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Where is the value of cluster associations for SMEs?

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Abstract

Purpose: To explore the role played by policies for co-operation and networking, such as cluster initiatives. We empirically examine not only the direct effect of cluster initiatives on firms' innovation performance, but also potential moderation and mediation effects with regards effort in other internal innovation activities.

Design/methodology: We analyze the case of the long-running and stable Basque Cluster policy. We built using SABI an extensive sample of 1779 industrial SMEs, 132 of which are members of cluster associations.

Findings: The results show that cluster associates do not have more innovation than non-cluster associates. It also rejects the moderation role of other innovation activities (such as technology management, environmental management or R&D activities). However, the results give support to the mediation role of cluster associations in enhancing the value of innovation activities.

Research limitations: There are two main limitations to the empirical analysis. Firstly, the impossibility of identifying the year in which cluster associates formally register to the cluster association through secondary sources could entail a degree of endogeneity in the direct and moderation

models. Secondly, we measure innovation as labour productivity growth, which is acknowledged as only a partial measure of innovation. More generally we acknowledge that evaluations of soft policies such as that reported in this paper should be combined with complementary qualitative analysis.

Practical implications: The results presented are relevant both for policy-makers seeking to achieve an optimal mix of "general cooperation" and "activity-specific" policies, as well as for the managers of firms who may accelerate the impacts of their innovation efforts by being members of cooperation networks.

Originality/value: Few empirical analyses have been conducted to empirically assess the efficiency of the Basque cluster policy. The research does not support the idea that cluster associates increase innovation per se. However, it reinforces the view that cluster associations can be conceived as a focal network or broker of knowledge. In particular, this could be interpreted in terms of the success of the cluster initiative as a mechanism for generating or demonstrating a certain degree of trust among firms that already engage in innovation activities, supporting in turn benefits from the exchange of their knowledge.

Keywords: innovation performance, innovation policy, networks, cluster associations, productivity

Jel Codes: L20, L60, O25, R58

1. Introduction

The promotion of innovation in and among SMEs has become a cornerstone of public policies supporting territorial competitiveness, particularly at regional and local levels (Aranguren, Larrea & Wilson, 2010; Aranguren, De la Maza, Parrilli, Vendrell-Herrero & Wilson, 2012; Bellandi & Caloffi, 2010). Firm innovation itself can be broadly defined as the creation, expansion and application of all kinds of knowledge in the production of goods and services. Moreover, following Lundvall (1992) and Smith (1994) it is both a technical and social process, involving interactive learning among firms and their broader environment. Given the virtual impossibility of encompassing all necessary knowledge and competences within a

single firm, innovation is widely acknowledged as being rooted in complex processes of interactions among a variety of actors within the wider innovation system. Thus firms have become increasingly reliant on external knowledge to develop and sustain innovation (Von Hippel, 1988; Freeman, 1991; Lundvall, 1992; Powell, Doput & Smith-Doerr, 1996), and networking has taken centre stage in much analysis of innovation.

Recognition of the importance of networking for innovation, alongside the sensitivity involved in sharing strategic knowledge, has coincided with the rise of policies designed to facilitate cooperation and trust-building among firms and other agents in the economy. Moreover, while Visser (2009) makes an important distinction between the concept of networking and that of spatial clustering in terms of their effects on knowledge, learning and innovation, the two are often merged together in a policy context. As such the establishment of cluster initiatives as a focal point for networked co-operation is an extremely popular contemporary policy focus (Porter, 1990, 1998; Sölvell; Lindquist & Ketels, 2003; Asheim, Cooke, & Martin, 2006; Pitelis, Sugden & Wilson, 2006), and one that is inextricably linked to the development of trust among a community of co-located firms (Dupuy & Torre, 2006).

However while cluster initiatives are extremely popular among policy-makers at different levels of government, there has been increasing concern around the tricky question of how to evaluate and interpret the impacts of such relationship-oriented policies (Bennett & Ramsden, 2007). In that sense there is a need to recognise that cluster policies generate non-economic impacts that only indirectly have economic impacts; for example the building of trust to facilitate the cooperation necessary for innovation. Indeed in some cases the most significant effects of these policies are produced in non-economic spheres (Díez, 2002; Fromhold-Eisebeith & Eisebith, 2005, 2008). In this paper we propose and test three different possible benefits from a specific cluster policy initiative.

The first is the direct benefit: do firms that form part of the cluster initiative innovate more than non-associated firms because of this association? We name this effect a "generator of knowledge". Recent evidence is contradictory. In one side Li and Geng (2011) in the Chinese context find that the exploitation of exclusive shared resources enhances the performance of cluster associates. On the other side, Martin et al. (2011a; 2011b) have studied the impacts of the large-scale French cluster programme to support Poles de Competitivité. They find that assisted firms do not exhibit higher productivity than non-assisted firms, and

suggest that this casts doubt on the benefits of cluster policies. Aranguren et al. (2012) analyses the Basque cluster policy. They constructed a matched sub sample of non-cluster associates with statistically identical characteristics than their cluster counterparts. Using the matched sub sample authors find weak evidence of a positive impact of cluster policy on productivity growth, but suggest caution in interpreting these findings in isolation.

An alternative possibility is that belonging to the cluster initiative produces an effect that complements other innovation activities that are already taking place at firm level: as such, the cluster initiative moderates activities such as internal research and development. We name this effect a "co-generator of knowledge". The last alternative proposed in this study is that the cluster initiative acts as a "hub" or "broker of knowledge" (Meyer, 2010; Ward, House & Hamer, 2009). In this case belonging to the cluster initiative is a way to mediate knowledge, through the trust that such initiatives precipitate, among firms that are already conducting their own innovation activities. We test this proposition through a mediation test (Baron & Kenny, 1986, p. 1177; Surroca, Tribo & Waddock, 2010, p. 489).

The case studied is one of the longest standing cluster policies in Europe, that of the Basque Country Autonomous Region of Spain (hereon "Basque Country". The policy was established in the early 1990s and remains in place today, currently supporting 12 fully-recognised Cluster Associations (CAs) in addition to a number of 'pre-cluster' associations. These CAs are institutions for collaboration whose main objective is to improve each cluster's competitiveness by facilitating and fostering co-operation among members, who include firms, R&D centres, universities, etc. While there has been no systematic evaluation of the impacts of this policy, a series of ad hoc studies have sought to analyse different aspects of its performance (Ahedo, 2004; Aranguren & Navarro, 2003; Aranguren Aragón, Larrea & Iturrioz, 2008; Aragón, Aranguren, Iturrioz, Larrea & Olarte, 2009).

