Geographic clustering, network relationships and competitive advantage

Two industrial clusters in Taiwan

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Abstract

Purpose – There are contradicted perspectives on relationship between geographic cluster and competitive advantage of firms in previous research. Extant research has paid extremely attention to the effect of both geographic cluster and industrial network on firms’ performance; however, little studies have delineated the relationship between geographic cluster, industrial network, and competitive advantage. The purpose of this paper is to demonstrate that firms within the same cluster that have established idiosyncratic network resources have stronger competitive advantages than firms that have not.

Design/methodology/approach – An empirical study of two prominent geographic clusters from Taiwan is analyzed by structural equation modeling.

Findings – The results indicate that the degree of networking does play a mediating role between geographic cluster and competitive advantage, which may help resolve the conflicting results obtained by researchers on the influence of clusters on competitive advantage. The results also find that both degree of networking and betweenness position are conducive to the pursuit of competitive advantage.

Practical implications – The research shows that firms merely locate themselves in the right cluster does not guarantee they can outperform their rivals. Rather, developing of network relationship with other firms proximate to the same cluster will strengthen a firm’s competitive advantages.

Originality/value – In the theoretical perspective, this paper attempts to fill the gap in the links between clusters, networks, and competitive advantage by providing that the networking as a mechanism for firms in a cluster to improve their competitive advantage.

Keywords Social networks, Networking, Competitive advantage, Small to medium sized enterprises, Taiwan

Paper type Research paper

1. Introduction

Geographic clusters and related issues have been popular research topics since the early 1990s in the fields of both economics and management (Bell, 2005; Krugman, 1991; McEvily and Zaheer, 1999; Porter, 1990; Saxenian, 1994; Tallman et al., 2004). