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Dynamics of Brokerage Positions in Clusters: Evidence from the Spanish Foodstuffs Industry

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Academic Editor: Domingo Ribeiro-Soriano
Received: 25 November 2016; Accepted: 10 February 2017; Published: 17 February 2017

Abstract: Shifting away from traditional approaches orientated towards the analysis of the benefits associated with brokerage, this paper provides valuable insights into the dynamics of this network position and the opportunities to innovate that it provides. Using fine grain micro data collected in a foodstuff Spanish cluster, the evolution of different brokerage profiles is analyzed in depth. It was particularly evident 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. The findings of this work partially validate expectations based on the network dynamics 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 brokers' relational behavior.

Keywords: brokerage; foodstuff clusters; social network analysis; social status; extra cluster linkages; innovation

1. Introduction

Thanks to the spectrum of relationships within knowledge networks, firms may gain access to crucial resources that may provide exceptional advantages. In particular, firm embeddedness in these inter-organizational structures determines the possibilities for capturing valuable information to overcome inertia and generate opportunities [1]. Some firms gain knowledge through dyadic relationships, which strictly comprise two organizations, while others gain access to disconnected ideas from at least two distant organizations. Both cases often involve further elaboration and absorption of 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 [2], occurring when firm's partners are not directly connected, and closed network positions in which partners are also linked to each other [3], is well known.

Recently, the literature has focused on identifying mediators of knowledge flows [4]. A review of literature on intermediation identified large number of terms and definitions used to denote the roles of mediators and mediation [4]: boundary organizations, innovation bridging, bridge builders, third parties or intermediary. In this paper, we generally opted for the most common denominator, broker

and brokerage. Notable contributions at individual or firm-level should be mentioned [5–9]. Most of this research builds on the ideas of brokers and structural holes [2,10,11]. A firm in a brokerage position connects two unrelated partners, and spans a structural hole between them [2]. By bridging unilateral ideas from two independent organizations, the broker performs two closely related roles: knowledge intermediation and knowledge integration. Intermediation and network position have remarkable implications in different dimensions [2,12,13], while integration explains the dissemination and combination of novel products or processes [14,15].

Regarding the above mentioned advantages, researchers have consistently provided empirical evidence supporting the claim that brokerage positions may enhance a firm's performance [16–20] or the contingent factors that moderate the effects of the structural holes [10,21–24]. However, with the exception of the descriptive contributions [25], increasing attention has recently been paid to the appearance, persistence and extinction of these bridging positions [26–30]. Additionally, in spite of the dynamic conceptualization of the phenomena, measurements and empirical data have mainly remained within the realm of static approaches [31].

In an attempt to contribute to this promising research path, this paper aspires to shed some light on the little explored phenomena of the dynamics of the different brokerage positions in clusters. Particularly, this paper looks at how firm's characteristics such as age, status, and 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 relational data collected in a well-known Spanish industrial cluster during 2011. Industrial clusters are extremely appropriate contexts for the aims of our research since they represent paradigmatic configurations where multiple territorialized networks coexist and interrelate.

The paper is organized as follows: the next section provides a literature review on brokerage, particularly in Small and Medium-Sized Enterprises networks, the relationship between these bridging positions and the afore-mentioned firm-level characteristics over a period of time. Based on this discussion, the various hypotheses were derived. Following this, there is a description of the main traits of the Spanish food industry and the Xixona industrial cluster. In the subsequent section, methodological issues are discussed and the different variables are specified. Thereafter, descriptive statistics, econometric issues and the results are presented. After discussing the main results and key findings, the paper closes by highlighting its crucial contributions, implications and limitations.

2. Theoretical Development

2.1. Networks, Structural Holes and Brokerage Positions

Through cooperation, firms engage in joint problem solving, share resources and transfer knowledge [32]. Such practices facilitate the acquisition of valuable external assets that stimulate innovation and enhance organizational performance. The Structural Hole Theory [2,10] 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—the idea of broker is often approached through the notion of "betweenness", or how often an actor is positioned "in between" two disconnected actors [33].

Previous research has found that effective knowledge brokers have to be capable of translating, coordinating and aligning different perspectives [34]. Brokering activities are social processes with the broker participating in the interactions [35]. Knowledge brokers therefore contribute to knowledge sharing between organizations by providing and integrating different perspectives, as a means to, for example, increase the understanding of other parties' needs. Boundary objects, that is, sketches and guidelines, and boundary endeavors, such as workshops, meetings and study tours, are often used as tools to bridge boundaries between, for example, the project and the end-user organization.