The paper is structured as follows. In Section 2 we provide a brief discussion of the theoretical rationale for networking and cluster policies as a key element in facilitating innovation. This is followed in Section 3 by the setting-up of hypotheses relating to three potential impacts of cluster initiatives on innovation performance. Section 4 then introduces the case, the data collection and the specification of variables. The empirical results are presented in Section 5, and the conclusions and implications discussed in Section 6.

2. Cooperation, knowledge, cluster associations and SMEs

Processes of globalisation have eased the flow of goods, services and knowledge across previous boundaries. In turn, this has contributed to fundamental changes in the business environment in which firms around the world operate, rendering knowledge and innovation particularly critical in maintaining and developing competitive advantage. More routine aspects of production activities are increasingly susceptible to the draw of low cost locations. In this context it is often argued that there has been a transition to a "knowledge-based economy", certainly in more developed economies. These trends have implications for all firms, and highlight specific problems faced by small and medium-sized firms (SMEs), which form the vast majority of the firm population in any territory and make a critical contribution to competitiveness. In particular SMEs frequently suffer from a deficit in intangible investments and assets: access to and effective use of technology; management skills; education and vocational training; quality of business organisation; marketing skills; software (Loveman & Sengenberger, 1991; Acs & Audretsch, 1993; Boekholt & Thuriaux, 1999; Audretsch & Thurik, 2001).

This has created a challenge for policy in terms of meeting the "support needs" of SMEs. In particular it is widely recognised that SMEs can contribute to regional innovation capacity through the dynamic nature of their inter-relationships among themselves and with larger firms. The creation of healthy sociocentric networks (Lechner & Dowling, 2003) that enable cooperative relationships with other firms can offer: more channels for learning and creating expertise; economies of scale; economies of scope; and heightened flexibility and shared risk (Boekholt & Thuriaux, 1999). Indeed, De Propris (2000) and Freel and Harrison (2006) have found that firms that cooperate are more likely to innovate. The existence and development of trust is an important element that underlies these benefits, as recognised for example by the seminal work of Marshall (1898) and later by Beccatini, Bellandi, Dei Ottati & Sforzi (2003) in the context of the Italian industrial districts. Thus much competitiveness policy targeted at SMEs aims either to support their specific needs in accessing intangible assets, or to facilitate processes of networking and trust-building so as to generate cooperation (among themselves and with larger firms).

Following Havnes and Hauge (2004), cooperation can be described as a relationship among independent firms or associates through which they combine their efforts and resources in a value-creation process. Indeed, innovation itself is widely acknowledged today to be an integrated process (where all areas of the firm

participate) and one that is network-oriented (based on interaction with clients, suppliers and other institutions).A fundamental contemporary challenge for all firms is the addition of new competences to their repertoire when embedded in constantly changing environments characterised by knowledge-based competition and rapid technological progress. As such it has become virtually impossible to encompass all necessary competencies within the firm, and innovation is increasingly rooted in complex processes of interactions among a variety of actors within the wider innovation system (suppliers, competitors, employees, customers/users, research institutions, regulatory bodies and so on). As a result, firms have become more and more reliant on external sources to develop and sustain innovation (Von Hippel, 1988; Freeman, 1991; Lundvall, 1992; Powell et al., 1996), and thus on developing their absorptive capacity (Cohen & Levinthal, 1990) in relationships that involve cooperation and work on (varying) foundations of trust.

In spite of the special relevance of cooperation and network participation for SMEs to overcome their aforementioned handicap in internal innovation resources, literature shows that they often exhibit both high barriers to innovation and a low tendency to participate in networks. Asheim, Isaksen, Nauwelaers & Tödling (2003), for example, conclude that smaller firms participate less in networks, and especially in innovation networks. Key obstacles to their co-operation including fear of loss of independence, lack of information about possible partners, fear to share information, and fiscal and legal restrictions (Havnes & Hauge, 2004).

This scenario provides a rationale for policy intervention: both in terms of addressing specific needs; and in more general terms, with policy-makers taking on the role of animateur in enhancing the ability of SMEs to access technology and innovation (Díez, 2001). A particular response has been the tremendous rise, during the last two decades, of 'soft' policies designed to nurture trust and support co-operative relationships between economic agents. Inspired by literature on successful experiences with cooperation in the Italian industrial districts (Piore & Sabel, 1984; Pyke, Beccattini & Sengenberger, 1990; Beccatini et al., 2003) and the work of authors such as Porter (1990, 1998), Saxenian (1994) and Schmitz (1995), policy-makers worldwide have progressively assumed key roles as facilitators in fostering networks to stimulate innovation and competitiveness. This has taken place at the national level, but the impact has been particularly strong at regional level. Indeed, the regional uptake of such policies has been strongly influenced by a convergence in the analysis of innovation and the field of economic geography, as seen for example in the burgeoning literature analysing the concepts

of "innovative milieu" (Maillet, 1995), "learning regions" (Morgan, 1997) and "regional systems of innovation" (Cooke, Uranga & Etxebarria, 1998; Cooke, Heidenreich & Braczyk, 2004).

Perhaps the most prevalent configuration of competitiveness-oriented networking policy is that which is framed in terms of "cluster policy". In the most widely-used definition (certainly among policy-makers), Porter (1998, p. 199) defines a cluster extremely broadly: "a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities". The extent of the popularity and uptake of initiatives that seek to support some aspect(s) of this broad 'cluster concept' can be seen in the findings of a recent report identifying 69 distinct national cluster policy programmes in Europe alone, with regional programmes also found in 17 European countries (Oxford Research, 2008).

