less than 27 thousand euros and 5 participants in programme 1.7.1E_2004, to almost 1.5 million euros for 35 participants in the only project in programme 171_2002.

Figure 2. Funds by programme and year (%)



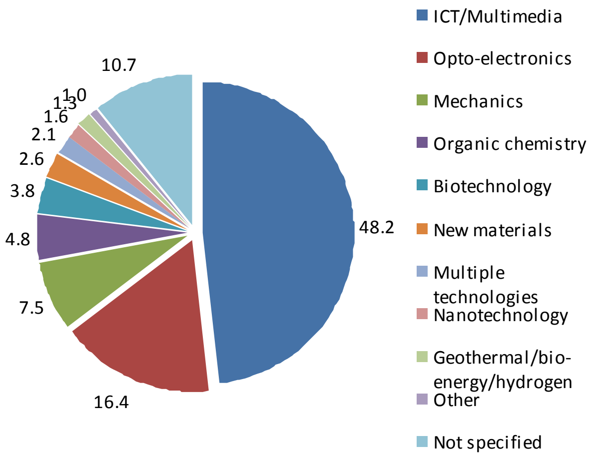
The various programmes were addressing a set of technology/industry targets (see table 1). With regard to the overall policy measures 2002-2008, resources were assigned to almost a proportional share of projects and funds by technology area. As shown in figure 3, a large share of funds was devoted to ICT and multimedia (48.2%): the goal was to widen the adoption of ICT in traditional industries and SMEs. Projects in opto-electronics, an important competence network in the region, received 16.4% of funds. The third targeted area, projects in mechanics, received 7.5% of funds. It is worth noting that 10.7% of funds were assigned to projects, mainly funded in the last three programmes, with no specific technology/industry target[10].

Both the size and the composition of individual networks are partly influenced by the rules set by the regional government, and specified within each tender, indicating the minimum number of SMEs and research centres (and sometimes also local

[10] The tender was not constraining to specific target, nor it has been possible to infer it from the proposals.

governments) that had to be part of the network. The different rules and targets are summarized in table 1, together with some basic features of the programmes.

Figure 3. Funds by technology/industry (%)



We have classified the organizations involved in the observed programmes into nine categories: firms[11] [Ent], other public organizations [Opubl], universities[12] [Uni], private research centres [PR], innovation centres, technology parks and other organizations providing a wide array of services [SC], business development service centres and other private organizations providing services [SP][13], local governments [LG], chambers of commerce [CC][14] and local/regional business associations [LA]. The agents are also classified on the basis of their localisation (provincial level). In what follows we shall consider only funded projects[15].

11 Not including those organizations classified as service centres or business service providers. In the tender these organizations were indicated as a separate group.

12 We have considered the different university departments as different agents, since data on the specific composition of the research units involved in the projects are not available for the entire set of projects. The same criterion has been used for CNR (National Research Council), where we have considered the different Institutes into which it is divided as different agents.

13 These organizations are pointed out by the tenders as KIBS, playing similar roles in supporting innovation policy.

14 None of the tenders explicitly mandates having a chamber of commerce as a partner, nevertheless, in network formation social norms have prevailed: chambers of commerce in fact have a recognized role of bridging different types of organizations. They have a role in the dissemination stage, and are assigned a non-negligible share of public funds.

15 See Russo and Rossi (2009a) for a comparative analysis of funded and not funded projects.

Table 1. Features of policy programmes

Policy measure*	Wave	Policy Programme	Objective**	Technology/industry targets	Matching grants?	Multiple participation is admitted?	N. Submitted Projects.	N. Funded projects	Total costs of funded projects	Funding	% funding (avg)	Minimum n. of participants indicated in the tender, of which:				
												Tot	Ent.	SC	LG	Uni
RPIA	2002	ITT_2002	A	Fashion industries (textiles, clothing, leather & shoes); marbles	Yes	Yes	35	14	6,463,849	4,617,490	71.4	6	4	*n.a.*	1	1
SPD 171	2002	171_2002	A	Fashion industries; marbles	No	No	2	1	1,465,820	1,465,820	100	5	4	1	*n.a.*	*n.a.*
SPD 172	2002	172_2002	A	Fashion industries; optoelectronics; biotech; other	No	No	16	8	1,550,479	1,550,479	100	5	4	1	n.a.	*n.a.*
SPD 171	2004	171_2004	A	ICT; biotech; env. protection; cultural goods and design	No	No	17	6	751,500	751,500	100	4	1	*n.a.*	*n.a.*	*n.a.*
SPD 171 and PRAA	2004	171E_2004	A	Environmental protection and energy	No	Yes	27	14	377,459	377,459	100	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
SPD 171	2005	171_2005	A	ICT; logistics; design for traditional industries; nanotech; new materials; optoelectronics; mech. & robotics; biotech	No	Yes	55	36	4,047,785	4,047,785	100	10	5	*n.a.*	1	*n.a.*
RPIA	2006	VIN_2006	B	Mech & robotics; shipbuilding; env protection; ICT applications for traditional industries	Yes	No	12	12	3,695,378	2,859,640	77.4	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
SPD 171	2007	171_2007	B	ICT; design; cultural goods; traditional industries; env. protection; biotech	No	Yes	65	41	10,110,692	10,010,692	99	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
SPD 171	2008	171_2008	B	Mechanics and robotics; ICT; biotech; traditional industries	Yes	Yes, max 2	36***	36	15,656,387	11,111,678	71	*n.a.*	*n.a.*	*n.a.*	*n.a.*	*n.a.*
Total							309	168	44,004,349	36,677,543	83.4					

