10. EMBEDDEDNESS IN CLUSTER KNOWLEDGE NETWORKS, THE MODERATING ROLE OF NETWORK COMPETENCE. THE CASE STUDY OF THE ROMANIAN WINE CLUSTER OF MUNTENIA-OLTENIA

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Abstract

This paper contributes to research on industrial clusters by analysing the relationship between embeddedness in cluster knowledge networks, network competence and innovation. The data analysed are drawn from 42 wineries from the wine cluster of Muntenia-Oltenia, one of the most appreciated wine regions in Romania. The results show that embeddedness is positively related to innovation in cluster firms, confirming previous studies in clusters. However, the most remarkable result is that network competence will moderate the nature of the relationship, highlighting the individual ability of firms to exploit the resources offered by the cluster. These results support the conclusion that firms must be aware that being properly embedded in clusters will allow them to obtain resources not available outside the cluster. Nevertheless, this is not only a question of ubiquity, but also of management skills. This represents a challenge, since the whole firm has to be managed towards a network-oriented culture change.

Keywords: industrial cluster, connectedness, network competence, innovation, Muntenia-Oltenia wine industry
JEL Classification: O10, O13, R11

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1. Introduction

The study of industrial clusters is a topic widely developed throught the scientific literature on management and economics (Porter, 1990; Pouder and St. John, 1996; Giuliani, 2007; Morrison and Rabellotti, 2009; Păuna *et al.,* 2014; Expósito-Langa *et al.,* 2015; García-Villaverde *et al.,* 2017, among others). Industrial clusters represent territorial agglomerations of firms and institutions connected by a set of common elements and complementary factors (Porter, 1998). Firms belonging to a cluster, as opposed to those acting in isolation, enjoy a number of externalities due to their location, including access to specialized suppliers, skilled labor or technological spillovers (Krugman, 1991), as well as the possibility of obtaining knowledge flows that circulate within the cluster because of the effect of industrial concentration (Capaldo, 2007).

It is worth mentioning that these externalities allow firms to obtain certain sustainable competitive advantages over time. However, the literature has criticized and questioned the uniform conception of the cluster, that is, the fact that all cluster firms have the same opportunities to exchange and share knowledge (Boari and Lipparini, 1999; Lazerson and Lorenzoni, 1999). For this reason, the current view of the cluster is rather as a set of heterogeneous firms (Boschma and Ter Wal, 2007). At the origin of this internal heterogeneity are the distinctive individual attributes of firms, which give them a different capacity to explore and exploit the externalities and available knowledge resources available.

Furthermore, clusters are now understood to be a network of inter-organizational relationships between customers, competitors, suppliers and support institutions. The use of the network concept is a suitable metaphor to represent the structure of relations between the actors that make up the cluster. Among these networks, both social and professional, the knowledge network is the most remarkable structure since it facilitates the exchange of knowledge flows, mainly tacit, thus favouring and promoting innovation processes in the cluster (Giuliani and Bell, 2005; Giuliani, 2007; Morrison and Rabellotti, 2009). In this way, access to and management of this network by firm represents an advance over the mere acquisition of information.

Considering the previously mentioned premises, the literature presents open questions that demonstrate the interest in new studies based on empirical evidence that deepen both the internal heterogeneity of the cluster and the individual capacities of the firms to manage the resources available in the cluster. Therefore, research that combines an analysis of the cluster's own attributes with those of the individual firms, as well as the effects of interaction, will make interesting contributions to science.

This paper complements other studies on the effect of being embedded in the cluster knowledge network of the cluster and innovation (Coombs *et al.*, 2009; Molina-Morales and Expósito-Langa, 2012). In addition, it proposes that ubiquity, *per se,* is not enough to generate competitive advantages, thus addressing the effect that other individual factors in the firm itself have on innovation, in this case, network competence (Ritter, 1999; Ritter and Gemünden, 2003).

The empirical study was carried out on the Muntenia-Oltenia wine cluster, located in one of the most appreciated wine regions in Romania. The results obtained reveal that, indeed, network competence is a factor that enhances the relationship between the position in the knowledge network and innovation in the cluster companies.