Yet for a policy focus with such wide extension there is a distinct shortage of academic analysis evaluating the effectiveness of individual policies in meeting their specified aims, usually defined in terms of enhancing productivity or competitiveness. The lack of such analysis is in large part due to methodological and generalisation issues arising from the heterogeneity of individual cluster policies and from their inter-relatedness with a whole range of other policies. Indeed the foundations of network policies such as cluster initiatives are an array of previous industrial, regional development and technology policies (Nauwelaers & Wintjes, 2008). The platform of cooperation that they provide inevitably interacts, for example, with the undertaking of specific innovation-oriented activities by firms, and the policies to encourage these. Being part of a cluster policy initiative can facilitate new information about the industry and productive context, about relevant innovation policy measures, and about risk-sharing opportunities with regards innovation activities (generator of knowledge). Moreover, participation in the cluster initiative is inevitably also a complement to range of more specific innovation-related activities undertaken within the firm, many of which are explicitly supported by other policies. Thus in evaluating the effectiveness of cluster policies it is important to test the moderating (co-generator) and/or mediating (broker) role that they could have with regards these specific innovation-oriented activities.

To summarise, firm innovation and therefore regional competitiveness depend both on the internal resources, attributes and capabilities of firms, and on their ability to exploit the ideas, resources and capabilities of their external environments.

Networks of cooperation are hence critical for innovation, although in practice it is difficult to integrate SMEs in formalised innovation networks due to various barriers to cooperation that include the need to build adequate levels of trust. Thus fairly general networking policies, such as cluster policies, are often employed with an aim of overcoming these barriers and facilitating an overall co-operative environment that is supportive of more specific innovation activities. Despite the popularity of these policies, the evaluation of their impacts is relatively weak.

3. Identifying cluster value: generator, co-generator and/or broker of knowledge

Direct effect: Generator of knowledge

We test three specific hypotheses about the impacts of network policies on innovation performance. Firstly, following Li and Geng (2011) we might expect a direct effect on firm innovation performance from being exposed to a network policy (see Figure 1). Using membership of a cluster initiative as a proxy for exposure to networking policies, this is based on the assumption that the cluster initiative is effective per se in generating innovation, and it tests the role of clusters as generators of knowledge.

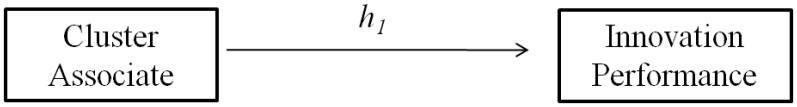

Figure 1. Direct Effect or Generator of Knowledge

Hypothesis 1: Cluster associates have a higher innovation performance than non-associates (h_1>0).

Complementary effects: Co-generator and broker of knowledge

Recent quantitative research from Martin et al. (2011a, 2011b) and Aranguren et al. (2012) raises doubts about Hypothesis 1. Their results suggest that simply being part of a cluster initiative does not result in higher productivity growth (Martin et al. 2011a, 2011b), or at least that it is difficult to show this categorically (Aranguren et al. 2012). However, we might also consider the possibility that being a cluster associate has a positive indirect effect, in terms of encouraging the adaptation of other innovation activities and supporting policies to the real needs of firms (Aranguren & Navarro, 2003). This leads us to consider that participating in a cluster initiative could serve also as a co-generator of knowledge, or in empirical

terms as a moderator of other innovation activities such as R&D investment or quality certifications. Baron and Kenny (1986, p. 1174) define the moderation effect as a "variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable". In our case belonging to a cluster association could be considered a moderator (see Figure 2a) with respect to the conduct of internal innovation-oriented activities, when it is assumed that both are independent (or uncorrelated) events.

Hypothesis 2a: Those firms exerting internal innovation activities have a greater innovation performance when they participate in cluster associations than when they do not (h2a>0).

A third option is that being part of a cluster initiative does not generate new knowledge for the firm as such; rather the cluster initiative serves as a hub for the interchange of knowledge between those firms that have a positive attitude towards knowledge. In other words a cluster association would act as a broker of knowledge (Meyer, 2010; Ward et al., 2009).

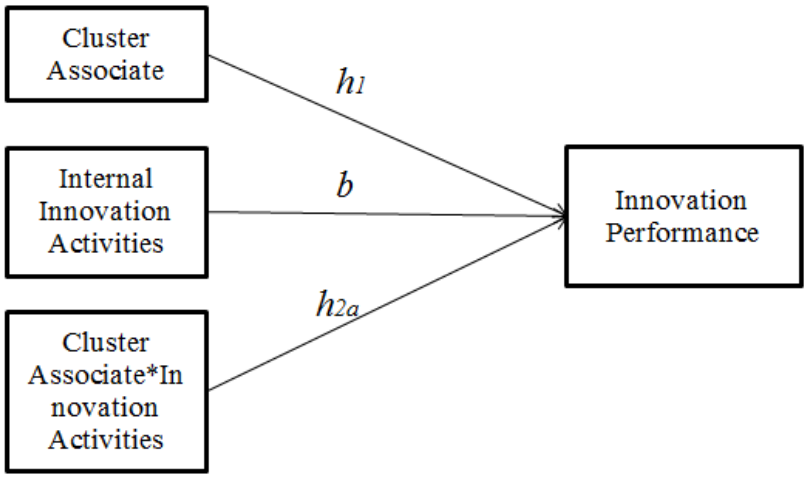

Figure 2a. Moderation effect or co-generator of knowledge

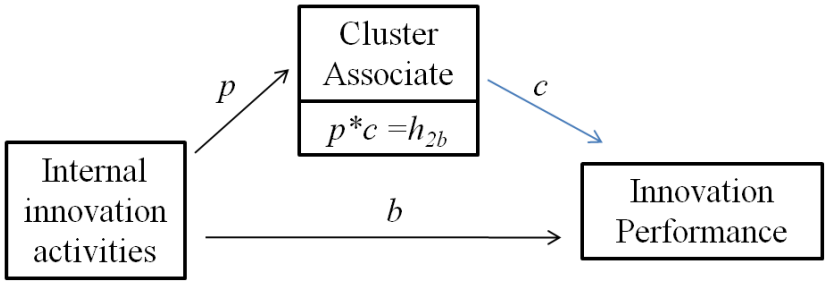

Figure 2b. Mediation effect or broker of knowledge

In empirical terms the fact of being a hub or a broker should be tested as a mediation effect. Baron and Kenny (1986, p. 1176) define that "a given variable may be said a mediator to the extent that it accounts for the relation between the predictor and the criterion". As summarised in Figure 2b, therefore, we could argue that firms exerting efforts in innovation activities are more likely to join the cluster initiative, and that it is this combination of behaviour that produces a higher innovation performance. As such the cluster initiative serves as a hub for firms with certain characteristics. This is in line with findings by Aragón et al. (2009), for example, of a positive correlation between cluster association membership and the conduct of innovation activities such as internal R&D.