Additionally, capabilities for adapting the use of boundary roles, such as interpreter, negotiator, ambassador, educator and translator, have been found to be essential for efficient bridging [36].

This is especially true in informal networks, as individual firms are normally unaware of the connections of their direct contacts. However, most of the discussion about brokers assumes that they are aware of their brokerage position. In the context of our research we consider this position since the role played is a relevant part of the company strategy.

Firms occupying such "in-between" positions may be seen to have increased influence and power as they manage who can access certain resources, when this input is received and in what form [22]. In other words, the broker benefits from non-redundant information, asymmetries or control [18,37]. To the extent that the bridging process may also involve some elaboration of these ideas [14], the broker's advantage can also depend on its ability to create value through the transformation of incoming knowledge, and subsequently withhold some of the generated value [38]. In view of the inherent advantages of these mediating positions, brokers try to impede triadic closure and to maintain linkages with unconnected partners in order to keep spanning structural holes. 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 [39].

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 [6]. In fact, actors can be grouped according to their activities or interests, thereby changing the nature and implications of the knowledge exchanges. As a consequence, the effect and importance of the brokerage activities would depend on who the connected actors are, that is to say, to which group they belong. Thus it makes sense to partition the full group into a set of mutually exclusive classes or subgroups of actors [40]. Assuming the existence of these topological particularities, authors [40] delineate a taxonomy of all possible types of two-step paths on which any firm may make ties. In contexts where a firm "a" makes a tie with firm "b", which in turn establishes a tie with 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 [41]. 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. There has been a range of recent empirical research on academic inventors and researchers [6,42], clusters and SME networks [9,43], knowledge sharing in hospitals [44], network dynamics [31], inter-industry technological knowledge flows [45] or collaboration in the Canadian biotech industry [46].

Industrial clusters can be conceived as geographical agglomerations of interconnected firms and local supporting organizations in a particular field [47]. Although globalization has challenged the relevance of co-location for performance [48], clusters are still recognized as sources of endogenous growth. Within cluster networks, we can identify subgroups of actors according to different productive activities of the whole cluster's system. So, brokers may form triads with actors located in the same or different phases of the value system. In this way, depending on the partners, each triad represents a context with particular goals and specific knowledge shared.

Although in a contingent manner [22], network centrality and brokerage appear to be important drivers of firm performance [37]. This seems particularly true in geographical clusters where different inter-organizational architectures overlap. The complex geographical and technological organization 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, and overall centrality, depend on actor's attributes and brokerage roles [43]. Even in mature clusters, both centrality and brokerage positions in tacit or explicit territorialized networks significantly affect innovation results [49].

We understand a bridge is a direct tie between nodes that would otherwise be in disconnected components of the graph. The analysis of bridging organizations 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 [9]. Among the brokerage roles, the gatekeeper configuration has received preferential attention [50–52]. 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 [53]. Such a connectivity function entails informational advantages [54] and performance implications [41]. From another perspective, authors [18,55] have widely studied cluster-supporting organizations connecting internal and external actors. In any case, the appropriate performance of this role requires high doses of both absorptive capacity and network relationships.

2.2. 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. Within clusters, brokers are consistently expected to use powerful tools such as experience, status, prestige or even opportunistic behavior to maintain their bridging role [2].

However, opposite forces run against the sustainability of the mediation activity. On the one hand, brokers may facilitate cooperation (favoring triadic closure) by selecting the right partners and emphasizing their commonalities when introducing them in order to build successful teams [39]. This trend towards triadic closure appears to be an important driver of network formation over time [56], particularly in clusters [57]. On the other hand, power imbalance resulting from asymmetric access to information and resources in unclosed triads triggers withdrawals by unconnected partners which leads to dissolution of ties and subsequently triad decays.

Former networking experiences and network structures explain the dynamics of inter-organizational relationships to a great extent [57]. In this vein, through past experiences, brokers accrue the ability to identify sources of information, to assess and synthesize information, and to coordinate flows between sources and recipients [58]. These specific capabilities accumulated through prior networking practices reinforce the broker's position and facilitate the engagement and success of new bridging activities [14]. Recent research has found that past network position and status explain the genesis of the structural holes spanned by teams [27]. Therefore, as brokerage experience matters [59], one may hypothesize that the greater the amount of brokerage abilities acquired through experience, the higher the amount of brokerage activity. In consequence, it is logical to express the following hypothesis:

2.2.1. H_1: Former Bridging Position Favors Firm's Subsequent Brokerage Activities

Status reflects social prestige of an actor stemming from the network position [60]. Prestigious firms have better access to crucial resources, are preferred as partners due to status spill-overs [61], and are respected by others. Firms become prominent depending on the number and characteristics of their links. Usually more links imply higher recognition, so firms reinforce their status through the formation of ties over time. These linkages are not created randomly; similarity in terms of network

position, traits and resources increases the chances to collaborate [12,62]. The assortativity mechanism which refers to the preference of a firm to attach itself to others with similar characteristics. Following this assortative logic, firms with high status tend to interact with similar alters [63], which favors the emergence of a local self-reinforcing elite of reputable firms. Conversely, linkages with lower status firms damage the prominent position of the focal firm [64]. Within asymmetric attachments, only the lower prestige firms benefit from status spill-overs [60].