* SPD is the Single Programming Document 2000-2006; RPIA is the Regional Programme of Innovative Actions; PRAA is the Regional Programme of Actions for Environmental Protection.
** Objective "A" refers to the Promotion of networks among heterogeneous agents for innovation and innovation diffusion, while objective "B" refers to the Promotion of networks among heterogeneous agents for organisational innovation and innovation diffusion
*** Data on projects presented to the 2008 call are not available. We have considered the number of funded project as minimal approximation of such data
n.a.: not assigned by the tender

The following tables 2a and 2b summarize the main features of the projects in terms of agents and participants in the different policy programmes. By "agent" we refer to each individual organization participating in the different policy programmes (and projects). By "participant" we refer to the single participation instance of an agent in a project. Since, most of the programmes allow multiple participation (each agent may participate in more than one project), the number of agents may differ from the number of participants.

Table 2a. Participants, agents and funding by type

	Participants		Agents		Total funding		Avg funding
	n.	%	n.	%	€	%	€ per participant
Firm	914	45.6	680	60.3	13348181	36.3	14604
Other public body	62	3.1	39	3.5	815448	2.2	13152
University	261	13.0	93	8.3	7355106	20.0	28180
Private research company	32	1.6	22	2.0	537613	1.5	16800
Service centre	150	7.5	34	3.0	6208052	16.9	41387
Business service provider	153	7.6	86	7.6	4015642	10.9	26246
Local government	176	8.8	77	6.8	691654	1.9	3930
Local association	209	10.4	85	7.5	3016694	8.2	14434
Chamber of commerce	49	2.4	11	1.0	802152	2.2	16370
Total	2,006	100.0	1127	100.0	36790543	100.0	18340

Table 2b. Number and funding of participants and agents involved in more than one project, by type

	Participants		Agents		Total funding		Avg funding
	n.	%	n.	%	€	%	€ per participant
Firm	373	30.4	139	39.9	8645097	30.3	23177
Other public body	36	2.9	13	3.7	552249	1.9	15340
University	207	16.9	41	11.8	6115727	21.4	29545
Private research company	16	1.3	6	1.7	267577	0.9	16724
Service centre	138	11.2	22	6.3	5979899	21.0	43333
Business service provider	101	8.2	34	9.8	3333562	11.7	33006
Local government	141	11.5	42	12.1	480807	1.7	3410
Local association	165	13.4	41	11.8	2373806	8.3	14387
Chamber of commerce	50	4.1	10	2.9	784469	2.7	15689
Total	1,227	100.0	348	100.0	28533193	100.0	23254

The total amount of agents involved in the nine programmes is 1,127[16], a subset of

[16] The project data refer to definitive projects, drafted in the format scheduled in the funding specifications. Our analysis includes all the subcontractors that have been explicitely identified in the application form.

which (348) took part in more than one project. The total number of participants to the 168 funded projects is 2,006. Enterprises and other public organizations represent 48.7% of participants, and a larger share of agents, but they have the smallest ratios of participation per project (number of participations divided by the number of agents)[17]. The most active agents are the chambers of commerce and the service centers (on average each of these agents participates to more than 4 projects), followed by university departments, local associations and local governments (respectively, 2.8, 2.5 and 2.3).

The set of agents and projects we have described above has been investigated by means of social network analysis, in order to map, measure and analyse the resulting web of relations. The database generates a two-mode network where each agent is connected with the project(s) in which it participates. This has been transformed into a one-mode undirected network (see analyses in sections 5 and 6): the various agents (the aforementioned organisations, represented here as nodes) are connected through co-membership relations in innovation projects. The web of agents participating in two different innovative projects may be also indirectly connected by those agents operating within both projects.

As suggested in section 2, network data will be examined according to different dimensions: heterogeneity in the nature of the participants, multiple participations (brokerage positions and intercohesion), and network dynamics (continuous versus episodic participation to the policies). These are key dimensions of the observed policies since: i) the policies promote networking among heterogeneous agents; ii) some of the programmes require the presence in the networks of bridging actors such as business development service centres; iii) in some of the programmes multiple participations is allowed, while in some others it is restricted.

With regard to the heterogeneity dimension (discussed in section 4), we apply to the set of participants in each project network an heterogeneity index that measures the diversity of the types of participants to the network, and we compare the different projects across the different policy programmes. Concerning the second dimension (discussed in section 5), we have measured brokerage positions and intercohesive nodes

[17] The total number of enterprises participating to one or more of the policy programmes (680), represents about 1% of the enterprises in the region in 2001.

with the help of two different SNA algorithms. The first one is the brokerage role, calculated on ego-network data, which is included in the Ucinet Software (Borgatti et al, 1999), while the second one is the clique percolation method, implemented in the Cfinder software (Palla et al, 2005). Finally, in order to analyse the third issue, network dynamics, we have analysed the extent of repeated participation over time (discussed in section 6).