The paper is structured as follows. In the next section, the theoretical part of the research is then developed together with the proposed hypotheses. Next, the empirical setting and variables in this study and the results obtained are described. Finally, the conclusions and limitations of the work are presented.

2. Theoretical Framework and Hypotheses

In a network economy, networking is a potential source of competitive advantage. Clusters and networks have been used as synonyms in a range of research work (Giuliani and Bell, 2005; Boschma and Ter Wal, 2007; Molina-Morales and Expósito-Langa, 2012). This manner of examining the cluster allows us to understand the inter-organizational relationships that are established between the agents that make up the cluster, as well as the effects that being embedded in the cluster has for the firms. Relationships, based mainly on elements such as stability, shared values, trust, reciprocity, etc., encourage entrepreneurial learning through the exchange of knowledge flows (McEvily and Zaheer, 1999). Therefore, as a dense network of connections, it is appropriate to consider the cluster as a space where knowledge flows rapidly and fluidly. Thus, firms with a larger relational portfolio will be more dynamic in exploring and exploiting this knowledge by reducing search costs (Maskell, 2001).

Cluster embeddedness is considered to be the density of connections in the cluster knowledge network. Thus, the position of the firm within the knowledge network of the cluster can be expected to be synonymous with opportunities, or restrictions, due to the access and availability of knowledge sources and resources (Giuliani, 2007). Moreover, certain studies analyze how the innovative result of firms is influenced by the firm's relational portfolio (Coombs *et al.*, 2009; Expósito-Langa *et al.*, 2015).

In short, the cluster knowledge network represents sources of knowledge for the clustered firms. Consequently, for firms in the cluster, being embedded in this network, means having a greater number of knowledge flows available for their innovation. Thus, we can propose the following hypothesis:

H1. *The level of embeddedness of a firm in the cluster knowledge network has a positive association with clustered firm's innovation*.

Social interactions favour the exchange of knowledge resources with other firms in the same cluster. Nevertheless, despite highlighting the importance of being embedded in the knowledge network, ubiquity, *per se*, is not sufficient to generate competitive advantages. It is considered that the relations that a firm establishes have a long-term orientation, as well as being focused on the creation of value (Chiu, 2009; Ritter and Gemünden, 2003). However, the inherent complexity of these relationships suggests that it is necessary to manage them properly. In this regard, any performance indicator of the company is dependent on how it is able to manage its relationship portfolio (Ritter and Gemünden, 2003).

This argument highlights the effect of the dynamic capabilities of the firm (Teece *et al.*, 1997) as moderators of business performance. Among them, the ability to manage the network of relationships and to deal effectively with the interactions among these relationships is considered a core competence. In this way, the firm should develop the organizational skills and abilities necessary to take advantage of the resources obtained from the network (Sapienza *et al.*, 2006). Specifically, network competence (Ritter, 1999) is considered one of an essential ability when analyzing the output of firms.

Network competence is defined as the ability to develop and manage relationships with other network actors (Ritter *et al.*, 2002; Ritter and Gemünden, 2003; Torkkeli *et al.* 2016). At the same time, this competence presents a dyadic structure, on the one hand, at the level of general management of the relational network, and, on the other hand, at the level of the specific management of relationships. The first, referred to as cross-relational network competence (CRR) captures the ability to manage a host of dyadic relationships embedded within a larger network. This competence involves planning and controlling the relationship portfolio to the maximum advantage of the firm, as well as evaluating its impact on the organization (Ritter *et al*., 2002). The second, entitled relationship-specific network competence (RSS) captures the ability of the firm to developing and maintaining individual dyadic relationships between network actors. This competence involves the generation of new relationships, the exchange of information and knowledge between the parties to each link and the coordination of specific activities (Ritter *et al*., 2002).

In short, the development by the firm of network competence will have a moderating effect on the relationship between embeddedness in the network and the innovative performance of the cluster firms. We can express these arguments more formally as the following hypotheses:

H2. *Network competence strengthens the effect of the connectedness on the clustered firm's innovation performance*.

