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**Persistence and extinction of brokerage roles in clusters: the role of status,
former experiences and extra-cluster relationships**

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PERSISTENCE AND EXTINCTION OF BROKERAGE ROLES IN CLUSTERS*

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Abstract

Shifting away from traditional approaches orientated towards the analysis of the benefits associated with brokerage, this paper provides valuable insights on the dynamics of this particular network position. Using fine grain micro data collected in a Spanish industrial cluster, the evolution of five different brokerage profiles is analysed in depth. Particularly, we observe how firm-level characteristics (status, former mediating experience and external openness), and their interactions may generate changes in the different brokerage roles over a period of time. Findings endorse our expectations mainly based on the social capital and network approaches. Status and previous mediating experience facilitate the creation of partnerships, fostering brokerage. Conversely, interaction effects demote brokerage activity at the intra-cluster level, suggesting the selective nature of broker's relational behaviour.

Keywords: Brokerage, Clusters, Social Network Analysis, Social Status, Extra-cluster Linkages

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Abstract

Shifting away from traditional approaches orientated towards the analysis of the benefits associated with brokerage, this paper provides valuable insights on the dynamics of this particular network position. Using fine grain micro data collected in a Spanish industrial cluster, the evolution of five different brokerage profiles is analysed in depth. Particularly, we observe how firm-level characteristics (status, former mediating experience and external openness), and their interactions may generate changes in the different brokerage roles over a period of time. Findings endorse our expectations mainly based on the social capital and network approaches. Status and previous mediating experience facilitate the creation of partnerships, fostering brokerage. Conversely, interaction effects demote brokerage activity at the intra-cluster level, suggesting the selective nature of broker's relational behaviour.

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1. Introduction

Thanks to the spectrum of relationships within the knowledge networks, firms may gain access to crucial resources providing exceptional advantages. Particularly, firm embeddedness in these inter-organisational structures determines the possibilities for capturing valuable information to overcome inertia and generate opportunities (March, 1991). Some firms gain knowledge through dyadic relationships which strictly comprise two organisations, while others access to disconnected ideas from at least two distant organizations. Both cases often involve further elaboration and absorption of the new knowledge, leading to novel solutions and higher performance. Consistently, most research has focused on the benefits derived from these network positions and the contingencies of these benefits. The traditional debate on the gains generated by the bridging or brokerage positions (Burt, 1992), occurring when firm's partners are not directly connected, and closed network positions in which partners are also linked to each other (Coleman, 1990), is well known.

Recently, literature has focused on identifying mediators of knowledge flows (Howells, 2006)¹. Notable contributions at individual or firm-level should be mentioned (Heinze and Bauer, 2007; Lissoni, 2010, Ma and Lee, 2008; Okamura and Vonortas, 2006; Kirkels and Duysters, 2010). Most of this research builds on the ideas of brokers and structural holes (Burt, 1992, 1997 and 2004). A firm in a brokerage position connects two unrelated partners, and spans a structural hole between them (Burt, 1992). By bridging unilateral ideas from two independent organisations, the broker performs two tightly related roles: knowledge intermediation and knowledge integration. Intermediation and networks position produce remarkable implications in different dimensions (Burt, 1992 and 2005; Granovetter, 1973), while integration explains the dissemination and combination of novel products or processes (Hargadon and Sutton, 1997; Hargadon, 2002).

Consistently with the above mentioned advantages, researchers have furnished empirical evidence supporting the claim on how brokerage positions may enhance a firm's performance (e.g. Rowley and Baum, 2004; Zaheer and Bell, 2005; McEvily and Zaheer, 1999; Shipilov, 2006) or the contingent factors that moderate the effects of the structural holes (Burt, 1997; Gargiulo and Benassi, 2000; Ahuja, 2000; Soda et al., 2004; Xiao and Tsui, 2007). Ironically, in spite of the dynamic conceptualization of the phenomena, measures and empirics have mainly remained within the realm of static approaches (Spiro et al., 2013). With the exception of the descriptive contribution by Burt (2002), just recently increasing attention is being paid to the appearance, persistence and extinction of these bridging positions (Janicik and Larrick, 2005; Zaheer and Soda, 2009; Baum et al. 2012; Min and Mitsuhashi, 2012; Boari and Riboldazzi, 2014).

In an attempt to contribute to this promising research path, this paper aspires to throw some light on the little explored phenomena of the dynamics of the different brokerage positions. Particularly, we test how firm's characteristics such as age, status, internal resources of former bridging experiences may influence the persistence or change of a certain brokerage position. For this purpose, moderated regression analysis was applied to micro-level and

¹ A review of literature on intermediation, identified large number of terms and definitions used to denote the roles of mediators and mediation (Howells, 2006): boundary organizations, innovation bridging, bridge builders, third parties or intermediary. In this paper we basically opted for the most common denominator, broker and brokerage.

relational data collected in a well known Spanish industrial cluster during 2011. In our view, industrial clusters are extremely appropriate contexts for the aims of our research since they represent paradigmatic configurations where multiple territorialised networks coexist and interweave.

The paper is organized as follows: the next section provides a literature review on brokerage, particularly in SME networks, the relationship between these bridging positions and the mentioned firm-level characteristics over a period of time. Based on this discussion, we derive our hypotheses. Next, a description of the main traits of the Spanish food industry and the Xixona industrial cluster follows. In the subsequent section, we discuss methodological issues and specify the different variables. Thereafter descriptive statistics, econometric issues and results are presented. After discussing our main results and key findings, the paper closes by highlighting the crucial contributions, implications and limitations.