4. Network heterogeneity

We first aim to measure the heterogeneity of each project network in terms of composition. To do so, we adopt a heterogeneity index which measures the diversity of the types of participants to the network. The index is the reciprocal of the Herfindahl index computed on the shares of participants belonging to each of the nine categories outlined previously (Ent, Opubl, Uni, PR, SC, SP, LG, CC, LA). The index takes values between 1 and 9. As a first step, we have computed this index for each project network within each programme. The distribution of the heterogeneity index within each programme is shown in the box-plot diagrams illustrated in figure 4. The average heterogeneity index is not too dissimilar across programmes, ranging between 2 and 4. The only exception is programme VIN_2006 which has lower average heterogeneity and low dispersion of these values around the average. Most of the variance (50%) is concentrated between values of the heterogeneity index comprised between 2 and 5 – again, indicating that dispersion is not very large. It is also remarkable that there is not a large difference in average and dispersion of the heterogeneity index between programmes that imposed a minimum heterogeneity constraint (ITT_2002, 171_2002, 172_2002, 171E_2004, 171_2005) and those that did not. The policymaker's decision to drop minimum heterogeneity constraints in later programmes does not appear to have significantly influenced the actual heterogeneity of the networks' composition. This could be due either to a positive learning effect – i.e., participants have learned that a certain degree of heterogeneity is associated with successful innovation performance – or simply to self-seeking behaviour – i.e., participants have learned that greater heterogeneity in candidate networks' composition leads to greater probability of being selected for funding.

To shed more light on these issues, we analyse the relationship between size and heterogeneity of project networks across all programmes (figure 5). We find that greater network size is associated with greater heterogeneity, although the relationship is only weakly positive and there is a large variety of possible heterogeneity index values for each network of a given size. What is interesting to observe is that networks funded within programmes where a minimum heterogeneity constraint was present are generally much larger than networks funded within programmes without such constraint – and very often much larger than the minimum size required to fulfil the heterogeneity constraint.

Figure 4. Distribution of heterogeneity index within each programme (box plot diagrams)

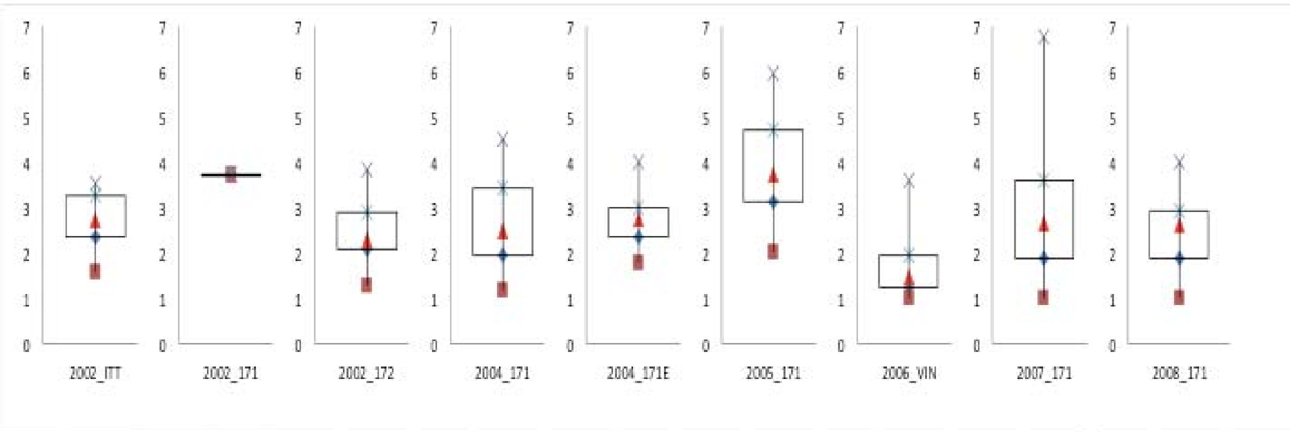
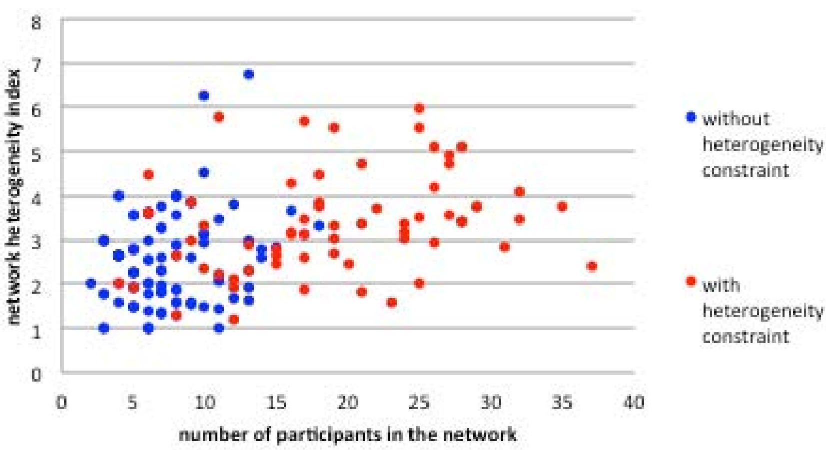