Hypothesis 2b: Those firms exerting internal innovation activities have an indirect and positive influence on firm innovation performance through being cluster associates (h2b>0).

Further sections will present and discuss the estimations of h1, h2a and h2b for the case of the Basque Country.

4. Case context, data and variables

Case Context

The Basque Country government was pioneering, together with Catalonia (Spain) and Scotland (UK) (Brown, 2000; Ketels, 2004), in the establishment of a cluster policy in line with Porter's emerging (1990, 1998) approach. From the beginning of the 1990s the Department of Industry, Trade and Tourism, and the Department of Transport and Logistics established 12 Cluster Associations (CAs). These are institutions for collaboration whose main objective is to improve competitiveness by facilitating and fostering cooperation among the range of agents that join them. Members include firms, R&D centres, universities, government and so on. In the framework of the policy activities are focused on co-operation to improve competitiveness in three key areas: quality management; internationalisation; and technology development. However the policy is conceived as an umbrella policy, providing partial support (50-60%) for the structure and operation of each CA, but not funding specific activities.

The twelve current CAs are in the areas of home appliances machine-tools, automotive components, environment, energy, telecommunications, the prot of Bilbao, maritime, aeronautics, paper, audiovisual and transport and logistics. While some of the CAs were formed from scratch, others emerged from existing industry

associations. In the latter case, for example machine tools, telecommunications, home appliances, maritime and the Port of Bilbao, the process of establishing a CA was shorter. Firms were already accustomed to some extent to work in a group or association, and the existing associations undertook a transition process to become cluster associations within the framework and philosophy of the cluster policy.

Data Collection

The paper incorporates data obtained from two main information sources: the SABI-Informa database (financial statements of Spanish firms appearing in the merchant register), and the DIRAE (Economic activity directory from the Basque Statistical Institute). To reach our research objective we needed to identify a group of cluster associates and a comparison sample. The information also required two points in time so as to ascertain productivity growth as the dependent variable. The years chosen were 2006, the most recent year for which complete data were available, and 2002, to enable a reasonable, stable period over which to measure productivity growth.

The information about cluster associates is public, thus no special authorization was needed. We merged the list of members of the CAs from their websites, identifying 1145 firms (see Table 1). The audiovisual and transport and logistics CAs had to be dropped because they were established in 2004 and 2005, respectively. In addition, there was lost information when merging cluster associations members name and address with their fiscal identification number. We first dropped 475 firms that were not related to industry NACE codes. We then also dropped all the firms which changed geographical location or industrial sector during the period analysed. Due to these issues our sample of CA firms was reduced to 520. Information relating to innovation behaviour and finance were extracted from the SABI database. Unfortunately not all registers were available for the periods analysed in that database; in particular, only 276 firms were found in SABI. 144 of them have less than 20 employees and were removed from the analysis. So we keep 132 firms, 12% of the population originally identified from the CA websites. The final sample can be categorised in 10 functional sectors. The most representative sector is industrial equipment and electronics, with 42% of the observations. It is followed by metallurgy with 29%, transport with 11%, and wood and paper with 8%. The rest of the sectors (food, drinks and tobacco; textiles; petrochemicals; plastics and minerals; recycling; and energy and water) have marginal presence.

In order to test the performance of cluster associates a comparison sample was constructed. We searched in SABI for all industrial firms operating in the Basque Country. We were able to identify 1647 SMEs. The sector distribution is similar that of the sample of cluster associates, with almost 80% of the firms in the metallurgy, industrial equipment and electronics, and wood and paper sectors.

Cluster Association	Created	Members	Coordinated by	HQ Province
Home Appliances	1992	11	Dept. of Industry	Gipuzkoa
Machine-tools	1992	94	Dept. of Industry	Gipuzkoa
Automotive	1993	90	Dept. of Industry	Bizkaia
Environment	1995	93	Dept. of Industry	Bizkaia
Energy	1996	78	Dept. of Industry	Bizkaia
Telecommunications	1996	238	Dept. of Industry	Gipuzkoa
Port of Bilbao	1997	151	Dept. of Industry	Bizkaia
Maritime	1997	192	Dept. of Industry	Bizkaia
Aeronautics	1997	36	Dept. of Industry	Bizkaia
Paper	1998	20	Dept. of Industry	Gipuzkoa
Audiovisual	2004	54	Dept. of Industry	Bizkaia
Transports&Logistics	2005	88	Dept. of Transport	Gipuzkoa
Total		1145		

Table 1. Relevant data of Cluster Associations of the Basque Country

Construction of variables

Our dependent variable is innovation performance. Assuming constant input elasticities over time it can be argued that the difference in productivity growth among two firms operating in the same sector and with the same initial productivity can be interpreted as demonstrating of innovation performance. Consequently innovation is approximated by ***labour productivity growth*** (Martin et al., 2011a; 2011b; Aranguren et al., 2012). Notice that this methodology requires controlling in the regression for productivity at the initial year and sector.

Labour productivity (LP) equals value-added over employees, where value-added is composed of total sales plus other exploitation income minus the use of raw materials and other exploitation costs. All of these items come from SABI. We deflated value-added data by the specific price index from the National Statistics Institute, which is valid for all industrial sectors and the electric, gas and water sectors. From the arguments above and the data available we define innovation performance as follows:

$$Y_i = LP_i^{2006} - LP_i^{2002} \qquad (1)$$

An increase in labour productivity could be generated because of a reduction in labour (capital substitution). In our sample the level of employment is almost the same in both periods considered. The average employment per firm in 2002 was 42.68, and in 2006 was 42.50. This strengthens the argument that an increase in productivity may be related to some kind of innovation.

Table 2 shows some descriptive statistics for this variable. On average, companies in the sample have initial labour productivity (in 2002) of €48000, which increases by around €6000 in the 4 year-period observed, equivalent to €1500 a year. It is worth noting that the heterogeneity in both variables is quite large as the standard deviation is larger than the mean.