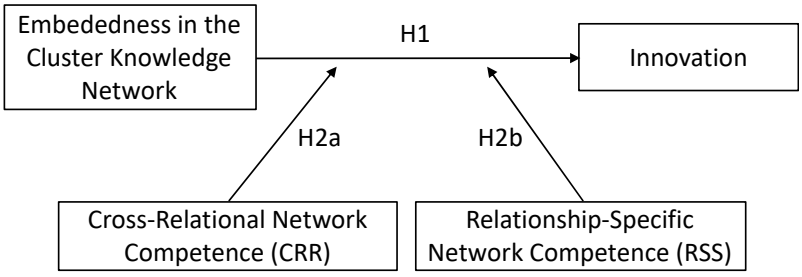
H2a. *Cross-Relational Network Competence strengthens the effect of the connectedness on the clustered firm's innovation performance*.

H2b. *Relationship-Specific Network Competence strengthens the effect of the connectedness on the clustered firm's innovation performance*.

Finally, Figure 1 represents the model with the proposed variables and hypotheses.

Figure 1

Proposed Model



Source: Own elaboration.

3. Research Methodology

Sample Collection and Data Sources

The empirical study is based on the population of wineries belonging to the Muntenia-Oltenia wine cluster in Romania. This area is located in the Southern part of Romania and possesses the largest group of wine producers in the country. According to the ONVPV (National Office

of Vine and Wine Products), the cluster in 2016 was made up of a total of 45 wineries. Consequently, this group of companies represented our initial population of study.

In order to explore empirically the proposed hypotheses a questionnaire was developed and a survey was conducted during 2016. As a preliminary step to the fieldwork, a pre-test of the questionnaire was carried out with two winemaking executives from the sector, which allowed us to incorporate some improvements. The final questionnarie was divided into two parts. The first included descriptive questions about the winery, innovation-related processes and network competence at the firm level. The second was developed to map the relational activity of the cluster using the Roster-Recall method (Wasserman and Faust, 1994). With this method, each firm has the complete list of firms belonging to the cluster and is asked to specify with which it has exchanged technical knowledge during the last three years. The data is organized into a square data matrix in which cell ij is coded '1' when the firm i reports knowledge transfer to the firm j. This data structure allows a reconstruction of the cluster knowledge network through directional links between the different firms.

The data collection process was carried out by the research authors through one-hour face-to-face interviews with winemaking executives and chief oenologists from each winery. During this data collection process, 42 cluster's wineries collaborated, thus representing a rate of over 93%.

Measurement Variables

Dependent Variable

Innovation. This variable tries to capture the research activity of a firm. Throughout the literature, it has been measured in different ways, for example by the firm's output, new products or patents, by input, investment in R&D, by market position or as having the status of pioneer or follower. Aware of the difficulty of measuring this indicator, the OECD-EUROSTAT Oslo Manual (2005) was followed, which encompasses the concept of innovation as the introduction of a new or significantly improved product or service, a process, a new marketing method, or a new organizational method in internal firm practices, workplace organization or external relations. Furthermore, the OECD recommends considering three-year periods in innovation studies, as innovation is a time-dependent process. Therefore, a tool of 8-items measured on a Likert scale of seven points that reflects these ideas expressed for the last three years of the firm was proposed. The list of scale items is shown in the Appendix.

The reliability of the construct was ckecked by a confirmatory analysis to identify the Innovation construct. A Cronbach's α value of 0.955 was obtained and the results of the factor analysis reported by the Barlett test of sphericity were significant (Chi-square = 403.672; df = 28; sig. = 0.000). Finally, the KMO measurement was greater than 0.6 (KMO = 0.864). Therefore, it was appropriate to proceed with a factor analysis (Coakes and Steed, 2001). Thus, the items included were considered to present an adequate construct of Innovation, and a one-factor solution was obtained with 79.044% of variance extracted from the overall variance.