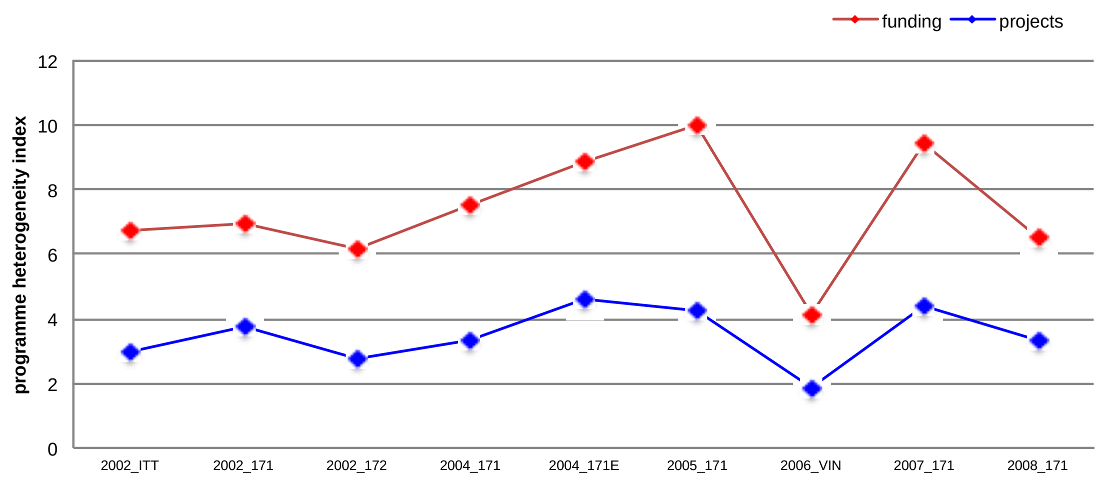
Figure 5. Relationship between heterogeneity and network size *



This can be interpreted as an indication that the formal heterogeneity constraint imposed by the tenders forced networks to include organizations that were not strictly necessary for the project's success, and required them to increase the number of participants to include all the desired members; while the elimination of such constraints allowed the partnership to be designed according to the effective project requirements and economise on the number of partners without necessarily reducing heterogeneity. This interpretation therefore suggests caution in imposing arbitrary heterogeneity constraints without previously investigating the actual partnership needs of the different projects.

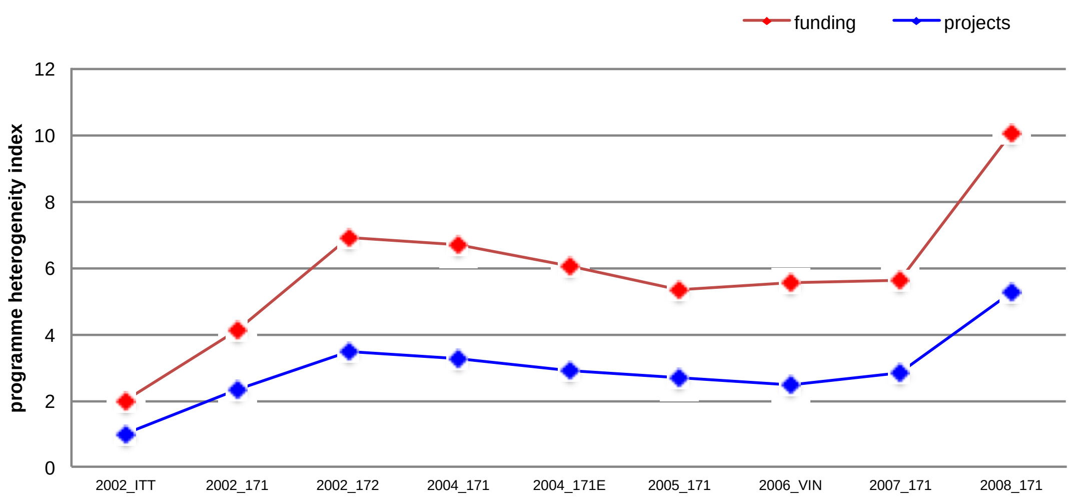
A different outlook can be presented by computing the heterogeneity index at the level of the entire programme rather than at the level of individual project networks. The next figures shows the heterogeneity index of the various programmes measured in terms of participants' types (figure 6a) and of participants' technology areas (figure 6b). In both figures, the index is measured both on the share of funding attributed to each category and on the share of participants belonging to each category.

Figure 6a. Programme heterogeneity index by participants' type



The heterogeneity index in terms of participants' types (figure 6a) follows a similar trend to the average heterogeneity index measured on the individual networks – except for a couple of outliers, it is generally stable over time and programmes with a minimum heterogeneity constraint are no more heterogeneous than the others. The heterogeneity index in terms of participants' technology area (figure 6b), instead, is increasing over time. This suggests that, going beyond the formal objectives of the different tenders, the programmes have progressively involved a wider range of technologically diverse organizations[18].

Figure 6b. Programme heterogeneity index by technology area



5. Bridging organizations, brokerage positions and intercohesive agents

We are interested in finding ways to analyze the presence and identity of bridging actors in order to measure, as an element of policy evaluation, the ability of policy-supported innovation networks to stimulate learning processes, which can further enhance the innovative capabilities of network participants. Bridging actors, which create connections between agents that are very heterogeneous in terms of competences, languages, experiences and outlook, can not only facilitate the transfer of knowledge between them (this way becoming vehicles for the transmission of knowledge spillovers) but they can also facilitate mutual learning within networks which improves the participants' innovation capabilities. Thanks to the intermediation of bridging actors characterized by "multivocality" (Russo and Rossi, 2009a), participants in networks can learn how to interact with other, heterogeneous agents, thus becoming more likely to enter processes of collaborative innovation in the future. Learning processes can also be stimulated by the continuous participation of agents in networks whose membership is

[18] The heterogeneity does not extend to the geographical dimension, as a significant part of the relations entertained by the individual agents are with agents localized within the same province (particularly so for firms): therefore, the webs of relations we are observing have specific territorial roots.

at least partly repeated – hence our analysis, in the following section, of continuous versus episodic participation to the regional policies.