2. Literature and hypotheses

2.1 Networks, structural holes and brokerage positions

Through cooperation, firms engage in joint problem solving, share resources and transfer knowledge (Gulati, 1998). Such practices facilitate the acquisition of valuable external assets that stimulate innovation and enhance organisational performance. The Structural Hole Theory (Burt, 1992 and 1997) is perhaps one of the most influential approaches used to explain a firm's performance in networks. In spite of certain ambiguities, the absence of a tie connecting two different actors that are indirectly linked points out the existence of a structural hole. The one positioned "in-between" the two disconnected actors is frequently labelled as broker.²

Firms occupying such "in-between" positions may be seen to have increased influence and power as they manage who can access certain resources, when these inputs are received and in what form (Ahuja, 2000). In other words, the broker benefits from non-redundant information, asymmetries or control (McEvily and Zaheer, 1999, Stam and Elfring, 2008). To the extent that the bridging process may also involve some elaboration of these ideas (Hargadon and Sutton, 1997), the broker's advantage can also depend on its ability to create

² The idea of broker is often approached through the notion of "betweenness", or how often an actor is positioned "in between" two disconnected actors (Wasserman and Faust, 1994).

value through the transformation of incoming knowledge, and subsequently withhold some of the generated value (Ryall and Sorenson, 2007). In view of the inherent advantages of these mediating positions, we may expect that brokers will aspire to keep spanning structural holes and to impede triadic closure or bridge decays in order maintain its strategic location within the network (see figure 1). Nonetheless, it should be specifically mentioned that these unilateral advantages are also compatible with the creation of benefits for the whole system in terms of global connectivity (Obstfeld, 2005).

INSERT FIGURE 1 ABOUT HERE

Actors in a network can be classified into a set of non-overlapping subgroups, as happens with researchers in a field who belong to different types of organizations such as universities, industry or students (Lissoni, 2010). If this logic is applied to clusters, industrial activities performed along the system value chain may determine coherent sets of firms. Consequently, knowledge flows within a cluster's subgroups can be distinguished from exchanges between members of different groups. Assuming the existence of these topological particularities, Gould and Fernandez (1989) delineate a taxonomy of all possible types of two-step paths on which any firm may tie. In contexts where a firm "a" makes a tie with firm "b" which in turn establishes a tie with a firm "c" and "a" and "c" remain unconnected, the total raw brokerage score of a firm can be partitioned in five different brokerage roles:

- *Coordinator*: all firms belong to the same group.
- *Itinerant*: "a" and "c" belong to the same group, while "b" belongs to a different one.
- *Gatekeeper*: "a" and "b" belong to the same group, while "c" belongs to a different one.
- *Representative*: "b" and "c" belong to the same group, while "a" belongs to a different one.
- *Liaison*: all firms belong to different groups.

Each type of brokerage represents a specific structural position and may exercise a different effect. In fact, each type of mediation has a distinct complexity and therefore must be

treated differently to accommodate context and goals (Graf and Kruger, 2011). However, it is worth mentioning that while any given brokerage relationship falls into one of these five categories, a firm presenting several relationships with other units can perform different mediating roles simultaneously. A wide range of disciplines has applied this refined representation in order to re-study the brokerage phenomenon. See recent empirical research on academic inventors and researchers (Lissoni, 2010; Ho and Liu, 2013), disaster response (Lind et al., 2008), entrepreneurial and relationship-building motivations (Kalish, 2008), clusters and SME networks (Kirkels and Duysters, 2010; Vicente et al., 2011), knowledge sharing in hospitals (Waring et al., 2013); network dynamics (Spiro et al., 2013), inter-industry technological knowledge flows (Lim and Park, 2010) or collaboration in the Canadian biotech industry (Schiffauerova et al., 2012). Figure 2 depicts the five possible brokerage roles, resource flows and group membership.

INSERT FIGURE 2 ABOUT HERE

2.2 Industrial clusters, SMEs and Brokerage

Industrial clusters can be conceived as geographical agglomerations of interconnected firms and local supporting organisations in a particular field (Porter, 1998). Although globalisation has challenged the relevance of co-location for performance (Asheim et al., 2006), clusters are still recognised as sources of endogenous growth. For decades, in line with the “Marshallian” tradition, localised knowledge spillovers thanks to specialised resources and pervasive information flows between co-located organisations seemed to be at the heart of the incremental innovations that foster firms and cluster competitiveness (Audretsch and Feldman, 1996; Maskell and Malmberg, 1999, among others). However, the automatic access to this knowledge “floating in the air” should not be taken for granted as it largely depends on the traits of the networked actors (Owen-Smith and Powell, 2004). For instance, cognitive endowments shape access to intra and extra-cluster knowledge networks (Giuliani and Bell, 2005).

Members’ individual positions within the overall configuration of their web of relationships provide opportunities for preferential access to knowledge resources. Although in a contingent manner (Ahuja, 2000), network centrality and brokerage appear to be important drivers of firm performance (Stam and Elfring, 2008). This seems particularly true in

geographical clusters where different inter-organisational architectures overlap. The complex geographical and technological organisation of a particular cluster can be perceived by the coexistence of different knowledge profiles and network structural roles among the clustered agents. Strategic positions in the cluster network, overall centrality, depend on actor's attributes and brokerage roles (Vicente et al., 2011). Even in mature clusters, both centrality and brokerage positions in tacit or explicit territorialised networks significantly affect innovation results (Casanueva et al., 2013).

The analysis of bridging organisations in SME networks and clusters has recently become popular. Empirics show how multifaceted brokers with specific characteristics that enable them to transfer and develop knowledge optimally, reduce the cognitive distance between members of technical knowledge and business information networks (Kirkels and Duysters, 2010). Among the brokerage roles, the gatekeeper configuration has received preferential attention (Giuliani, 2007; Morrison, 2008; Hervás-Oliver and Albors-Garrigós, 2012). Gatekeepers managing the local-global interface of geographical agglomerations, indirectly connect network members with external repositories of knowledge without the cost of maintaining side-by-side relations (Rychen and Zimmermann, 2008). Such connectivity function entails informational advantages (Giuliani and Bell, 2005) and performance implications (Graf and Kruger, 2011). From another perspective McEvily and Zaheer (1999) and Molina-Morales (2005) profusely studied cluster-supporting organisations connecting internal and external actors. In any case, the appropriate performance of this role requires high doses of both absorptive capacity and relational capital.