Independent Variables

Embeddedness in the Cluster Knowledge Network. EmbeddedKN is measured as the connections to the knowledge network, considering them as the total number of links that a certain actor (winery) gives and receives in the network. To estimate the number of links of each actor in the network, wineries were asked to select from the list of the all wineries belonging to the cluster with which they had interacted to solve technical problems, provided relevant knowledge or participated jointly in R&D projects in the last 3 years. Finally, the

structural properties of the network in relational terms (Wasserman and Faust, 1994) were explored by using UCINET v.6 software application (Borgatti *et al.*, 2002). In this way, the total number of links for each cluster firm was calculated.

Network competence. Network competence has been operationalized through a 13-items scale based on the original work of Ritter *et al.* (2012), and used in other works such as Chiu (2009) or Torkkeli *et al.* (2012). The items were measured through a seven-item Likert scale, and differentiated into two contructs, the CRR and the RSS. The reliability of both constructs was ckecked by a confirmatory analysis. On the one hand, for the multi-item scale of the CRR construct, a Cronbach's α value of 0.900 was obtained and the results of the factor analysis reported by the Barlett test of sphericity were significant (Chi-square = 130.785; df = 6; sig. = 0.000). Finally, the KMO measurement was greater than 0.6 (KMO = 0.702). Thus, it was appropriate to proceed with a factor analysis (Coakes and Steed, 2001). Thus, the items included were considered to present an adequate construct of CRR, and a one-factor solution was obtained with 77.872% of variance extracted from the overall variance. Moreover, a confirmatory factor analysis was run to identify the multi-item scale of the RSS construct. A Cronbach's α value of 0.919 was obtained and the results of the factor analysis reported by the Barlett test of sphericity were significant (Chi-square = 159.246; df = 10; sig. = 0.000). The KMO measurement was greater than 0.6 (KMO = 0.777). Thus, it was appropriate to proceed with a factor analysis (Coakes and Steed, 2001) and the items included were considered to present an adequate construct of RSS. Finally, a one-factor solution was obtained with 75.846% of variance extracted from the overall variance. The list of scale items is shown in the Appendix.

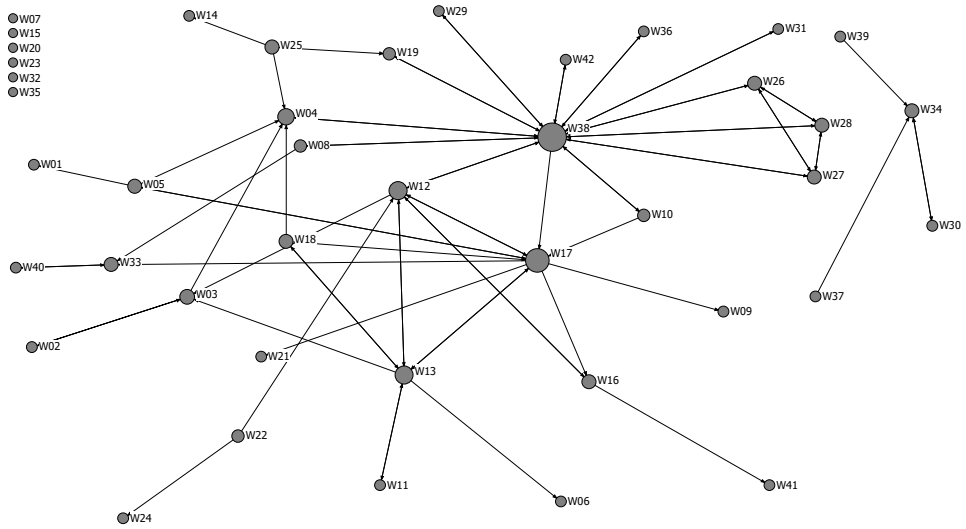
Control variables. To complete our model, several control variables were introduced. These non-hypothesized variables can be expected to be associated with the dependent variable. Their inclusion allowed the isolation of the independent variables' effect on the model. Size is usually used as a control variable. Different arguments support the Schumpeter's hypothesis that large firms are more innovative (Cohen *et al.*, 1987) due to them having superior access to resources. Nevertheless, other studies suggest that this is not true in all industries (Pavitt *et al.*, 1987). Size was made operational through total employees. Finally, age was also included, since some authors have suggested that in clusters, temporary evolution affects performance (Pouder and St. John, 1996). Firm age was measured as the number of years since it was established.