As mentioned previously, the set of policy programmes often explicitly identified requirements to be met in terms of involvement of organizations which should play a particular bringing role in the network: namely, innovation centres and other private organizations providing services (knowledge-intensive business service providers; henceforth: KIBS). The presence of some kind of KIBS (be they public, private, or mixed) is often required in order to introduce some interfaces between the manufacturing SMEs – particularly those operating in low-tech sectors – and the organisations belonging to the world of research[19]. Besides their interface role, the KIBS (together with a broader set of agents) are supposed to act as catalysts, and to stimulate the participation of the SMEs to the policy-elicited innovation networks.

Moving from the programme requirements to the analysis of the implemented programmes, we would like to understand the extent to which agents in the networks have played a bridging role, and which agents have actually played this role. To do so, we analyze the presence of brokers and intercohesive nodes.

In SNA terms, a broker is a "go-between" for pairs of other agents that are not connected directly to one another. If A, B, C are three agents and A and C are not linked without the intermediation of B, B is our broker. In other terms, brokers cover a brokerage position[20].

In order to explain the concept of intercohesion and intercohesive nodes we start again from the basic features of the policies we are observing. Since in some of the programmes multiple participation was admitted, we can detect a set of agents that have been active in more than one project (network) in the same programme and hence that participate in more than one community of innovators. Following the definition provided by Stark and Vedres (2008), such multiple participants can be defined as intercohesive nodes, that is nodes which belong to more than one community, and hence

[19] In some cases the presence of a minimum number of service centres (a particular kind of knowledge-intensive business provider) was expliciteely required by the call for tender (see table 1), while in other cases it responded to the general objective of the observed policies, which is: "the promotion of networks among enterprises, research centres and universities, innovation centres and other public and private organisations" for innovation and innovation-diffusion purposes.

[20] There may be several kinds of brokerage positions. The contribution of Fernandez and Gould (1994) identify four different positions (coordinator, consultant, liaison, gatekeeper, representative) on the basis of the specific group to which the broker and the agents it connects belong.

belong to different social groups at the same time[21]. According to Stark and Vedres (2008) these nodes play a crucial role in connecting communities to each other. “The importance of intercohesion lies in the fact that it is an intersection of social structures. Such intersection points are locations of structural tension where multiple routines of operation and schemas to organize resources are at work. As prominent locations of restructuring agency, such intersecting social structures can be engines of social change from within (Sewell 1992)”.

Our empirical strategy is composed of the following steps. First, we select only those programmes in which participation to more than one project was admitted (ITT_2002, 171E_2004, 171_2005, 171_2007 and 171_2008). It must be noted that in only two of this programmes (ITT_2002 and 171_2005) there were specific constraints on the composition of the network by type of participants (see table 1). Second, we select an appropriate algorithm for the identification of brokers, communities and intercohesive nodes. For the analysis of brokers, we refer to the ego-measure of density which is implemented in the Ucinet software (Borgatti et al, 1999). The index we refer to is the normalized brokerage index, which calculates the number of times an ego lies between two nodes (included in his neighbourhood) that are not connected directly to one another. For the analysis of intercohesive nodes and communities, we rely on the clique percolation algorithm (Palla et al, 2005), implemented in the Cfinder software, which identifies communities as groups of adjacent k-cliques (where a k-clique is a set of nodes each of which is connected to at least other k nodes): two k-cliques are adjacent if they have k-1 vertices in common. The idea underlying the identification of such communities is that, for a social group to be cohesive, it is not necessary for all members of the group to interact with all others (as in a k-clique) but there can be cohesion even if some actors interact with only k-1 others. Intercohesive nodes are those which belong to more than one community at the same time.

Third, we apply these algorithms to our policies. The following table 3a summarizes the results of the analysis of brokerage positions. It displays the share of agents, classified by type and programme, which can be classified as brokers on the share of agents of that kind. If the figure is greater than one, that type of agent has a more-than-

[21] Communities are groups of nodes which are more intensively connected to each other than to the rest of the network, identifying particularly cohesive social groups.

proportional representation as a broker in that programme. Chambers of commerce, business development service centres, business and trade associations and universities are among the kinds of agents that more often appear as brokers. This suggests that, despite the absence of explicit requirements in terms of network composition by type of participants, these categories of organizations have participated intensively to the programmes and have performed a bridging role across different projects. As it is quite obvious, brokerage positions are usually more frequent as the size of the programme network grows. In fact, the largest programme (171_05) has the largest incidence of brokers (see table 3b).

Table 3a. Incidence of brokers by programme and by type of agent

Type of agent	ITT_2002	171E_2004	171_2005	171_2007	171_2008	Total
Firm	0.2	0.4	0.4	1.0	0.9	0.5
Other public body	1.3	0.0	0.7	0.0	0.0	0.6
University	3.1	1.9	1.9	0.4	1.4	1.5
Private research company	0.0	0.0	0.0	0.0	0.0	0.0
Service centre	3.5	2.6	2.2	2.9	2.1	2.2
Business service provider	0.6	2.1	0.8	0.9	1.4	0.9
Local government	0.0	0.0	1.7	0.9	0.0	1.7
Local association	0.0	1.8	2.1	0.8	0.7	1.8
Chamber of commerce		0.0	3.5	2.1	2.0	2.8

Note: each figure in this table is the ratio between the share of agents of each kind that can be classified as broker and the share of agents of that kind that participate to the programme. The last column refers to the incidence of brokers on the total number of participants to the five programmes here considered.

Table 3b. Number and percentage of brokers by programme

Brokers	ITT_2002	171E_2004	171_2005	171_2007	171_2008	Total
n.	21	6	130	36	31	224
as % of programme's participants	9.4	8.6	23	12.9	12.6	16.3

We then move on to the analysis of communities and intercohesive nodes. The following table 4 summarizes the communities found in each network. In order to identify communities that are larger than individual projects, we chose to search for k-cliques whose size is $k = n + 1$ where n is the minimum effective size of project networks in the programme. The number of communities found is generally increasing over time and the share of programme participants included, on average, in each community, is decreasing.