2.3 The dynamics of brokerage positions

Brokerage positions are extremely attractive because of access to non-redundant resources, control of information flows or the ability to play one party against the other. Consistently with the “*tertius gaundens*” (the third who enjoys), in clusters, we may expect that brokers will use powerful tools such as experience, status, prestige or even opportunistic behaviour to maintain their bridging role (Burt, 1992 and 2005). However, opposite forces run against the mediator goal. The “*tertius iungens*” (the third who connects) behaviour encourages new links between the direct network neighbours of a node (Obstfeld, 2005). This tendency towards triadic closure appears to be an important driver of network formation over time (Ter Wal, 2014), particularly in clusters (Giuliani, 2013). Moreover, power imbalance

resulting from asymmetric access to information and resources in unclosed triangles, triggers withdrawals by bridged partners, and leads to bridge decays. See figure 1 for visualisation of bridge dynamics over time.

To a great extent, former networking experiences and network structures explain the dynamics of inter-organisational relationships. Over time, brokers accrue abilities to identify sources of information, to assess and synthesise information, and to coordinate flows between sources and recipients (Hargadon, 1998). These assets accumulated through prior networking practices shape subsequent activities and advantages of the brokers (Hargadon and Sutton, 1997; Sapsed et al., 2007), as they greatly facilitate the engagement and success of new bridging activities. Zaheer and Soda (2009) recently found that past network position and status explain the genesis of the structural holes spanned by teams. As brokerage experience matters (Burt and Ronchi, 2007), one may hypothesise that the greater the amount of brokerage abilities acquired through experience, the higher the amount of brokerage activity.

H₁: Former bridging position favours firm's subsequent brokerage activities

Status reflects social prestige of an actor stemming from the network position (Gould, 2002). Prestigious firms have better access to crucial resources, are preferred as partners due to status spill-overs (Podolny, 1993), and are respected by others. Consequently, social status 'per se' may facilitate linkages with those of a similar status and the emergence of brokerage positions. Stuart et al. (1999) suggest that a firm's social status is tightly related to the social esteem of its allies. For instance, low status linkages possibly damage the prominent position of the focal firm.

From our previous arguments, former brokerage experiences foster bridging activities over time. But, this positive effect can be influenced by the particular characteristics of the broker and its unconnected counterparts. In our view, social status underpins the advantages of the broker, making power asymmetries more pronounced. Bridged firms correct this adverse situation by building balanced relationships with new partners. As networking takes time and effort, former bridge decays and brokerage position recede.

From a different perspective, similarity in terms of network position and resources increases the chances to collaborate (Gulati and Gargiulo, 1999; Ahuja et al., 2009; Lane et al., 2001). By following this pattern, firms avoid downgrading in terms of social status (Podolny, 1993) and favour resource complementarities (Mitsubishi and Greve, 2009). Within unclosed triads, thanks to homophily and information flows through brokers, uncertainty about the suitability of the unconnected third party is reduced. Unrelated members perceive each other as potential partners, and try to link directly. Considering that triadic structures may also act as mechanisms of social control that demote opportunistic behaviours (Ter Wal, 2014), a marked trend towards triadic closure and disappearance of brokerage positions emerge. Therefore, it can be hypothesised:

H₂: Social status negatively moderates the effect of former bridging positions on a firm's subsequent brokerage activities

Clusters may be conceived as spaces where many territorialised networks coexist. Within these contexts, brokers gain control and privileged access to knowledge from syndication partners, enjoying temporary advantages mostly of a local nature (Burt, 2005). However, embeddedness in dense networks may produce undesirable effects such as redundancy and lock-in. To avoid them, brokers also build linkages with firms and supporting organisations located beyond the cluster boundaries. The appropriate combination of local buzz and global pipelines sustains the competitiveness and innovativeness of the local brokers (Bathelt et al., 2004). However, local advantages derived from “in-between” standings are not easily transferable to new contexts where no previous affiliation exists or mediation occurs between non-direct linkages (Burt, 2007).

Collocation favours pervasive interactions and dense-knitted networks. On the other side of the coin, extra-cluster relations with distant partners are conceived as loose social architectures providing non-redundant knowledge (Zaheer and Bell, 2005). As collective sanction mechanisms require dense networks to function properly (Coleman, 1988), social control is less likely to function when partners are located beyond the cluster boundaries. Considering that brokers are frequently perceived as opportunistic (Guler and Guillem, 2010; Xiao and Tsui, 2007), distant partners will perceive them as scarcely reliable and

potential destabilizers of their own network. Therefore, since social control characterising intra-cluster networks does not predominate because brokers operate from their original location, extra-cluster units will be reluctant and brokers should devote additional efforts to forge external relationships. Attention and resources are removed from traditional brokerage activities to implement this alternative strategy. Consequently, in line with recent evidence (Guler and Guillen, 2010; Jensen, 2008; Shipilov, 2009), we may hypothesise that:

H₃: Extra-cluster connections negatively moderate the effect of former bridging positions on a firm's subsequent brokerage activities

Figure 3 shows the theoretical model and proposed hypotheses.

INSERT FIGURE 3 ABOUT HERE

3. The Study setting

3.1 The Foodstuffs cluster in Xixona

Vibrant economic activities frequently exhibit important levels of geographical agglomeration in clusters or regions, where well-networked firms and local organisations coexist. The Spanish confectionary industry is not an exemption. Over time, manufacture has become concentrated in a few regions and cities, Xixona (Valencia region) being a paradigmatic case. Although the local economy has always pivoted around the production of nougat and Christmas sweets for centuries, evolution of the industry has received scarce scholarly attention. Its origins are linked to old traditions and geography. The low rainfall and arid nature of the land favour the cultivation of almonds, crucial for the manufacture of nougats. The artisanal structure of the industry characterised by a myriad of home based craftsmen and a few companies 'stricto sensu', drastically changed during the second half of the past century when artisans expanded their operations to other regions and countries. During the 60's, firms and employment increased by 17% and 45% respectively. Small and rudimentary firms grew and became modernised thanks to huge investment efforts by local entrepreneurs while home-based operations tended to disappear. The average size of firms rose from 53.9 to 66.6 employees. This transformation ultimately led to the appearance of a

sizeable group of large units. In fact, 7 firms representing 20.5% of the total population, hired 1.489 employees accounting for 66.5% of the local labour force (Jordá, 1973). Generally speaking, this polarized configuration has relatively persisted over time (see Table 1).