Due to homophily and information flows through brokers, uncertainty about the suitability of the partners in triads is reduced. Particularly, thanks to the tendency to bond with similar others and information feedback, unrelated members try to link directly as they perceive each other as appropriate partners. Considering that triadic closure acts as mechanisms of social control that demotes opportunistic behaviors [55], the disappearance of brokerage positions emerges.

Moreover, considering that status effects promote fragmentation and hierarchy within the network structure [50,60], a high social status makes broker's advantages in terms of power and control more pronounced. Unconnected partners correct this extremely adverse situation by building more balanced relationships with new collaborators. As this networking process takes time and effort, the former bridge is abandoned and the brokerage position recedes.

Attending the whole previous conceptual development, it can be suggested that social status affects and moderates the effect of the former bridging positions on brokerage activities. Therefore, the following can be hypothesized:

2.2.2. H_2: 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 territorialized networks coexist. Within these contexts, brokers gain control and privileged access to knowledge from syndication partners, enjoying temporary advantages of a local nature [12]. However, embeddedness in dense networks may produce undesirable effects such as redundancy and lock-in. To avoid this, brokers also build linkages with firms and supporting organizations located beyond the cluster boundaries. The appropriate combination of local buzz and global pipelines sustains the competitiveness and innovativeness of the local brokers [65]. 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 [62].

Collocation favors pervasive interactions and densely knitted networks. On the other side of the coin, extra-cluster relationships with distant partners are conceived as loose social architectures providing non-redundant knowledge [17]. But for many firms, particularly SMEs, the creation of these relationships means overcoming traditional weaknesses in non-local network creation by accumulating knowledge and experiences to develop alternative forms of cooperation, adjusting the strategic objectives to common goals in non-local networks, considering the compatibility of local operations with non-local linkages, evaluating cultural barriers, etc. [66]. The cost and effort devoted to distant cooperation affect investment in local networking. Brokers should constantly readjust resources and devote additional effort to forging external relationships. Therefore, in line with recent evidence [67,68], the hypothesis may be made that:

2.2.3. H_3: Extra-Cluster Connections Negatively Moderate the Effect of Former Bridging Positions on a Firm's Subsequent Brokerage Activities

Figure 1 shows the theoretical model and proposed hypotheses.

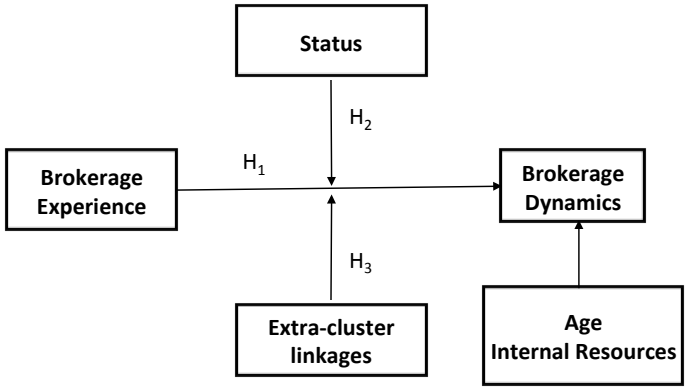

Figure 1. Proposed model.

3. The Study Setting

3.1. The Foodstuffs Cluster in Xixona

The nougat cluster of Xixona—a small city located in the southern part of the Valencia region—is a paradigmatic case founded on old traditions and the exceptional conditions for the cultivation of almonds, a crucial ingredient for the manufacture of nougat. The successful trajectory of the agglomeration is based on the widespread recognition of a unique product firmly anchored in the local community and the externalities linked to the territory. Nowadays, the cluster exhibits a distinct competitive behavior compared to the whole sector, low internationalization and a marked internal heterogeneity [69]. Leaving aside commonalities in terms of product specialization and recognition, manufacturers appear to be a fragmented group with pronounced differences in terms of strategies and capability building.