To analyze the extent to which the communities found in each programme overlap, table 5a displays the percentage of agents, classified by type and programme, which can be classified as intercohesive nodes on the total number of participants. Programme ITT_2002 does not include any intercohesive nodes, because for k = 14 there is only one community in the network. In later programmes, we find a number of intercohesive nodes ranging from 6.3% to 29.1% of the programme participants. The largest programme in terms of number of participants, 171_2005, displays the greater share of intercohesive nodes, as observed in the case of brokers. The heterogeneity in the composition of intercohesive nodes appears to be increasing over time.

Table 4. Communities in each policy programme network

policy programme	k	n. of communities	network size	Community size				Community size as a % of network		
				min	max	average	standard deviation	min	max	average
ITT_2002	14	1	107	35	35	35.0	0.0	32.70%	32.70%	32.70%
171E_2004	4	10	63	4	8	5.8	1.6	6.30%	12.70%	9.20%
171_2005	12	30	278	13	60	25.4	9.2	4.70%	21.60%	9.10%
171_2007	3	25	278	3	104	12.0	19.6	1.1%	37.4%	4.3%
171_2008	4	32	247	4	23	8.4	5.0	1.60%	9.30%	3.40%

Table 5b shows the share of agents, classified by type and programme, which can be classified as intercohesive nodes on the share of agents of that kind. If the figure is greater than one, that type of agent has a more-than-proportional representation as an intercohesive node in that programme. The types of agents that appear more frequently as intercohesive nodes are, just as in the case of brokers[22], chambers of commerce, business development service centres, business and trade associations, local governments and universities.

These results confirm that certain organizations (chambers of commerce, business development service centres, business and trade associations, local governments and universities) play the roles of bridging actors across all programmes, even though their

[22] The fact that the distributions by type of brokers and intercohesive nodes in the various programme networks are broadly similar is not surprising due to the nature of our networks, which are derived from the conversion of two-mode project-agents networks into one-mode agents networks: in such kind of networks, both algorithms tend to identify as brokers or intercohesive nodes those agents which participate to more than one project. These two indexes are however constructed very differently and may lead to very different results when applied to other kinds of networks.

participation, in most programmes, was not specifically mandated. It must be noted that while chambers of commerce, business and trade associations and local governments are over-represented as bridging actors nodes only in a few programmes (one or two) where they have been particularly involved, service centres and universities are consistently over-represented as bridging actors across all programmes.

Table 5a. Number, percentage, and heterogeneity of intercohesive nodes

Intercohesive nodes	ITT_2002	171E_20004	171_2005	171_2007	171_2008	Total
n.	0	4	81	22	25	132
as % of programme's participants	0	6.3	29.1	7.9	10.1	13.6
heterogeneity by type	0	5.33	5.9	5.44	11.16	5.83

Table 5b. Incidence of intercohesive nodes in each policy programme network

	171E_20004	171_2005	171_2007	171_2008	Total
Firm	0.61	0.25	0.49	0.68	0.38
Other public body	0.00	0.56	1.26	0.00	0.61
University	1.43	1.84	2.73	1.73	1.83
Private research company	0.00	0.00	0.00	2.42	0.43
Service centre	3.94	2.71	3.16	1.94	2.46
Business service provider	0.00	0.65	0.94	1.34	0.84
Local government	0.00	1.61	1.01	0.00	1.46
Local association	2.63	2.97	0.00	0.88	2.34
Chamber of commerce	0.00	4.88	0.00	2.42	2.68

Note: Programme ITT_2002 is not considered here since it does not include intercohesive agents.

6. Stable vs temporary networks

Considering the progressive evolution of the policy-elicited network of agents through time, we identify a set of agents and relations that remains relatively stable. Starting from the observation of the different policy programmes, the following figure 7 summarizes the evolution of our network of networks: for each of the programmes, the figure details the composition of participants in terms of their history of participation.

By definition, the first programme includes a number of participants that are all new to this network programme. Then, as time goes by, we observe a progressive increase in the number of agents that have already benefited from this kind of public funds. As shown by figure 7, the incidence of such kind of agents peaks at around 65% of the total number of participants in the last programme issued in 2008. In general, around 40% of the total number of agents participates in more than one policy programmes, and the average participation is 2.4 policy programmes.

Apart from the first programme, the interventions that attract the largest share of new participants are the 172_2002 and the 171_2005**.** Interestingly, these two programmes provide funds only to those projects that exhibit a high minimum number of participants. Therefore, one of the effects of the presence of a high minimum number of participants seems to be that of involving a large number of agents that are new to the policy. On the contrary, the widening of the range of target sectors/technology areas – that we can observe in the programmes implemented after 2004 – does not seem to have the same effect.

As shown in figure 7, we can distinguish between continuous participation and relatively stable presence in the network. As noted below, most of the agents fall in the latter category. Only two out of the total number of agents that are included in the funded projects (that is 1,127 agents) have participated in all the policy programmes. These agents – a national research centre localized in the regional capital and a local service centre – are representative of two main technology/industry areas of the region, namely optronics-optoelectronics and textiles.