INSERT TABLE 1 ABOUT HERE

Similarly to many agri-food industries, the availability of crucial inputs, specifics of the elaboration techniques and the official denomination of origin status explain the survival of nougats in Xixona (Sanz Cañada, 1991). At the firm level, different business strategies have been implemented to successfully meet challenges such as competition from substitutes, changes in market structure, new customer demands, low internationalisation and the seasonal nature of sales (65-70% during the Christmas season). The active presence of both a community of people and a population of firms in this naturally and historically bounded area (Boix and Galletto, 2006) is at the heart of this organisational and strategic pluralism. However, recent research raises some doubts about the robustness of the relational dynamics of this local productive system (March-Chordá et al., 2007).

Although the cluster has enjoyed limited attention, two local organisations offer programmes aimed at promoting internal efforts and cooperation among local organisations. Since 1997, the Nougats Manufacturers Association (TDC) diffuses updated management practices and fosters cooperation between over thirty members. Closely and symbiotically related to the TDC, the Regulatory Council of the official designation of origin supervises the production processes, and guarantees the quality and the essence of the products. Nowadays, 21 top firms, accounting for 38% of national sales and 42% of the total exports, market their products protected by the geographical indication label "Turrón de Xixona y Alicante".

From the innovation perspective, local improvements transformed a home-based craft industry into a prosperous sector based on an autochthonous and original product (Ybarra et al., 2008). Significant changes hosted by local producers, implied unique technological and chemical transformations in this food speciality. New procedures such as the development and use of pre-cooked mixtures based on ground and baked ingredients, have transformed and enhanced the efficiency of the cluster.

3.2 Data collection and sample issues

Primary data for the analysis was gathered through face-to face interviews in the foodstuffs cluster of Xixona. Prior to the main fieldwork, several interviews with representatives of both firms and local organisations (business associations, universities, etc.) were conducted. Insights from this qualitative analysis were used to develop our pilot questionnaire, and subsequently to enrich the discussion of the results. Based on feedback from a pre-test in the field, items and layout were improved to enhance comprehensibility and readability. Both representatives and members of the panel of practitioners were extremely interested in several aspects of the project. So, we were confident about the value of their contribution. During 2011, a structured questionnaire was administered to top-level managers and business owners by an experienced technician. Each interview lasted on average about 50 minutes and allowed us to collect fine-grained data on aspects such as the firm's characteristics, inter-organisational relationships or performance in 2005 and 2010. Network data were captured using "roster-recall" methodology (Wasserman and Faust, 1994). Each firm was confronted with a full list of clustered units obtained from the TDC and Regulatory Council archives, and provided information related to technical advice giving and seeking in the two periods considered. A free recall area was also included. Following methodological suggestions (Giuliani and Pietrobelli, 2011), all manufacturers and suppliers populating the cluster were interviewed due the limited size of the population. The questions designed captured the existence of a tie and its relative value based on a 1-3 scale.³ Due to the purpose of this research, we reduced the three possible values into a single category reflecting the existence of a tie. Finally, relational data were expressed in a squared matrix, corresponding to 24 manufacturers and 12 suppliers. Each cell in the matrix reports the occurrence and value of a technical advice relationship between the firms in the row to the firms in the column. Peer debriefing with local organisation and member checks confirmed that the 36 firms recorded in the mentioned databases represented the whole population.

³ The question capturing the technical relational data reads as follows: a) From which of the following firms on the list did you regularly ask for technical information over the last three years?; b) To which of the following firms on the list did you regularly provide technical information over the last three years?

Difficulties to reconstruct networks and cognitive distortions raise concerns about the robustness of our methodology. However, scholars also emphasise the advantages and validity of retrospective designs if they are properly applied. In order to minimise potential risk and enhance the reliability of our data frame, we proceed in the following way: a) indications about the questionnaire (measures, chronological structure, pilot testing or anticipation of the questionnaire to reluctant respondents) and data collection process were strictly considered (Miller et al. 1997; Zijlstra-Koning and De-Jong, 2005); b) inaccuracies were minimised by restricting the recall time to recent years, as verisimilitude of retrospective interviews is higher when events are recent (Eisenhart and Graebner, 2007); c) respondents' capacity to recall their network links was enhanced through recognition strategies which imply greater depth and recall efforts (Marsden, 2002); d) interest and rigorous involvement in the study was fostered by offering access to results (Miller et al., 1997); e) the interviewer placed particular emphasis in the retrieval of past experiences, guided respondents by prompting examples and repeatedly reminded that answers should be based on the pertinent time wave (Miller et al. 1997).

3.3 Variables

Dependent variables

Our dependent variables attempt to capture the variation of the brokerage activities per role at the firm level between 2005 and 2010. Using SNA R-Package (Butts, 2008), we performed the brokerage analysis of Gould and Fernandez (1989), given the two binary matrixes and four groups outlined by the position on the value system of the cluster – nougat manufacturers, raw input suppliers (sugar, honey or almonds), specialised providers (machinery and chemicals) and confectionary manufacturers. Both, the raw brokerage scores (total number of times a firm intermediates globally or in any of the five specific roles) and the standardised brokerage scores were obtained. As firms within larger subgroups of the value system have greater choices of spanning structural holes, raw measures were discarded to avoid potential bias. Once the right indicator was selected, the five dependent variables (corresponding to coordinator, gatekeeper, liaison, itinerant and representative) were calculated by taking the difference between the two waves observed.

Independent variables

Brokerage Experience. Standardised cumulative brokerage scores from 2005 were used to assess the breadth of a firm's mediating experience. By proceeding with this operationalisation of brokerage experience, we assumed that capabilities and skills related to intermediation accumulate whatever the "in-between" position previously performed by the focal actor. Although, it could be argued that certain specific abilities may derive from the accomplishment of each brokerage role. In our view, brokers learn how to successfully manage information flows or asymmetric relationships either as coordinators or itinerants.