Neither the effects of globalization nor the growing weight of other foodstuffs have weakened the tight identification of Xixona with this Christmas sweet. Until the middle of the previous century, the socio-economic life of the city pivoted around an industry made up of a myriad of home-based craftsmen. Nevertheless, the strengthening of new markets disrupted this ancient industrial structure. Increasing demand forced the modernization of production processes and facilities of a rising number of the larger firms. Furthermore, the emergence of a core group of seven large firms employing 66.7% of the local labor force, has led to a polarized configuration which has persisted over time (see Table 1). After a turbulent period when changes in retailing and customer demands induced severe adjustments, firms recovered the dynamism at the beginning of the last decade.

From the innovation perspective, unique technological and chemical transformations carried out by local entrepreneurs transformed the nougat industry into a prosperous autochthonous industry. Knowledge transfer and mutual learning are the engine that fuels local inventive. Novel solutions co-developed by local manufacturers, metalworkers and mechanics allowed technological convergence with similar industries in aspects such as: grinding, heating, cooling, cutting or packaging. In fact, some of these specialists founded the awarded technology supplier MEJISA, a local technological reference for many foodstuffs industries. Complementing these inventors and collective initiatives, the University of Alicante and the Polytechnic University of Valencia have helped to introduce improvements during production processes.

Despite the difficulties inherent to maturity, firms are sparking consumer interest through the renewal of the range of products on offer and innovative marketing approaches. R&D has enabled not only the inclusion of new flavors, but also the development of formulations sugar-free nougat and nougat suitable for coeliacs. In this vein, The University Miguel Hernández has joined forces with local manufactures to enhance the product's properties or create new product formats (e.g., the world's first spreadable nougat). However, the most burgeoning trend is the creation of modern boutiques intended to entice people year-round. Firms sell premium products packaged in sleek black boxes

and sophisticated gift assortments in luxurious shops, or set up "sweet and chic" areas in the gourmet section of top department stores.

In sum, through relationships, firms gain access to a plethora of intra-cluster repositories of knowledge, which are crucial to innovation. Discussion and exchanges of information with competitors circumscribe to production specifications and quality guaranteeing. Upstream relationships afford access to retailers' market information about emerging trends on packaging or marketing, while the interactions with providers may range from screening of the supply base for new input to involvement in the creation of products and quality improvements. Links with third parties such as research centers are clearly focused on the improvement and implementation of product and process innovation.

Table 1. Sample characteristics.

Characteristics	Numbers of Firms (%)
Employees	
$\leq$10	10 (27.8)
10 < X $\leq$ 25	7 (19.4)
25 < X $\leq$ 50	10 (27.8)
50 < X $\leq$ 100	6 (16.7)
100<	3 (8.3)
Sales (thousands of Euros)	
$\leq$1000	10 (27.9)
1000 < X $\leq$ 3000	12 (33.3)
3000 < X $\leq$ 6000	7 (19.4)
6000<	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	24 (66.7)
Suppliers	12 (33.3)
City	
Xixona	36 (100)

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 organizations (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, the 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. Consequently, we were confident of 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 min and allowed us to collect fine-grained data on aspects such as the firm's characteristics, inter-organizational relationships or performance in 2005 and 2010. Network data were captured using the "roster-recall" methodology [33]. Each firm was presented with a full list of clustered units obtained from the TDC and Regulatory Council archives, and provided information at the firm-level related to informal technical advice given and sought in the two periods considered. A free recall area was also included.

Following methodology suggestions [70], all manufacturers and suppliers populating the cluster were interviewed due to the limited size of the population. The questions designed captured the existence of direct ties and their relative values based on a 1–3 scale. 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? 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 organization and member checks confirmed that the 36 firms recorded in the mentioned databases represented the whole population.

Difficulties in reconstructing networks and cognitive distortions raise concerns about the robustness of our methodology. However, scholars also emphasize the advantages and validity of retrospective designs if they are properly applied. In order to minimize potential risk and enhance the reliability of our data frame, we proceeded 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 processes were strictly considered [71]; (b) inaccuracies were minimized by restricting the recall time to recent years, as verisimilitude of retrospective interviews is higher when events are recent [72]; (c) respondents' capacity to recall their network links was enhanced through recognition strategies which imply greater depth and recall efforts; (d) interest and rigorous involvement in the study was fostered by offering access to results [71]; and (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 scale [71].