Figure 7. Composition of network of participants in policy programmes

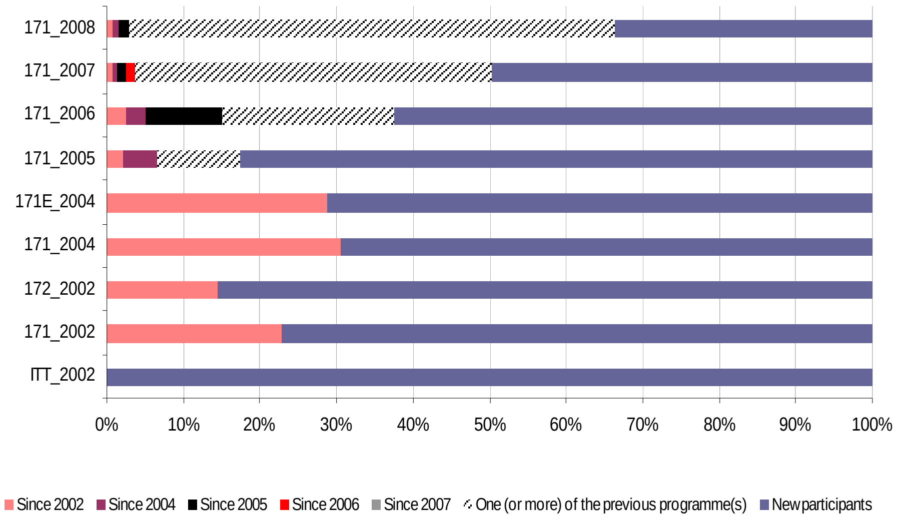


Table 6 shows the overlap of participants across the different policies. Rows and columns display the different programmes, and at their intersection we have the number of agents that participate in both policies. Not surprisingly, the policy programmes which overlap the most are those participated by the largest number of agents. In fact, almost half of the participants to the 2007 call (43%) had already participated in the 2005 call and 107 out to the 247 participants to the 2008 call (43%) had already participated to the 2005 call.

While the previous analysis takes into account the agents participating (in a more or less continuous manner) in the different programmes, the following figure 8 and tables 8 and 9 adopt the relation as the unit of analysis. As shown by figure 8, each network computed at programme level builds on pre-existing relations, while the remaining part is both the result of new relations established between new agents and of the emergence of new relations among old participants. The incidence of pre-existing relations varies between a minimum of 1% of the total network in 2005 and a maximum of around 24% of the total network in 2008. There are no continuous relations covering the whole set of policy programmes.

Table 6. Overlap of participants across policy programmes

	ITT_2002	171_2002	172_2002	171_2004	171E_2004	171_2005	VIN_2006	171_2007	171_2008
ITT_2002	223	8	11	4	19	45	13	31	32
171_2002		35	4	4	3	17	2	10	10
172_2002		4	76	3	4	26	6	22	17
171_2004				36	4	18	3	10	14
171E_2004					70	22	5	16	15
171_2005						565	20	120	107
VIN_2006							80	15	32
171_2007								278	93
171_2008									247

Also along this dimension, the policy programmes which overlap the most in terms of cross-participation by the same dyads (couples of agents) are those participated by the largest number of agents (table 7).

In particular, we can identify 702 linkages (over a total of more than 15,500 relations[23]) repeated over time: the large majority of which (605 relations, which is about 86% of the total number of relations) are repeated over 2 years, while 11% are repeated over 3 years and only 15 out of 702 are repeated over 4 years (table 8). Table 8

[23] The number of total relations we consider here is the sum of the total number of relations that develop in each of the observed programmes.

describes the type of agents that are involved in the previously identified long-term relations. Very often, such kind of relations develop among enterprises or between enterprises and service providers (be they service centres or private service providers) or universities[24].

Figure 8. Composition of network of relations in policy programmes

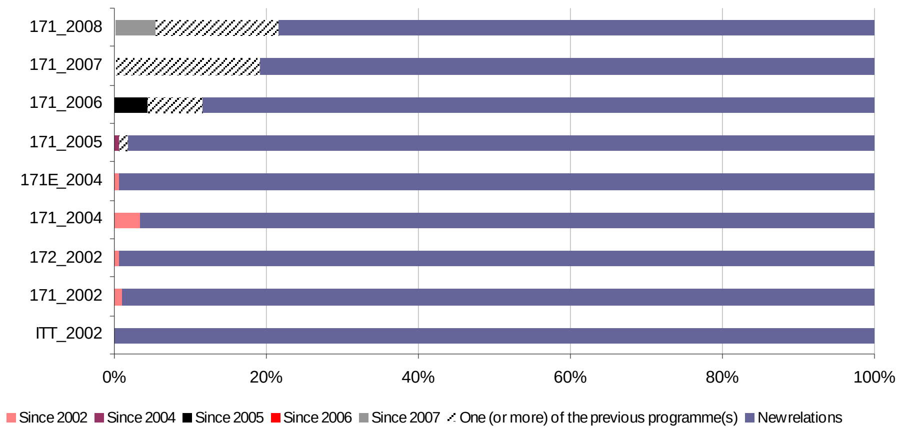


Table 7. Overlap of network relations across policy measures

	ITT_2002	171_2002	172_2002	171_2004	171E_2004	171_2005	171_2006	171_2007	171_2008
ITT_2002	2261	6	2		14	65	11	22	30
171_2002		595	1	4		22	1	1	13
172_2002			339	1		10	3	5	1
171_2004				115		35	1	4	5
171E_2004					195	16	1	7	3
171_2005						9269	21	288	174
VIN_2006							231	4	40
171_2007								1386	132
171_2008									1236

In conclusion, we observe that although a non-negligible part of the agents exhibit a repeated participation to the policies, there is a very small number of them who are involved in a stable partnership. In other terms, regional agents participate several times to the funded networks, but in almost all the cases they do so, they change partner.