Dependent Variables	**Mean**	**Standard Deviation**
LP Growth (thousand €)	6.289	36.639
Cluster	0.0742	0.262
Independent Variables	**Mean**	**Standard Deviation**
Technology Management	0.391	0.488
Environmental Management	0.053	0.225
R&D Activities	0.121	0.326
Control Variables	**Mean**	**Standard Deviation**
Employees	46.153	159.084
LP^{2002} (thousand €)	47.917	165.554

Table 2. Descriptive Statistics

Our key independent variable – a dependent variable in the instrumental equation of the mediation model – reflects exposure to network policies. Following Aranguren et al. (2012) methodology we approximate exposure to network policies as membership of a cluster association. Thus ***cluster*** is a dummy variable that takes the value 1 when the firm *i* is a member of a cluster association and 0 otherwise. 132 firms out of 1779 are cluster associates (7.42%). According to the Basque Institute of Statistics (EUSTAT) there were a total of 39,564 manufacturing firms in the Basque region in 2006. As mentioned in section 4, in 2006 there were a total of 1,145 manufacturing cluster associates. So our sample roughly doubles the proportion of cluster associates of the entire population (2.89%).

SABI database only reports qualitative information on whether firms perform internal R&D activities. Fortunately it was possible to complement this information crossing SABI database with Basque directory of firms (DIRAE) which belongs to EUSTAT. DIRAE collects information on quality certifications of Basque firms. The combination of all this information allows constructing our independent variables that relate to internal innovation efforts of the SMEs.

We will consider that firms are making an effort in technology management when they achieve management quality certifications (Heras et al., 2008). In particular ***technology management*** is a dummy variable that takes value 1 when the firm has an ISO9K. Almost 40% of the firms observed have achieved this quality certification. Similarly, for effort in environmental management we will consider that firms are making an effort in this direction when they achieve environmental quality certifications. In particular ***environmental management*** is a dummy variable that takes value 1 when the firm has an ISO14K. Only 5% of the firms observed have achieved this quality certification. Finally, with regards effort in R&D, due to lack of data on the level of R&D investment made by the firm, we control for firm behaviour. In particular, ***R&D activities*** is a dummy variable that takes value 1 when the firm engages in internal R&D. Around 12% of the firms carry out R&D activities.

We also include control variables for potential ***functional closeness*** through 10 subsectors (see Table 3), ***initial labour productivity***, and in the instrumental regression for the mediation model we use the ***number of employees*** (in 2002) to control for firm size. On average SMEs in our sample have 46 employees. The dispersion of this variable is quite large as the standard deviation is larger than the mean.

Variable Name	Sub Sector	NACE 2-digit Codes
SECTOR1	Food, drink and tobacco	15, 16
SECTOR2	Textiles	17, 18, 19
SECTOR3	Wood and paper	20, 21, 22, 36
SECTOR4	Petro-chemicals	23, 24
SECTOR5	Plastics and minerals	25, 26
SECTOR6	Metals	27, 28
SECTOR7	Industrial equipment, information and electronics	29, 30, 31, 32, 33
SECTOR8	Transport	34, 35
SECTOR9	Recycling	37
SECTOR10	Energy and Water	40, 41

Table 3. Classification of Firms by 10 Functional Sectors

5. Empirical results

Direct effect: Generator of knowledge

Columns 1 and 2 of Table 5 respectively report results pertaining to the direct effect of network policies on innovation performance (Hypothesis 1) and their moderation role in increasing the impact of internal innovation activities on innovation performance (Hypothesis 2a). In both models being a cluster associate has a positive and insignificant effect on firms' absolute labour productivity growth. So we can not reject that the parameter equals 0 (h1=0). These results do not

support the evidence of Li and Geng (2011), and are consistent with those found by Martin, Mayer and Mayneris. (2011a, 2011b) implying that cluster associations are not *per se* a generator of knowledge.

Regarding the effects of internal innovation activities on innovation performance, the results are heterogeneous depending on the activity/effort considered. In both models technology management and environmental management have positive parameters, with only the later being significant. These parameters are consistent with previous studies (Heras et al., 2008). On the contrary, R&D activities are found to have a negative effect on labour productivity growth, a result that is also found by Díaz-Díaz, Aguiar-Diaz and Saá-Pérez (2008).

Complementary effects: Co-generator and broker of knowledge

In terms of the moderation hypothesis, at the bottom of Column 2 are the interactive terms (parameters h2a in figure 2a). These capture the argument that CA member ship may interact with independently-conducted innovation activities in determining innovation performance. None of these variables are significant at the usual levels, so we also cannot accept Hypothesis 2a. So, according to our results there is not empirical support to the hypothesis that cluster associations are a co-generator of knowledge.

In order to test whether cluster membership mediates the relationship of operations management, R&D investments and productivity, we use a similar methodology to that of Surroca et al. (2010, p. 489). In this case, the reduced form that leads to consistent and asymptotically normal estimations of cluster membership emerges from a conventional maximum likelihood probit specification, where the probability of cluster membership is not directly observed and it represents a good linear approximation of this variable.

Following Baron and Kenny (1986, p. 1177) to test the mediation hypothesis is necessary to first estimate whether the internal innovation activities (technology management, environmental management and R&D activities) increase the likelihood of becoming a cluster associate (p in Figure 2b). Table 4 reports the Probit estimates and the marginal effects. The three parameters are positive and significant at 1% which is consistent with the descriptive findings of Aragón et al. (2009). In particular, according to the marginal effects, firms exerting technology management efforts have 4.5% more likelihood of becoming cluster associates, firms exerting environmental management efforts have 9.7% more likelihood of

becoming cluster associates, and firms investing in R&D have 9.3% more likelihood of becoming cluster associates.

	Coefficient p	Marginal effect dy/dx
Technology Management	0.359***	0.045***
	(0.101)	(0.013)
Environmental Management	0.572***	0.097***
	(0.162)	(0.037)
R&D Activities	0.578***	0.093***
	(0.120)	(0.025)
Employees	8.4*10-4***	9.8*10-5***
	(2.8*10-4)	(3*10-5)
Intercept	-1.851	
	(0.073)	
Observation	1779	1779
Pseudo-R2	0.127	

Table 4. Determinants of belonging to a cluster association

Column 3 of Table 5 tests the mediation role of cluster associations. Notice that taking as a reference Column 1, and as mentioned above, we substitute only the dummy Cluster by the linear predicted value of the Probit shown in Table 4 (Instrumented Cluster). Another variation is that we correct for the variance-covariance matrix by applying the correct mean squared error (Baltagi, 2002, p. 278). Also notice that the model with the instrumented variable (Column 3) has more explicative capacity than the direct model (Column 1), since with the same amount of explanatory variables the R2 raises from 0.088 to 0.095.