3.3. Variables

3.3.1. Dependent Variable

The dependent variable (Brokerage_Dynamics) attempts to capture the variation of the brokerage activities at the firm level in two time periods, 2005 and 2010. The brokerage analysis [40] was performed, identifying previously groups according to their position in the value system of the cluster: nougat manufacturers, raw material suppliers (sugar, honey or almonds), specialized providers (machinery and chemicals) and confectionary manufacturers. The brokerage scores per specific brokerage role were estimated using SNA R-Package as the total number of times a firm intermediates globally in the cluster. Scores per role in 2005 and 2010 were obtained, and then, standardized variation for each role was calculated (coordinator, gatekeeper, liaison, itinerant and representative) in this period. Definitively, a variable per role was established.

3.3.2. Independent Variables

Brokerage Experience (ABE). Similar to the procedure described above, standardized cumulative brokerage scores were used to assess the breadth of a firm´s mediating experience. In order to operationalize brokerage experience, it was assumed that capabilities and skills related to intermediation accumulate whatever the "in-between" position previously performed by the focal actor. However, it could be argued that certain specific skills may derive from the performance of each brokerage role. The evidence seems to demonstrate that brokers learn how to manage knowledgeably and intermediate in relationships regardless of the source of the flows or the position of the partners in the value chain of the cluster.

Status (STAT). To build this variable, the ratio of in-degree to out-degree to measure a firm's status was selected. A firm's out-degree gives the number of other firms that the focal actor is requesting advice from, while the in-degree evaluates the number of other firms requesting technical advice

from the focal actor. According to this measurement, an actor's status is the combined result of the engagement in advice-giving relationships which improve status, and refrain from advice seeking that reveals lack of knowledge and harms status. In this vein, 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 (Ext_Clust). There is increasing awareness of the heightened role being played by non-local repositories of knowledge. Although different types of ties can provide access to distant knowledge, here the focus is on business-related ties due to the firm-level nature of this research. Social ties such as family bonds were relegated because they operate at the individual level. Therefore, using answers to the questionnaire, a variable was constructed that indicates the existence of extra-cluster connections with types located beyond the cluster boundaries.

The focus of this study, as mentioned earlier, is on how status, brokerage experience and extra-cluster relationships affect the dynamics of the different brokerage roles. In addition, organizational efforts in knowledge sharing and management were monitored, as investment in aspects such as enterprise systems may affect a broker´s trajectory (Ent_Systems). Besides direct effects, investment in enterprise systems influences the knowledge brokerage profile [73]. By establishing connections and communication between repositories of knowledge, the implementation of Customer Relations Management (CRM) or Enterprise Resources Management (ERP) systems generates synergies which strengthen the firm's knowledge base and fosters innovation (an ERP system is designed to integrate the firm's software for economy and accounting. The CRM focuses on e-Commerce, content management, project management, e-mail, file sharing and calendar, etc.). Consequently, the enterprise systems were assessed by mixing data from two binary variables measuring whenever or not the firm applies CRM and ERP respectively. In addition, firm age was also monitored and measured as the logarithm of the number of years since it was established (AGE). In the view of this paper, age may affect brokerage dynamics because older firms accumulate higher relational experience and are easily identified in dense local spatial agglomerations.

3.4. Econometrics

Ordinary regression was run, which is the way most actor-level hypotheses are tested. Specifically, three different models for each brokerage profiles were used to assess the exploratory power of each set of variables. The models read as follows:

- Model 1: Brokerage_Dynamics = β_1ABE + β_2STAT + β_3Ext_Clust + β_4AGE + β_5Ent_Systems
- Model 2: Brokerage_Dynamics = β_1ABE + β_2STAT + β_3Ext_Clust + β_4ABE $\times$ STAT + β_5AGE + β_6Ent_Systems
- Model 3: Brokerage_Dynamics = β_1ABE + β_2STAT + β_3Ext_Clust + β_4ABE $\times$ Ext_Clust Linkages + β_5AGE + β_6Ent_Systems

Network data has limitations to the "classical" regression because the assumption of independence of observations is clearly violated and the sample is sometimes small. Indeed, there is not an actual sample as the whole population of cluster members were surveyed. One elegant way to circumvent these issues is to apply a permutation test. The three models were consistently re-estimated to corroborate the robustness of our results.

4. Empirical Analysis and Results

Graphic representations of the two networks were run, which offer a visual image of the 2005 and 2010 relational architectures and shed light on overall structural patterns (see Figure 2). Additionally, several indicators such as density, reciprocity, transitivity and centralization (see Table 2) were calculated. The density of the technical networks, the 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 of the existence of strong ties. The degree of centralization, which measures to what extent network cohesion is hinged on particular focal importance, signals slightly growing inequality of node importance and capacity of brokering.