Status. To build this variable, we take into account that a firm's status is the combined result of the engagement on advice-giving relations (improve status), and refrain from advice seeking that may negatively affect status (Agneessens and Wittek, 2012). A firm's outdegree measures the number of other firms that the focal actor is asking advice to, while the indegree evaluates the number of other firms requesting technical advice from the focal actor. Consequently, we opted for the ratio of indegree to outdegree to measure a firm's status. A high status member of the network will have a large proportion of units seeking information from it, compared with the number of firms sought out by that high status member for information.

Extra-cluster linkages. There is increasing awareness of the heightened role being played by non-local repositories of knowledge (Bathelt et al., 2004). Although different types of ties can provide access to distant knowledge, we just focus on business-related ties due to the firm-level nature of this research. Social ties such as family bonds (Andersen and Lorenzen, 2007) were relegated because they operate at the individual level. Therefore, using answers to the questionnaire, we constructed a variable that indicates the existence of extra-cluster connections with types located beyond the cluster boundaries.

The focus of our study as mentioned earlier is on how status, brokerage experience and extra-cluster relationships affect the dynamics of the different brokerage roles. In addition, we we monitor organisational investments in knowledge sharing and management, as internal resources may affect a broker's trajectory. In this vein, using data from the Canadian health service, Landry et al. (2007) showed how organisational investments influence knowledge broker profile. Particularly, information technologies enable brokers to better manage the external knowledge or diffuse valuable information within the organisation. Customer Relations Management applications (CRM) facilitate interactions

with external sources of knowledge, while Enterprise Resources Management applications (ERM) enhance information flows between business functions and intra organisational collaboration.⁴ Consequently, we assess the internal resources by mixing data from two binary variables measuring whenever or not the firm applies CRM and ERP respectively. In addition, we also monitor firm age measured as the logarithm of number of years since it was established. In our view, age may affect brokerage dynamics because older firms accumulate higher relational experience and are easily identified in dense local spatial agglomerations.

4 Empirical analysis and results

We first ran graphic representations of the two networks, which offer a visual image of the 2005 and 2010 relational architectures and sheds light on overall structural patterns (see figure 4). Additionally, we computed several indicators like density, reciprocity, transitivity and centralisation (see Table 2). The density of our technical networks, number of ties between firms divided by the total possible connections, reveals tightly knit structures and suggests quicker flow of resources. The reciprocity value, reflecting mutuality in the information exchange, shows the solid trend of the members to reciprocate. Transitivity indicates balanced triads, which is therefore evidence for the existence of strong ties. Centralisation shows an approximation to the cohesion or integration of the network and the value indicates capacity of brokering.

INSERT FIGURE 4 ABOUT HERE

INSERT TABLE 2 ABOUT HERE

As Table 2 shows, a comparative analysis of the values of the knowledge network at both moments of time raises a few considerations. Over time the network governing the exchange of knowledge within the cluster has become denser, dyadic reciprocity has improved, as well as centrality. All of this suggests that the network has evolved to become

⁴ An ERP (Enterprise Resource Planning) system is designed to integrate the firm's software for economy and accounting, CRM (Customer Resource Management), e-Commerce, content management, project management, e-mail, file sharing and calendar, etc.

a more cohesive structure with a more dynamic flow of knowledge. However, transitivity has not registered any change in the same period, that is, there has not been a global improvement in the dynamics of brokerage and the increase of activity in some firms has been offset by the reduction of activity in others. This leads us to take a closer look at different broker roles to see if there are significant variations at a specific level. So, in order to identify significant variations on the five different brokerage profiles in the period considered we use the Wilcoxon non-parametric test (Table 3). Values showed that only the coordinator scores have changed relevantly.

INSERT TABLE 3 ABOUT HERE

These results obtained a priori are not surprising given the structure and long history of the cluster subject to analysis. Regardless of any statistical significance, a decreasing trend in brokerage activity within the cluster is observed. This decline in all brokerage profiles appears to be consistent with both high density and reciprocity in the cluster, which have increased by 2.7% y 4.7% respectively, during the period in question. So, on one hand, in view of the known negative effects stemming from excessive density, it would appear that firms compromise the intensity of local relationships in favour of extra-cluster ties (e.g. international) which are able to offer innovative knowledge and contribute to overcoming situations of crisis. This strategy is doubly plausible among the stronger companies in the sector, which are usually those considered as knowledge brokers. On the other hand, the stability observed in the rate of transitivity suggests a trend towards relationships which are balanced by reciprocity, avoiding asymmetries of power and access to information.

Finally, only the coordinator role has changed significantly ($p\text{-value} < .05$). Merely from a methodological point of view, this finding may suggest some bias derived from the characteristics of our data. As we already mentioned, nougat manufacturers clearly predominate in our sample. This obviously favours the creation of linkages between firms belonging to this homogenous group; while the small number of firms involved in other

stages of the value system makes the establishment of inter-group ties difficult. Henceforth, we focus our regression analysis exclusively on the coordinator role⁵.

In Table 4 we present the basic descriptive statistics and the Pearson correlation for all variables. Detailed analysis of the matrix in Table 4 allows us to discard the existence of multicollinearity, as correlations did not exceed (0.70).

INSERT TABLE 4 ABOUT HERE

To test the hypotheses we ran three models to assess the exploratory power of each set of variables. The models are as follows:

- **Model 1:** Brokerage Dynamics = β_1 Brokerage Experience + β_2 Status + β_3 Extra-cluster Linkages + β_4 Age + β_5 Internal Resources
- **Model 2:** Brokerage Dynamics = β_1 Brokerage Experience + β_2 Status + β_3 Extra-cluster Linkages + β_4 Brokerage Experience*Status + β_5 Age + β_6 Internal Resources
- **Model 3:** Brokerage Dynamics = β_1 Brokerage Experience + β_2 Status + β_3 Extra-cluster Linkages + β_4 Brokerage Experience*Extra-cluster Linkages + β_5 Age + β_6 Internal Resources

Results of the proposed Models are shown in Table 5⁶. Regarding Model 1 a significant and positive association between Brokerage Experience and Status appears. This means that, as expected, the degree in which a cluster firm develops more and more status and reputation on the network will increase its brokerage dynamics (Chandler et al., 2013). Another relevant finding refers to the results of the control variable Internal Resources, meaning that the application of information technologies enhance coordination activities.