While the coefficient of instrumented cluster is positive and significant at 5% (c=26.41) all the parameters regarding internal innovation activities are smaller than those shown in Column 1. These findings seem to indicate the existence of a mediation role of cluster associations. The strength of the mediation effect depends on the innovation activity analysed. For Environmental and Technology management practices we will refer to total mediation as long as we cannot reject that the coefficients of those variables are distinct to zero in Column 3 of Table 5, whereas for R&D activities we will confirm partial mediation. Although the coefficient of R&D activities is different from zero (Column 3 of Table 5), the coefficient is smaller than that reported in Column 1 of Table 5 (R&D activities among SMEs out of the cluster have a greater negative effect on productivity, compared to the effect of R&D on productivity among cluster members).

In order to quantify this effect we may conduct the Sobel (1982) test. This test gives a parameter for the full indirect effect ($p*c = h_{2b}$) and a t-student value. In particular, the parameter of technology management activities, h2b, equals 9.48

(=26.41*0.359) and has an associated t-student of 2.024, which implies that the parameter is statistically significant at the 5% level. The parameter of environmental management activities, h2b, equals 15.11 (=26.41*0.572) and has an associated t-student of 2.019, which implies a that the parameter is statistically significant at the 5% level. Finally, the parameter of R&D activities, h2b, equals 15.26 (=26.41*0.578) and has an associated t-student of 2.192, which implies a that the parameter is statistically significant at the 5% level. So the Hypothesis 2b is accepted. Therefore our results support the role of cluster associations as a broker of knowledge. It implies that Basque SMEs with internal knowledge become associates with the intention to interchange knowledge they have for knowledge they lack, and they get monetary value in this exchange.

	Column 1	**Column 2**	**Column 3**
	Direct effect	**Moderation Effect**	**Mediation Effect**
Cluster	4.935 (3.384)	2.760 (5.704)	
Instrumented Cluster			26.410** (10.725)
Technology Management	1.617 (1.837)	1.961 (1.907)	-7.882 (4.939)
Environmental Management	9.282** (4.088)	8.396* (4.797)	-8.960 (10.176)
R&D Activities	-5.260* (2.845)	-7.043** (3.161)	-21.644*** (8.259)
Technology Management*Cluster		-2.697 (7.083)	
Environmental Management*Cluster		2.913 (8.992)	
R&D Activities*Cluster		9.916 (7.265)	
LP2002	-0.064*** (0.005)	-0.064*** (0.005)	-0.066*** (0.005)
Intercept	7.419 (6.401)	7.475 (6.404)	55.948** (22.311)
Sector variables	Yes	Yes	Yes
Observation	1779	1779	1779
R^2	0.088	0.096	0.095

Table 5. Determinants of firm's absolute labor productivity growth (2002-2006)

6. Conclusions and implications

This paper empirically evaluates the value of general policies for cooperation and networking, such as cluster initiatives, that are often targeted at SMEs. It explores the case of a policy implemented in the Basque Country through a large dataset

compiled from secondary sources for the years 2002 and 2006. According to previous research, inter-firm cooperation should enhance the likelihood of achieving innovations (De Propris, 2000; Freel & Harrison, 2006). We therefore first analyse the direct effect that being part of the cluster initiative might have on labour productivity growth between 2002 and 2006. Similarly to Martin et al. (2011a, 2011b) and broadly consistent with Aranguren et al. (2012) only finding weak evidence of a positive impact for the same cluster policy over a longer time-period (2002-2008), we don not find a significant relationship. A second step of our research has been to consider a combination of the behaviour of firms in terms of their own innovation efforts with their participation in the cluster initiative. When assuming independence between the mentioned behaviours (moderation effect) we do not find evidence suggesting the existence of synergies. However when considering that both behaviours are correlated (Aragón et al., 2009), we find that being part of the cluster initiative plays a mediation role. More precisely, those firms exerting internal innovation activities have an indirect and positive influence on firm innovation performance through being cluster associates. To sum up we can conclude that in this case the cluster associations appear economically relevant because of their role of broker of knowledge – as defined by (Meyer, 2010; Ward et al., 2009) – and not because of a role as a of generator (or co-generator) of knowledge. This could be interpreted in terms of the success of the cluster initiative as a mechanism for generating or demonstrating a certain degree of trust among firms that already engage in innovation activities, supporting in turn benefits from the exchange of their knowledge.

It is worth mentioning that according to our results exerting effort in R&D activities has a direct negative effect on labour productivity growth. This somewhat surprising result is in fact in line with previous literature, where evidence is inconclusive on the effects of R&D on firm profits and growth (Díaz-Díaz et al., 2008). Moreover, in combination with the positive mediation effect of cluster membership, this result can be interpreted as suggesting that non-cooperative firms exerting R&D activities will be non-successful innovators with a high probability.

We acknowledge an empirical limitation in the construction of the sample. The impossibility of identifying the year in which cluster associates formally register to the cluster association could entail a degree of endogeneity in the direct and moderation models. However, our qualitative knowledge of the issue leaves us optimistic that most of the firms analysed joined the CAs prior to 2002. Moreover, we share limitations with other studies exploiting secondary databases. Generally

speaking, those studies have the advantage of dealing with large datasets but they face difficulties in finding precise proxies for the theoretical constructs defined. In our case it is reflected in almost all the variables considered. Our approximation to innovation (i.e. labour productivity growth) and networking policies (i.e. belonging to a CA) are reasonable but limited. For instance CA membership is based on previous literature (Aranguren et al., 2012) but only accounts for formal and local inter-firm networks, ignoring both informal and international cooperation (Visser, 2009); effects of the policy may therefore spill over in encouraging informal networking among firms outside the CAs. More generally we must also acknowledge the various other impacts that soft policies may have that are not captured in simple measures of labour productivity. We did important efforts to identify variables reflecting internal innovation effort. For instance, we crossed SABI database with DIRAE to have extensive information on quality certifications. However, we are aware that this information is limited and caution should be taken when generalizing the results.

All those empirical limitations suggest that evaluations of soft policies such as that reported in this paper should be combined with complementary quantitative (i.e. structural equation modelling or panel data) and qualitative (i.e. survey) analysis. More research in these areas will further enrich the evaluation of such cluster initiatives in meeting their objectives of enhancing competitiveness through facilitating cooperation.