[24] Stable relationships link enterprises and universities, while linkages with contract research organisations are weaker.

This kind of participating rule – the same agent participates to more than one programme (and to more than one innovation project), but with different partners – can be evaluated as a positive feature, as it facilitates the recombination of knowledge and competencies and prevents lock-in effects.

Table 8. Type of agents involved in relatively stable/stable relations

Agents involved in long-term relations	N. relations repeated over time			
	Total	*of which (in percentage)*:		
		over 2 years	over 3 years	over 4 years
Industry – industry	117	89.7	6.0	4.3
Industry – university	103	85.4	11.7	2.9
Industry - KIBS	103	88.3	11.7	0.0
Industry - local associations	23	78.3	21.7	0.0
Industry – local governments&others	52	88.5	11.5	0.0
KIBS - KIBS	43	83.7	14.0	2.3
KIBS – local associations.	30	76.7	16.7	6.7
KIBS – local governments&others	32	84.4	15.6	0.0
University & university	26	73.1	23.1	3.8
University - KIBS	59	83.1	13.6	3.4
University - local associations	23	82.6	17.4	0.0
University – local governments&others	23	82.6	17.4	0.0
Other combinations	68	95.6	2.9	1.5
Total	702	86.2	11.7	2.1

Note to table 9: KIBS (knowledge-intensive business service providers) refers here both to the service centres and to the private service companies. The term university refers both to the university and to the research centres.

7. Concluding remarks

The set of policies we have observed have been implemented under uncertainty on the amount and the flows of funds actually available for supporting the programme. This less than ideal situation has produced a fragmented action, with implications for the design of the set of policy interventions (in terms of fragmented goals, resources, beneficiaries). Nonetheless, we have found that the structural characteristics of the policy interventions have allowed several positive outcomes.

We have performed a set of simple analyses, using a small set of indices borrowed from the SNA literature, in order to asses if, and to what extent, the policies have succeded in their goal of promoting the development of successful R&D and innovation diffusion network projects among heterogeneous agents. Our analysis and evaluation exercise has assumed that the networks' innovative potential may be strongly influenced by: (i) the interaction, within the same network, of actors having different nature, knowledge and competencies; (ii) the action of bridging organizations linking different parts of the network, and (iii) striking the right balance between stable and occasional networks. These features were somehow recognised by the regional policy programmes we have considered.

Three main results emerge from the empirical analysis of the Tuscany innovation policy programmes 2002-2008. We now summarize them focusing on their implications on policy design.

First, the earlier programmes imposed constraints on the composition of the innovation networks, mandating some degree of heterogeneity: although these constraints were progressively abandoned, their importance (at least in order to obtain funding!) has been recognized by the applicants, which have continued to set up increasingly heterogeneus networks. Our results show that the presence of heterogeneity constraints stimulates, on average, larger project networks; that is, these constraints forced networks to include organizations that were not strictly necessary for the project's success, and required them to increase the number of participants to include all the desired members. This can be therefore interpreted as suggesting caution in imposing arbitrary heterogeneity constraints without previously investigating the actual partnership needs of the different projects. We also found that the heterogeneity of the policy measures has increased over time, as programmes have become more diverse in terms of projects' technological composition. So, while the calls issued by the region have progressively reduced the mandatory requirements in terms of network composition, the involvement of heterogeneous sets of actors has increased. This could suggest a process of learning on the part of programme participants.

Second, we found that business development service centres, local associations, local government bodies, chambers of commerce and universities have played an important bridging role throughout the programmes, being instrumental in activating many relationships. Paradoxically, their involvement and engagement in bridging role was particularly evident in those programmes where their participation was not specifically mandated. This is another result which suggests that policymakers should exercise caution when imposing constraint on network composition, as these may turn out to be not necessary in order to achieve the desired results.

The network analysis has also shown that the larger innovation networks involve the greatest shares of “brokers” and of “intercohesive” nodes: members of bigger networks have more opportunities of setting up potential indirect links with agents active in other networks that are connected by intercohesive agents. A possible explanation is that larger programmes could fund more diverse project networks and this increased diversity has made it more important to involve bridging organizations.

Finally, the continuity of the policy interventions, despite some gaps, has allowed many of these relationships to continue over time (especially among agents with a common technological and research focus), contributing to the stability of the policy networks. Our results show that around 40% of the total number of agents participates in more than one policy programme, and around 86% of the total number of relations is repeated over at least two years. Very often, such relations develop among enterprises or between enterprises and service providers (be they service centres or private service providers) or universities, indicating that while bridging actors are important in order to activate a diverse range of relationships, repeated relationships develop among organizations that have a common technological or research focus. The experience of joint participation in an innovation network fosters further joint participations to subsequent networks: this is shown by the fact that the share of relations which were already active in previous networks is increasing.

These findings suggest that, thanks to the policy programme implemented in 2002-2006, many organizations involved in the networks have improved their ability to organize and engage in collaborative interactions. It would be valuable to investigate whether this programme has produced long lasting results by tracking the collaborative behaviour of these organizations after the end of the policy programme.

This exercise has also more general implications for the issue of evaluating innovation networks. By focusing on the most relevant characters of the innovation network that are described in the literature, the study has identified and empirically tested a small set of indices borrowed from the SNA literature that can be used in order to assess both ex ante evaluation of the single innovation networks submitting proposals to be funded and for evaluating the impact of a network-based policy.

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