INSERT TABLE 5 ABOUT HERE

⁵ In addition we have developed the analysis of the regression models as a variable dependent on the variations in brokerage activities in the rest of the roles, which did not give any relevant results.

⁶ With the aim of guaranteeing the validity of the models (independence, homoscedasticity and normality) an analysis has been carried out on the behaviour of residuals, not finding any correlation between them or models of association.

In Model 2, the moderating role played by the Status variable is supported. Figure 5 shows a representation of the moderating effect of the Status in the Model 2. The moderator variable exerts a lesser effect on Brokerage Dynamics when the firm has high values of Brokerage Experience. That is, as a firm develops Brokerage Experience, the status and reputation acquired on network structure makes the firm more selective to enhance new dynamics in brokerage. Thus, the firm is more selective in the establishment of new relationships. On the other hand, in the earlier stages of brokerage experience creation, status enhances the dynamics of the firm. In consequence, we can confirm hypothesis 2.

INSERT FIGURE 5 ABOUT HERE

Concerning to Model 3, we can observe in Figure 6 that the moderated role by the Extra-Cluster Linkages is supported in a negative sense. The moderator variable exerts a negative effect on Brokerage Dynamics when the firm has relevant experience in brokerage. This situation can be produced due to non-local firms who perceive brokers as less desirable partners, because brokerage advantages suggest potential opportunistic behaviour. Consequently, hypothesis 3 is supported.

INSERT FIGURE 4 ABOUT HERE

4. Discussion, conclusions and implications

Studies dealing with brokerage and network dynamics have become a promising research path for scholars from different research fields. Particularly, empirical research on brokerage dynamics is extremely rare, inconclusive and often limited to qualitative evidences. Using data from a foodstuff cluster in the Valencia region (Spain), this paper entails a relevant contribution to the present literature and provides opportunities for future research. Generally speaking, our dynamic approach allows a refined analysis of how brokerage activities and the benefits originated from in-between positions evolve. Moreover, we closely examine the concept of brokerage by using the canonical typology suggested by Gould and Fernandez (1989). Although, five different brokerage roles were considered in a preliminary stage of the study, only the coordinator role displayed

significant changes over time. So, we opted for circumscribing our study to this specific brokerage profile. In our view, the maturity and low innovation performance of the cluster may shape the stability of the other four roles. As follows, we further discuss the main findings and implications.

First, literature suggests that in-between positions produce network benefits from new information flows and access to non-redundant resources. Being the broker between two unconnected partners is a source of value creation because information brokered is more likely to be additive than overlapping. Additionally, empirics confirm that firms require a solid knowledge base to successfully absorb and apply the incoming information from unconnected partners. In this vein, our findings corroborate the need for a minimum threshold of internal resources and capabilities, to accrue the benefits generated by the access to external valuable information and non-redundant resources. Firms reinforce their brokerage rate to the extent that their solid knowledge base allows the maintenance of the advantages inherent to this central position.

Secondly, as suggested by Burt and Ronchi (2007) experience in brokerage activities is relevant. The results obtained show that previous experience in brokerage promotes the development of subsequent activities beyond brokerage. Businesses can accrue a set of specific skills that allows a better diagnosis of brokerage opportunities, better relationship management, often characterised by marked asymmetries, or a more effective use of the resources they can access thanks to their position between two unrelated members. In other words, evidence suggests that there is a specific dynamic capacity related to brokerage activities. This capacity ought to be cultivated from senior management, insofar as it will allow the sustainability of the company's central position in the relational architecture of the overall cluster.

Thirdly, if over time brokerage activities are reinforced by experience, this positive effect may differ depending on the characteristics of the broker in question. Our results show how prestige or status negatively affect the evolution of brokerage activity. Within contexts of geographical proximity, firms identify and try to connect with reputed actors that are capable of offering advantages such as access to valuable resources or status spillovers. What is more, in most cases, they are a burden and damage the image of these leaders. The implication is immediate, a highly prestigious broker at cluster level is constantly sought

for advice or collaboration. The greatest power granted of being the object of “desire” (Knobe and Burt, 1983), will enable it to be tremendously selective and manage the forces linked to relational activity much more efficiently.

We find the dynamics brought about by this behaviour extremely interesting. On one hand, previous experiences in brokerage tend to promote this activity over time. However, the possible improvements in terms of status induced by better performance, as a result of privileged access to information and control, provide for greater conservatism of brokerage strategies. At the overall agglomeration level, connectivity of leading brokers tends to be restricted to a group sharing a similar status, thus hindering access of the weaker companies to resources controlled by leaders at a local level. Economic policy-makers and executives, ought to try and break this inertia which will gradually end up by impoverishing the development possibilities of those firms with the least capacity for contributing valuable inputs.

Fourthly, the influence of accrued experience in the evolution of brokerage activity, also seems to be determined by certain decisions taken of a strategic nature at a company level. Therefore, the results obtained underline the negative dampening effect exerted by the establishment of relationships at an extra-cluster level. On one hand, this evidence highlights compromise in terms of intra-cluster relational activity, resulting from the intensification of collaboration with distant actors. The magnitude of resources devoted to the establishment of these relationships acquires a particularly onerous character in view of the peculiarities of brokerage and its protagonist (associated with opportunist behaviour or positions of power. On the other hand, it seems to reveal a depletion in local sources of knowledge and a possible lock-in phenomenon. This is plausible given the longevity, considerable maturity and stability of the agglomeration in this study.

Fifthly, we have obtained valuable evidence on the sustainability of brokerage activity and its implications at an overall cluster level. In the context of this study, a declining trend has been observed, mainly due to the substitution of relationships where the benefits stemming from access to knowledge are unevenly distributed, by others where reciprocity and balance prevail. It is likely that the smaller size, longevity and widespread knowledge that local firms can expect from potential partners, minimises the role played by triadic closure.