More generally the results of the paper give rise to various implications for policy-makers, but two are particularly relevant in the context of the literature in which we have framed this analysis. Firstly, policies promoting cluster associations can benefit from the mediating or brokering role of those institutions, facilitating positive indirect impacts of the innovation-specific activities of firms. Thus we can establish insights for policy learning as we understand further the channels through which such impacts are arrived at. Secondly, and more practically, the results suggest potential benefits for designing and implementing appropriate incentives to attract firms to cluster initiatives that are willing to invest in innovation and knowledge related areas. In so doing the policy can serve as a key hub for other policies and impacts.

Besides policy implications there is also a clear message for SMEs that are investing in different innovation and knowledge related areas such as quality management, environmental management and R&D. Firms investing in these areas should consider the benefits of also joining appropriate networks that create a

'trusted' environment for fostering cooperation and exchange of knowledge in their core business areas, so as to benefit from the potential synergies between these networks and their investments.

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References

ACS, Z.J.; AUDRETSCH, D.B. (Eds.). (1993). *Small firms and entrepreneurship: An east-west perspective*, Cambridge: Cambridge University Press.

AHEDO, M. (2004). Cluster policy in the Basque Country (1991-2002): Constructing "industry-government" collaboration through cluster-associations. *European Planning Studies*, 12(8): 1097-1113.

ARAGÓN, C.; ARANGUREN, M.J.; ITURRIOZ, C.; LARREA, M.; OLARTE, F.J. (2009). *A new step in cluster policy evaluation in the Basque Country*. Working Papers no. 2009-01, Basque Institute of Competitiveness – Orkestra, Donostia.

ARANGUREN, M.J.; NAVARRO, I. (2003). La política de clusters en la Comunidad Autónoma del País Vasco: una primera valoración. *Ekonomiaz*, 53: 90-113.

ARANGUREN, M.J.; ARAGÓN, C.; LARREA, M.; ITURRIOZ, C. (2008). Does cluster policy really enhance networking and increase firm competitiveness?. In M.J. Aranguren, C. ITURRIOZ & J.W. WILSON (Eds.), *Networks, Governance and Development: Bridging Disciplinary Frontiers*, Chetlteham, UK: Edward Elgar.

ARANGUREN, M.J.; LARREA, M.; WILSON, J.W. (2010). Learning from the Local: Governance of Networks for Innovation in the Basque Country. *European Planning Studies*, 18(1): 47-65. http://dx.doi.org/10.1080/09654310903343526

ARANGUREN, M.J.; DE LA MAZA, X.; PARRILLI, D.; VENDRELL-HERRERO, F.; WILSON, J. (in press). Nested Methodological Approaches for cluster policy evaluation: An application to the Basque country. *Regional Studies*.

ASHEIM, B.T.; ISAKSEN, A.; NAUWELAERS, C.; TÖDLING, F. (2003). *Regional innovation policy for small-medium enterprises*. UK: Edward Elgar.

ASHEIM, B.; COOKE, P.; MARTIN, R. (2006). *Clusters and Regional Development: Critical Reflections and Explorations*. London: Routledge.

AUDRETSCH, D.B.; THURIK, R. (2001). What is new about the new about the economy: Sources of growth in the managed and entrepreneurial economies. *Industrial and Corporate Change*, 10: 267-315. http://dx.doi.org/10.1093/icc/10.1.267

BALTAGI, B.H. (2002). *Econometrics*. New York: Springer.

BARON, R.M.; KENNY, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6): 1173-1182. http://dx.doi.org/10.1037/0022-3514.51.6.1173

BECCATINI, G.; BELLANDI, M.; DEI OTTATI, G.; SFORZI, F. (2003). *From Industrial Districts to Local Development: An Itinerary of Research*. Cheltenham, UK: Edward Elgar.

BELLANDI, M.; CALOFFI, M. (2010). An Analysis of Regional Policies Promoting Networks for Innovation. *European Planning Studies*, 18(1): 67–82. http://dx.doi.org/10.1080/09654310903343534

BENNETT, R.J.; RAMSDEN, M. (2007). The contribution of Business Associations to SMEs: Strategy, Bundling or Reassurance?. *International Small Business Journal*, 25(1): 29-46. http://dx.doi.org/10.1177/0266242607071781

BOEKHOLT, P.; THURIAUX, B. (1999). Public policies to facilitate clusters: Background, rationale and policy practices in international perspective. In *Boosting innovation: the cluster approach*. Paris and Washington: OECD Proceedings.

BROWN, R. (2000). *Cluster Dynamics in Theory and Practice with Application to Scotland*. Regional and Industrial Policy Research Paper, no 38. European Policies Research Centre, University of Strathclyde, Glasgow, UK.

COHEN, W.M.; LEVINTHAL, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35:128-152. http://dx.doi.org/10.2307/2393553

COOKE, P.; URANGA, M.G.; ETXEBARRIA, G. (1998). Regional systems of innovation: an evolutionary perspective. *Environment and Planning A*. 30: 1563-1584. http://dx.doi.org/10.1068/a301563

COOKE, P.; HEIDENREICH, M.; BRACZYK, H.J. (2004). *Regional Innovation Systems: The Role of Governance in a Globalised World*, New York: Routledge.

De PROPRIS, L. (2000). Innovation and inter-firm co-operation: The case of the West Midlands. *Economics of Innovation and New Technology,* 9: 421-446. http://dx.doi.org/10.1080/10438590000000017

DÍAZ-DÍAZ, N.L.; AGUIAR-DIAZ, I.; SAÁ-PÉREZ, P. (2008). The effect of technological knowledge assets on performance: The innovative choice in Spanish firms. *Research Policy,* 37: 1515-1529. http://dx.doi.org/10.1016/j.respol.2008.06.002

DÍEZ, M.A. (2001). The evaluation of regional innovation and cluster policies: towards a participatory approach. *European Planning Studies*, 9(7): 907-923. http://dx.doi.org/10.1080/09654310120079832

DÍEZ, M.A. (2002). Evaluating new regional policies. Reviewing the theory and practice. *Evaluation,* 8: 285-305. http://dx.doi.org/10.1177/135638902401462439

DUPUY, C.; TORRE, A. (2006). Local clusters, trust, confidence and proximity. In C. Pitelis, R. Sugden & J.W. Wilson (Eds.) *Clusters and Globalisation: The Development of Urban and Regional Economies.* Cheltenham, UK: Edward Elgar.