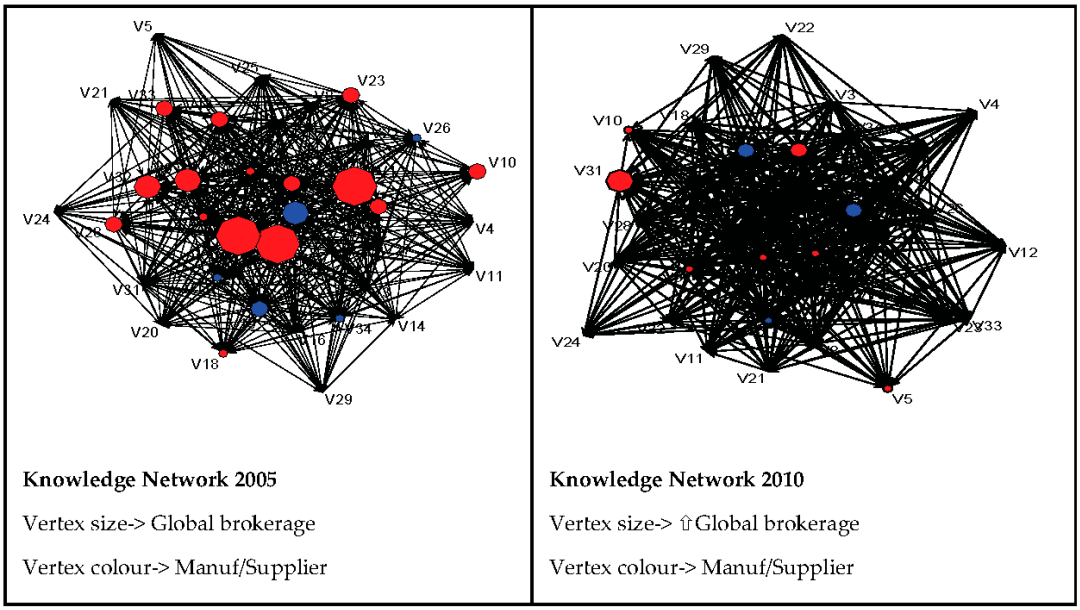

Figure 2. Graphic representations of the 2005 and 2010 knowledge networks.

Table 2. Network indicators.

	Knowledge Network 2005	Knowledge Network 2010
Density	0.483	0.494
Reciprocity	0.503	0.527
Transitivity	0.669	0.668
Centralixation (degree)	0.305	0.339

As Table 2 shows, a comparative analysis of the values of the knowledge network at both moments in time raises a few questions. Over time, the network governing the exchange of knowledge within the cluster has become denser, and dyadic reciprocity has improved. This suggests that the network has evolved to become a more interconnected structure with a more dynamic flow of knowledge. However, transitivity remained unaltered during the same period, perhaps because variation of brokerage activity in some firms has been offset by opposite changes in others.

This means taking 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 the Wilconxon non-parametric test (Table 3) was used. Values showed that only the coordinator scores have changed relevantly.

Table 3. Wilconxon non-parametric test.

	Coordinator	Itinerant	Gatekeeper	Representative	Liaison
Z	−1.949 **	−0.440	−1.194	−0.299	−0.503

$N = 36$; ** $p < 0.05$

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% and 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 favor 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-value < 0.05). Merely from a methodological point of view, this finding may suggest some bias derived from the characteristics of our data. As was already mentioned, nougat manufacturers clearly predominate in our sample. This obviously favors the creation of links 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, the focus the regression analysis will be on the coordinator role.

Regression Models

Firstly, in Table 4 the basic descriptive statistics and the Pearson correlation for all variables are presented. Detailed analysis of the matrix in Table 4 allows the existence of multicollinearity, as correlations did not exceed (0.70), to be discarded.

Table 4. Descriptive statistics and correlations of the measurements.

Variables	Mean	S.D.	1	2	3	4	5
(1) Brokerage Experience (ABE)	−1.54	1.83	1				
(2) Status (STAT)	2.23	2.52	−0.588 **	1			
(3) Extra-Cluster Linkages (Ext_Clust)	0.11	0.31	−0.111	0.237	1		
(4) Age (AGE)	0.54	2.34	0.090	0.063	−0.088	1	
(5) Enterprise Systems (Ent_Systems)	0.43	0.40	0.048	0.016	0.064	0.019	1

$N = 36$; ** $p < 0.05$

Results of the Models for Coordinator Brokerage Dynamics are shown in Table 5. The analysis of the regression models was developed as a variable dependent on the variations in brokerage activities in the rest of the roles, which did not give any relevant results. Regarding Models for Coordinator role, Model 1 shows a significant positive association between Brokerage Experience and Status with Brokerage Activities, confirming hypothesis 1. This means that, as expected, the degree in which a cluster firm develops more and more status and reputation in the network will increase its brokerage dynamics [74]. Another relevant finding refers to the results of the control variable Enterprise systems, showing that the application of information technologies enhances coordination activities.