4. Empirical Results

Social network analysis has been applied in multiple studies on clusters (Boschma and Ter Wal, 2007; Giuliani, 2007; Morrison and Rabellotti, 2009 or Expósito-Langa *et al.*, 2015) to analyse relational structures. Figure 1 shows the Knowledge network obtained in the first stage of the analysis. In the network, one node represents one winery, and a line between two nodes indicates the presence of a relationship between them. The size of the nodes is associated with their degree of relational activity. Thus, the larger the size of the node is, the higher the degree of interaction. This value was computed and included in the following step of the study as variable EmbeddedKN.

Figure 2

Structure of the Knowledge Network



Source: Own elaboration.

Table 1 presents the basic descriptive statistics and the Pearson's correlations for all variables. It is important to point out that the variables on which the factorial analysis has been applied do not show a mean and standard deviation because they are standardized. Detailed analysis of the results in Table 1 confirms the non-existence of significant correlations between the independent and the moderating variables.

Table 1

Descriptive Statistics and Correlations of the Measurements

Variables	**Mean**	**S.D.**	**1**	**2**	**3**	**4**	**5**	**6**
(1) Innovation	-	-	1					
(2) EmbeddedKN	2.285	2.597	.580*	1				
(3) CRR	-	-	-.164	.150	1			
(4) RSS	-	-	.508*	.479*	.524*	1		
(5) Age	12.830	9.471	-.164	-.193	-.158	-.176	1	
(6) Employees	37.833	56.126	.404*	.391*	.206	.358*	.017	1

N=42; * p<.05

Source: Own elaboration.

To test the hypotheses, a stepwise hierarchical regression approach was carried out to assess the explanatory power of each set of variables. Previously, variables included in the interaction terms were z-centered before they were entered into the regression equations (Aiken and West, 1991). In any event, to ensure that multicollinearity was not a problem in the models, variance inflation factors (VIF) were calculated for all the variables included in the models. All VIF levels were below the critical threshold of 10, thus indicating that the results were not contaminated by multicollinearity (O'Brien 2007).

Therefore, the models for the moderating effect of the CRR variable are as follows:

Model 1: Innovation = α1 + β1EmbeddedKN + β2Age + β3Employees

Model 2: Innovation = α1 + β1EmbeddedKN + β2CRR + β3Age + β4Employees

Model 3: Innovation = α1 + β1EmbeddedKN + β2CRR + β3EmbeddedKNxCRR + β4Age + β5Employees

On the other hand, the models for the moderating effect of the RSS variable are as follows:

Model 4: Innovation = α1 + β1EmbeddedKN + β2Age + β3Employees

Model 5: Innovation = α1 + β1EmbeddedKN + β2RSS + β3Age + β4Employees

Model 6: Innovation = α1 + β1EmbeddedKN + β2RSS + β3EmbeddedKNxRSS + β4Age + β5Employees

Table 2 shows the results of models 1, 2 and 3. As can be seen, in all models, there is a significant and positive relationship between the EmbeddedKN and the innovative performance of the cluster's wineries, supporting hypothesis 1. In a similar vein, the moderating role played by the CRR in the relation between EmbeddedKN and innovation is supported in model 3, confirming hypothesis 2a, and enhancing the value of ajusted R^2 with respect to the model 1 and 2. Finally, Figure 3 exhibits a graphic representation of the moderating effect of the CRR variable. It is appreciable that embeddedness in the knowledge network exerts a higher effect when the firm has a high value of CRR as moderator variable.