FREEL, M.S.; HARRISON, R.T. (2006). Innovation and cooperation in the small firm sector: Evidence from "Northern Britain". *Regional Studies*, 40(4): 289-305. http://dx.doi.org/10.1080/00343400600725095

FREEMAN, C. (1991). Networks of innovators: A synthesis of research issues. *Research Policy*, 20: 499-514. http://dx.doi.org/10.1016/0048-7333(91)90072-X

FROMHOLD-EISEBITH, M.; EISEBITH, G. (2005). How to instituzionalize innovative clusters? Comparing explicit top down and implicit bottom-up approaches. *Research Policy,* 34: 1250-1268. http://dx.doi.org/10.1016/j.respol.2005.02.008

FROMHOLD-EISEBITH, M.; & EISEBITH, G. (2008). Looking Behind Facades: Evaluating Effects of (Automotive) Cluster Promotion. *Regional Studies*. 42: 1343-1356. http://dx.doi.org/10.1080/00343400701654202

HAVNES, E.; HAUGE, P.A. (2004). *Observatory of European SMEs. SMEs and cooperation*. Luxembourg: Office for Official Publications of the European Communities.

HERAS, I.; ARANA, G.; CAMISÓN, C.; CASADESÚS, M.; MARTIARENA, A. (2008). *Gestión de la calidad y competitividad de las empresas en la CAPV*. Donostia-San Sebastián, Spain: Basque Institute of Competitiveness.

KETELS, C. (2004). *European Clusters, in Structural Change in Europe 3 – Innovative City and Business Regions*. Boston: Harvard Business School Press.

LI, J.; GENG, S. (2011). Industrial clusters, shared resources and firm performance. *Entrepreneurship and Regional Development*. http://dx.doi.org/10.1080/08985626.2011.591841

LECHNER, C.; DOWLING, M. (2003). Firm networks: External relationships as sources for the growth and competitiveness of entrepreneurial firms. *Entrepreneurship and Regional Development,* 15(1): 1-26. http://dx.doi.org/10.1080/08985620210159220

LOVEMAN, G.; SENGENBERGEN, W. (1991). The re-emergence of small-scale production: An international perspective. *Small Business Economics*, 3(1): 1-38. http://dx.doi.org/10.1007/BF00389842

LUNDVALL, B.A. (1992). *National systems of innovation: towards a theory and interactive learning*. London: Pinter.

MAILLET, D. (1995). Territorial dynamic, innovative milieus and regional policy. *Entrepreneurship and Regional Development,* 7(2): 157-165. http://dx.doi.org/10.1080/08985629500000010

MARSHALL, A. (1898). *Principles of Economics*, London: Macmillan.

MARTIN, F.; MAYER, T.; MAYNERIS, F. (2011a). Spatial Concentration and Firm-Level Productivity in France. *Journal of Urban Economics,* 69(2): 182-195. http://dx.doi.org/10.1016/j.jue.2010.09.002

MARTIN, F.; MAYER, T.; MAYNERIS, F. (2011b). Public Support to Clusters: A Firm Level Study of French "Local Productive Systems". *Regional Science and Urban Economics*, 41: 108-123. http://dx.doi.org/10.1016/j.regsciurbeco.2010.09.001

MEYER, M. (2010). The rise of the knowledge broker. *Service Communication.* 32(1): 118-127.

MORGAN, K. (1997). The learning region: Institutions, innovation and regional renewal, *Regional Studies*, 31(5): 491-503. http://dx.doi.org/10.1080/00343409750132289

Nauwelaers, C.; Wintjes, R. (2008). Innovation policy in Europe – Measurement and Strategy. Cheltenham, Edward Elgar.

OXFORD RESEARCH (2008). *Cluster Policy in Europe: A Brief Summary of Cluster Policies in 31 European Countries*. Report for the Europe Innova Cluster Mapping Project, available online in: www.clusterobservatory.eu.

PIORE, M.J.; SABEL, C.F. (1984). *The second industrial divide: possibilities for prosperity*. New York: Basic Books.

PITELIS, C.; SUGDEN, R.; WILSON, J.R. (2006). *Clusters and Globalisation: The Development of Urban and Regional Economies*. Cheltenham: Edward Elgar.

PORTER, M.E. (1990). *The competitive advantage of nations*. London: The Macmillan Press.

PORTER, M.E. (1998). Clusters and competition: New agendas for companies, government, and institutions. In M.E. Porter (Ed.), *On Competition.* Boston: Harvard Business School Press.

POWELL, W.W.; DOPUT, K.W.; SMITH-DOERR, L. (1996). Interorganisational collaboration and the locus of innovation: networks of learning in biotechnology. *Administrative Science Quarterly*, 41: 116-145. http://dx.doi.org/10.2307/2393988

PYKE, F.; BECCATTINI, G.; SENGENBERGER, W. (1990). *Industrial districts and inter-firm co-operation in Italy*. Geneva: International Institute for Labour Studies.

SAXENIAN, A.L. (1994). *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Cambridge, MA: Harvard University Press.

SCHMITZ, H. (1995). Collective efficiency: Growth path for small scale industry. *Journal of Development Studies*, 31(4): 529-586. http://dx.doi.org/10.1080/00220389508422377

SMITH, K. (1994). *Interactions in knowledge systems: Foundations, policy implications and empirical methods*. Oslo: STEP Group Report.

SOBEL, M.E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.). *Sociological Methodology,* 290-312. Washington DC: American Sociological Association.

SÖLVELL, Ö.; LINDQUIST, G.; KETELS, C. (2003). *The cluster initiative greenbook*. Stockholm: Bromma tryck AB.

SURROCA, J.; TRIBO, J.; WADDOCK, S. (2010). Corporate responsibility and financial performance: The role of intangible resources. *Strategic Management Journal,* 31: 461-490.

VISSER, E.J. (2009). The complementary Dynamic Effects of Clusters and Networks. *Industry and Innovation,* 16(2): 167-195. http://dx.doi.org/10.1080/13662710902764287

Von HIPPEL, E. (1988). *The sources of innovation*. New York: Oxford University Press.

WARD, V.; HOUSE, A.; HAMER, S. (2009). Knowledge Brokering: The missing link in the evidence to action chain?. *Evidence & Policy,* 5(3): 267-279. http://dx.doi.org/10.1332/174426409X463811