In Model 2, the moderating role played by the Status variable is supported. Figure 3 shows a representation of the moderating effect of Status in the Model 2. The moderator variable exerts a lesser effect on Coordinator Brokerage Dynamics when the firm has high values of Brokerage Experience. That is to say that, 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, hypothesis 2 is confirmed.

Table 5. Regression results of models.

Dependent Variable: Brokerage_Dynamics			
	M1	**M2**	**M3**
ABE	0.174 * (0.093)	0.266 *** (0.097)	0.204 ** (0.088)
STAT	0.128 * (0.072)	−0.533 (0.309)	0.096 (0.069)
Ext_Clust	0.530 (0.457)	0.645 (0.434)	−0.699 (0.663)
ABE x STAT		−0.193 ** (0.088)	
ABE x Ext_Clust			−0.638 ** (−0.264)
Control (AGE)	−0.002 (0.031)	0.065 (0.043)	0.015 (0.030)
Control (Ent_Systems)	0.321 ** (0.147)	0.321 ** (0.139)	0.235 (0.141)
Model *F*	2.463 **	3.110 **	3.345 **
R^2	0.284	0.383	0.401
Adjusted R^2	0.169	0.260	0.281

N = 36; *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$; Unstandardized regression estimates (error).

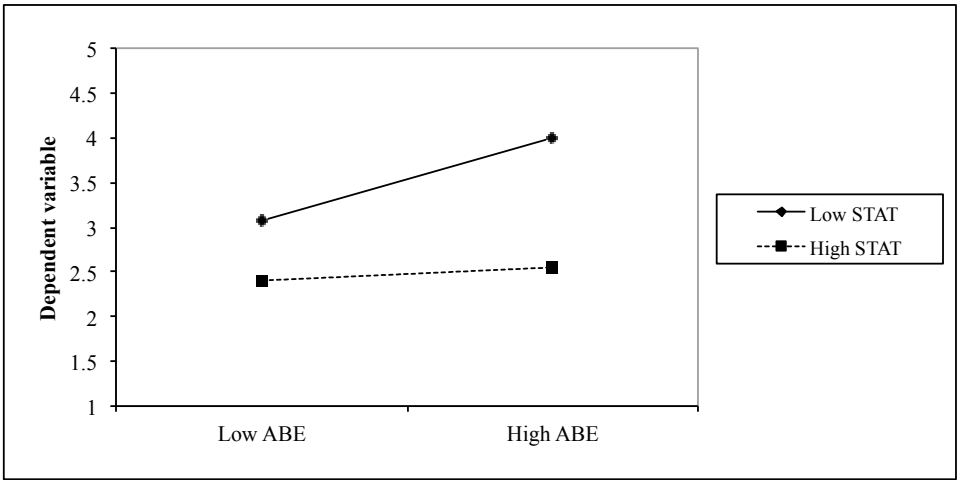

Figure 3. Moderating effect of Status on the relationship between ABE and Innovation in the Coordinator role.

Concerning Model 3, Figure 4 shows that the brokerage role moderated by the Extra-Cluster Links is supported in a negative sense. The moderator variable exerts a negative effect on Coordinator Brokerage Dynamics when the firm has relevant experience in brokerage. This situation could be produced due to non-local firms who perceive brokers as less desirable partners because brokerage advantages suggest potential opportunistic behavior. Consequently, hypothesis 3 is supported.