Table 2

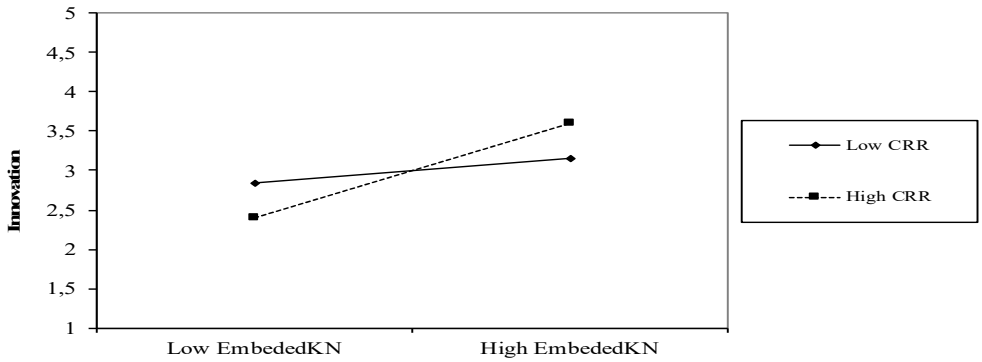
Regression Models for the Moderating Effect of the CRR Variable

Dependent variable: Innovation			
	M1	**M2**	**M3**
EmbeddedKN	.349* (1.952)	.352* (1.946)	.377* (1.790)
Cross-Relational Network Competence (CRR)		.068 (.532)	.017 (.137)
EmbeddedKN x CRR			.227* (1.293)
Control (Age)	-.104 (-.831)	-.095 (-.739)	-.025 (-.210)
Control (Employees)	.322* (1.807)	.308* (1.700)	.184 (1.106)
Model *F*	6.046**	6.727**	7.409**
Adjusted R^2	.371	.358	.439
Change in R^2		.004	.086*
N= 42; **p< .01; *p< .05 Standardized regression estimates (t-values)			

Source: Own elaboration.

Figure 3

Moderating Effect of CRR on the Relationship between EmbeddedKN and Innovation



Source: Own elaboration.

Table 3 shows the results of models 4, 5 and 6. Once again, the results obtained support hypothesis 1, confirming the positive effect of embeddness in knowledge networks on innovation. Furthermore, the RSS variable in model 6 has a moderating role between EmbeddedKN and innovation, supporting hypothesis 2b. This model enhances the value of ajusted R^2 with respect to the model 4 and 5. Figure 4 shows this moderating effect, where the embeddedness in the knowledge network has a greater influence when the firm has a high value of RSS variable.

Table 3

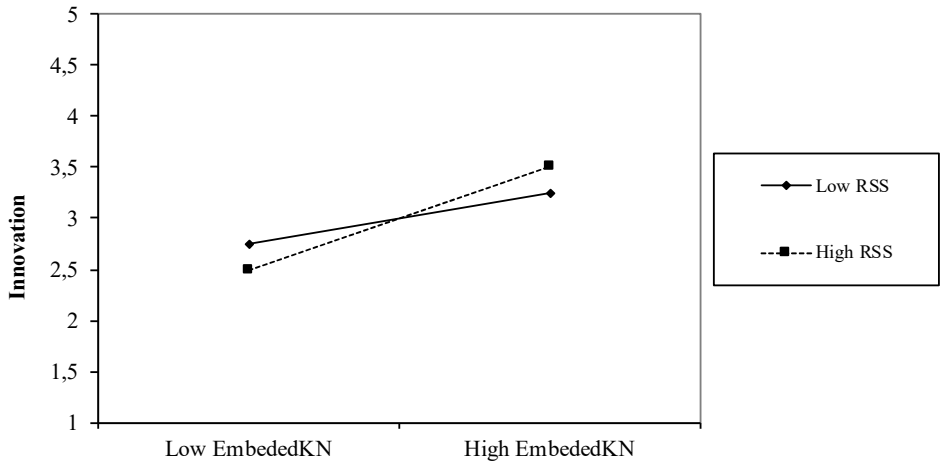
Regression Models for the Moderating Effect of the RSS Variable

Dependent variable: Innovation			
	M4	**M5**	**M6**
EmbeddedKN	.322* (1.784)	.287* (1.598)	.379* (1.530)
Relationship-Specific Network Competence (RSS)		.227 (1.501)	.120 (.795)
EmbeddedKN x RSS			.135* (.634)
Control (Age)	-.062 (-.484)	-.040 (-.315)	-.017 (-.139)
Control (Employees)	.346* (1.941)	.250* (1.335)	.167 (.974)
Model *F*	8.398**	7.063**	7.275**
Adjusted R^2	.351	.372	.434
Change in R^2		.035	.031*
N= 42; **p< .01; *p< .05 Standardized regression estimates (t-values)			

Source: Own elaboration.