This research is not exempt from some limitations that may affect the potential generalisation of the conclusions and which are related to the specific features of the selected case. Focusing on one single industry may provide us with some advantages but it also presents certain drawbacks. The research allows us better control over specific aspects of this industry. However, we must be cautious when it comes to the conclusions to other cases, particularly using high-tech clusters. A broader analysis generalising is therefore needed to study how other cases vary. The temporal horizon used and the number of actors considered is small. Probably, the use of a wider time frame or a larger sized agglomeration would modify some of the results obtained or back them up. However, the information available does not allow us to establish a clear explanation in relation to the stability of certain types of brokerage roles. This aspect represents an exceptional opportunity for research. Finally, the methodology used in the reconstruction of inter-organisational relationships, has limitations because of the studies based in retrospective, such as memory lapses or excessive simplification of experiences. Nonetheless, the careful design and implementation of the fieldwork based on guidelines suggested by Miller et al. (1997), guarantees the validity and reliability of the data used.

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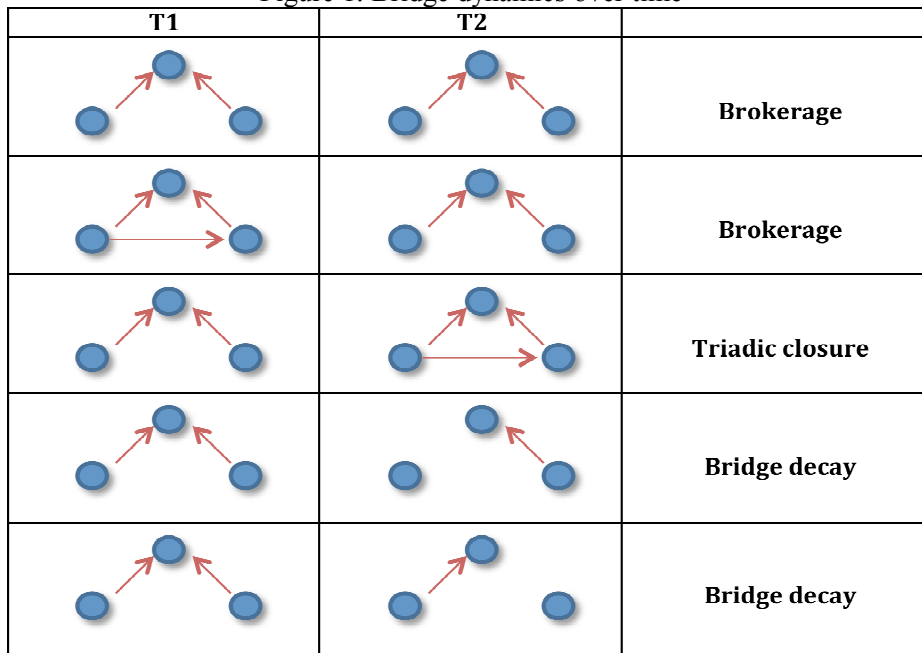
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Figure 1. Bridge dynamics over time



Note: Each node represents a firm, T1 represents the first time period; T2 represents the second time period; Lines and arrows represents directed ties between nodes.

Figure 2. The five graphic types of brokerage roles (Gould and Fernandez, 1989)