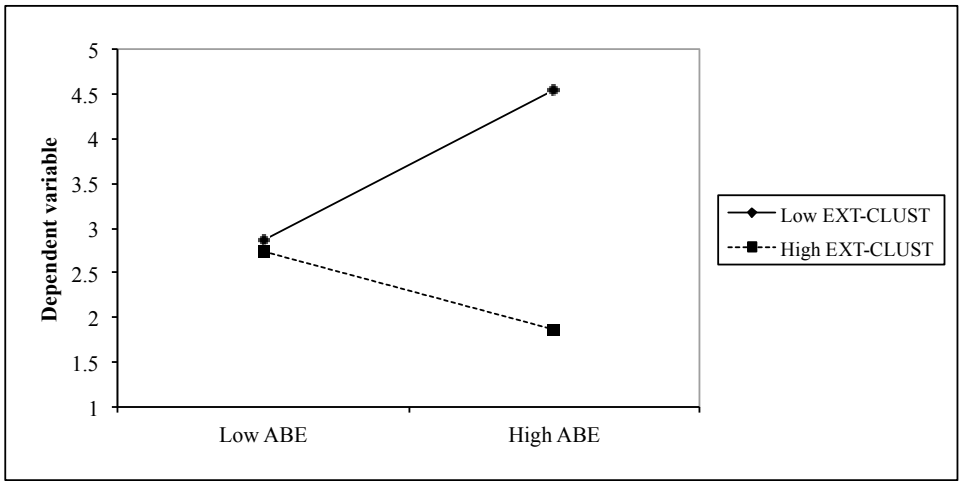

Figure 4. Moderating effect of Extra-Cluster Linkages on the relationship between ABE and Innovation in the Coordinator role.

5. Discussion and Conclusions

Studies dealing with brokerage and network dynamics have become a promising research path for scholars from different research fields. In particular, empirical research on brokerage dynamics is extremely rare, inconclusive and often limited to qualitative evidence. Using data from a foodstuffs cluster in the Valencia region (Spain), this paper presents a relevant contribution to the present literature and provides opportunities for future research. Generally speaking, the dynamic approach used here allows a refined analysis of how brokerage activities and the benefits originated from in-between positions evolve. Moreover, the concept of brokerage is closely examined by using a canonical typology [40]. Although five different brokerage roles were considered in a preliminary stage of the study, only the coordinator role displayed significant changes over time. Consequently, this study focused on this specific brokerage profile. The results of this work seem to suggest that maturity and low innovation performance of the cluster may shape the stability of the other four roles. Here follows further discussion of the main findings and implications.

Firstly, the 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, empirical data confirms that firms require a solid knowledge base to successfully absorb and apply the incoming information from unconnected partners. In this vein, the findings of this work 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, experience in brokerage activities is relevant [59]. 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, and better relationship management, often characterized 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, the 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 overspills. 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" will enable it to be tremendously selective and manage the forces linked to relational activity much more efficiently. The dynamics brought about by this behavior are extremely interesting.

Previous experiences in brokerage tend to promote this activity over time. However, the possible improvements in terms of status induced by better performance, gained 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 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 activities also seems to be determined by certain decisions of a strategic nature taken at a company level. Therefore, the results obtained underline the negative dampening effect exerted by the establishment of relationships at an extra-cluster level.

The findings suggested that extra-local linkages moderate the effect of brokerage experience on dynamics but not on less local interaction; in fact, density increases and brokerage decreases because of triadic closure. An interpretation of the results would be that firms with extra local linkages do not need to exploit their internal brokerage position anymore because of external opportunities and can therefore let triads close.

On the 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 behavior or positions of power). On the other hand, it seems to reveal 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, and 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, minimizes the role played by triadic closure.

On the whole, this paper has relevant policy implications not only for firms, but also for practitioners and academics. Assuming that brokerage activities involve advantages for firms, both practitioners and academics should develop a list of prescriptions to simultaneously foster networking and cluster dynamics and to enhance internal capacities building. When doing so, they should be conscious that not all brokerage activities generate benefits to the same extent or are subject to specific cluster's features. Thus, prior diagnosis is essential to better select what efforts should be devoted to reinforce firms' endowments or how intra-cluster networking should be promoted.

This research is not exempt from some limitations that may affect the potential generalization of the conclusions, limitations 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 better control over specific aspects of this industry. However, one must be cautious when it comes to applying the conclusions to other cases, particularly those of high-tech clusters. A broader analysis 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. A particular concern refers to the possible unawareness of the brokerage role played by firms, particularly in the context of informal relationships, where a gap between the actual and perceptual role played by actors could occur. Consequently, further inquiry into this dysfunction would be welcomed. Throughout this work, the existence of a specific accumulated mediation capacity has been assumed regardless of the type of mediation performed. Future research must confirm the validity of this assumption.

Finally, the methodology used in the reconstruction of inter-organizational relationships has limitations due to being based on retrospective factors, such as memory lapses or excessive simplification of experiences. Nonetheless, the careful design and implementation of the fieldwork based on the literature [71] guarantees the validity and reliability of the data used.

Acknowledgments: Financial support from the Spanish Ministry of Economy and Competitiveness (ECO2015-67122-R) is gratefully acknowledged.

Author Contributions: Each individual author contributed equally and significantly to the development of this work. All the authors contributed in conception, data collection phase, design, and interpretation of the econometric analysis. Belso-Martinez and Exposito-Langa wrote the article. Molina-Morales and Más-Verdú refined and critically reviewed the article.

Conflicts of Interest: The authors declare no conflict of interest.

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