Figure 4

Moderating Effect of RSS on the Relationship between EmbeddedKN and Innovation



Source: Own elaboration.

Finally, it should be noticed that the control variable Employees has a positive effect on regression models 1, 2, 4 and 5. This relationship is to be expected, since a larger number of employees means a larger amount of available resources for the firm. Although, with the introduction of the moderating effects, this variable loses prominence in favor of the use and management of the resources and capacities of the company, in this case the network competence.

5. Discussion

This research aims to deepen the analysis of the interconnections established between the firms in a cluster, as well as the implications of the development of the competences required for the management of the cluster firm's relationship network. The econometric models confirm the importance of not only being well-embedded in the network, which allows the firm to obtain advantages to access knowledge resources, but also the need to develop managerial abilities to develop successful network cooperation. These factors will enable firms to improve their innovative performance, according to other research (Ritter and Germünden, 2003; Presutti *et al.*, 2007). These results reinforce the idea that beyond the resources and capacities of each firm, the network structures developed and the cooperative activities carried out by the firms are key elements for competitiveness (Chiu, 2008).

The implications of this research are wide-ranging. Firms must be aware that being properly embedded in the network represented by the different agents of the territory will allow them to obtain certain privileges in the access and management of information and knowledge. However, this is not only a question of ubiquity, but also of management skills, both at the general portfolio level and at the individual level, *i.e.* for each link within the cluster. That is, the capacity to manage in networks is inseparable from the firm itself (Ritter and Gemünden,

2003). This represents a challenge, on the one hand for firms, since the whole firm has to be managed towards a network-oriented culture change, and on the other hand, at the institutional level, in the sense of the need to favour industrial policies for the creation of common spaces of collaboration that generate agreements and conventions between firms. In this way, aspects such as innovation in cluster firms and, in short, the competitiveness of the cluster itself will be enhanced.

Furthermore, the results are particularly interesting, as they are determined in a cluster belonging to an emerging economy. Accessing international markets undoubtedly involves offering innovative and quality products, as well as knowing how to manage global value chains. In short, corporate cultural leaps in the way firms do business.

Finally, this work is not without limitations that may affect the generalization of the conclusions. On the one hand, it has been carried out in a single low-medium knowledge-intensive cluster, so it would be interesting to compare the results with other higher knowledge intensive clusters. On the other hand, it is a cross-sectional study, thus considering evolutionary dynamics in the structure of the network would provide new evidence to research in the context of industrial clusters. In short, this is a first study that covers the objectives initially proposed, but which is open to new advances proposed in future lines.

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Appendix. Scale Items for Research Variables

Innovation:

- We develop new or improved goods and services that our competitors already offered;
- We develop new or improved goods and services before our competitors;
- We develop manufacturing methods for new or improved goods or services;
- We develop new or improved logistics systems, or delivery or distribution methods;
- We develop new practices in the organization of work or company procedures;
- We develop new methods of managing external relations with companies or institutions;
- We develop new techniques or channels for product promotion;
- We develop new methods to positioning the product in the market or sales channels.

Cross-relational network competence (CRR):

- We evaluate the way our relationship with each partner helps our relations with other partners;
- We evaluate the way the results of collaboration with each of our partners fit together;
- We compare our partners in terms of their technical knowledge;
- We share the same goals with our partners;
- We initiate meetings and discussions among those in our firm involved in relationships with our partners;
- We assign people to each relationship with our partners;
- We coordinate the activities involved in different relationships with our partners;
- We assess how much effort our people put into relationships with partners;
- We monitor the extent to which relationships with our partners work to our advantage.

Relationship-specific network competence (RSS):

- We search actively for new partners;
- We visit potential partners in order to get to know them;
- We exchange confidential information with our partners;
- We inform others in our firm about the requirements of our partners;
- We put people from our partners in contact with key people in our firm;
- We put people in our firms in contact with key people from our partners.