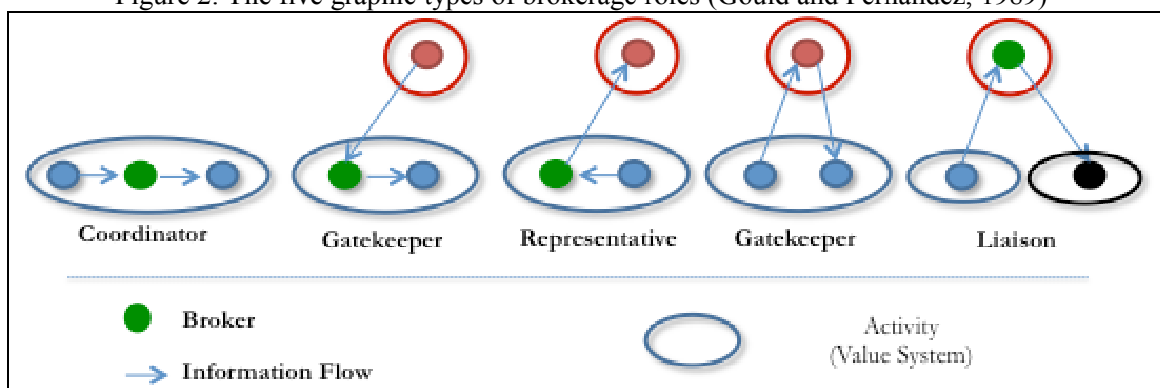


Figure 3. Proposal model

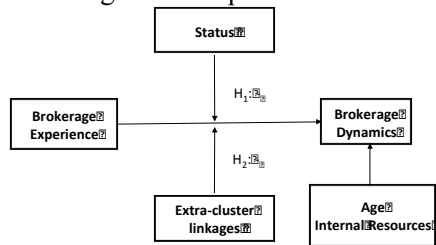


Figure 4. Graphic representations of the 2005 and 2010 knowledge networks

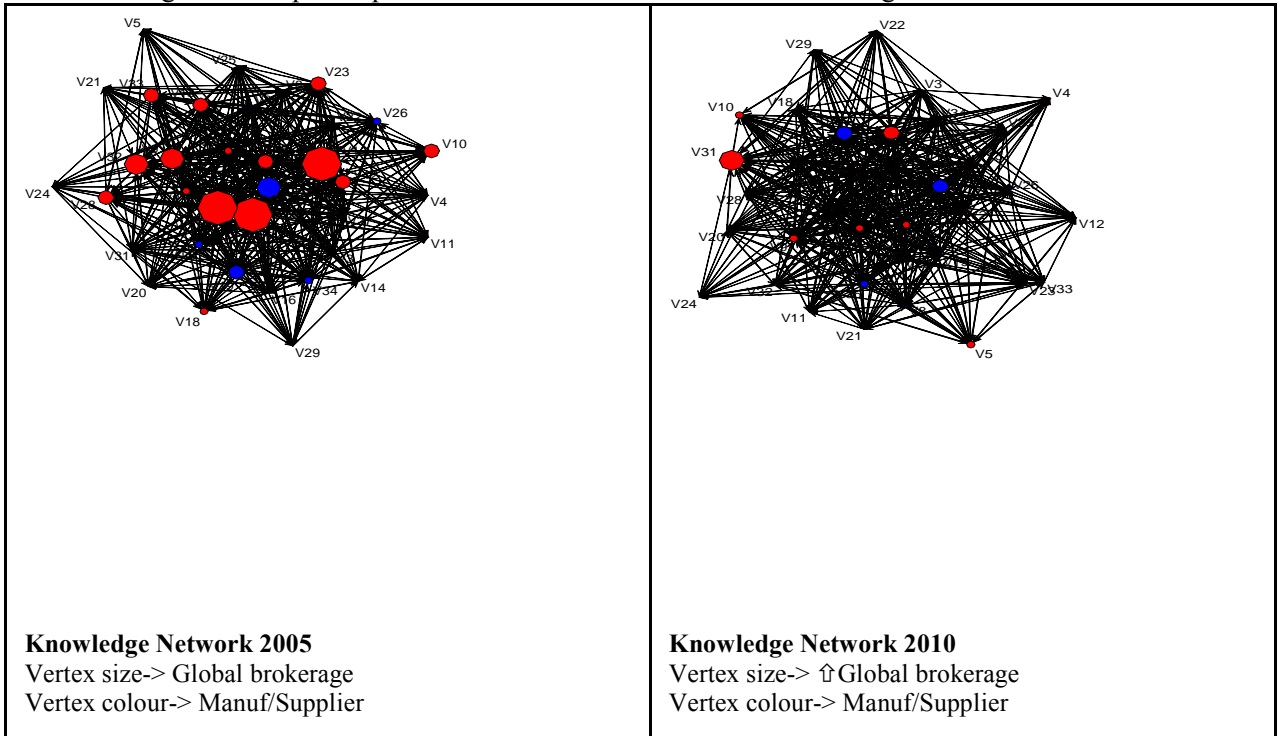


Figure 5. Moderating effect of Status on the relationship between ABE and Innovation

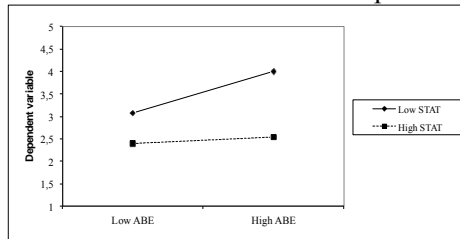


Figure 6. Moderating effect of Extra-cluster Linkages on the relationship between ABE and Innovation

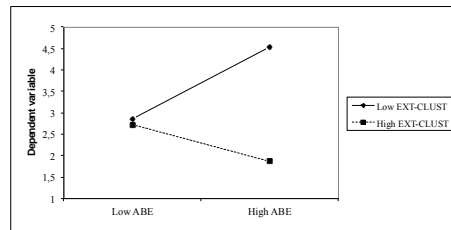


Table 1. Sample characteristics

Characteristics	Numbers of firms (%)
Employees	
{ QUOTE " }10	10(27.8)
10<X{ QUOTE " }25	7(19.4)
25<X{ QUOTE " }50	10(27.8)
50<X{ QUOTE " }100	6(16.7)
100<	3 (8.3)
Sales (thousands Euros)	
{ QUOTE " }1.000	10(27.9)
1.000<X{ QUOTE " }3.000	12(33.3)
3.000<X{ QUOTE " }6.000	7(19.4)
6.000<	7(19.4)
Year of creation	
Up to the 1970's	15(41.7)
1980's	4(11.1)
1990's	10(27.8)
2000's	7(19.4)
Business activities	
Manufacturers	26 (72.2)
Suppliers	10 (27.8)
City	
Xixona	36 (100)

Table 2. Network indicators

	Knowledge Network 2005	Knowledge Network 2010
Density	.483	.494
Reciprocity	.503	.527
Transitivity	.669	.668
Centralisation	.305	.339

Table 3. Wilconxon non-parametric test

	Coordinator	Itinerant	Gatekeeper	Representative	Liaison
Z	-1.949**	-.440	-1.194	-.299	-.503

N= 36; ***p< .01; **p< .05; *p< .1

Table 4. Descriptive statistics and correlations of the measurements

Variables	Mean	S.D.	1	2	3	4	5	6
(1) Brokerage Dynamics	.36	.93	1					
(2) Brokerage Experience	-1.54	1.83	.108	1				
(3) Status	2.23	2.52	.220	-.588**	1			
(4) Extra-cluster Linkages	.11	.31	.258	-.111	.237	1		
(5) Age	.54	2.34	.108	.090	.063	-.088	1	
(6) Internal Resources	.00	.97	.367*	.048	.016	.064	.019	1

N= 36; ***p< .01; **p< .05; *p< .1

Table 5. Regression results of models

Dependent variable: Standardized variation in Coordination activities 2005-2010			
	M1	M2	M3
ABE	.174* (.093)	.266*** (.097)	.204** (.088)
STAT	.128* (.072)	-.533 (.309)	.096 (.069)
EXT-CLUST	.530 (.457)	.645 (.434)	-.699 (.663)
STATxABE		-.193** (.088)	
EXT-CLUSTxABE			-.638** (-.264)
Control (AGE)	-.002 (.031)	.065 (.043)	.015 (.030)
Control (INTERNAL RESOURCES)	.321** (.147)	.321** (.139)	.235 (.141)
Model <i>F</i>	2.463**	3.110**	3.345**
<i>R</i> ²	.284	.383	.401
Adjusted <i>R</i> ²	.169	.260	.281

N= 36; ***p< .01; **p< .05; *p< .1

Unstandardized regression estimates (error)

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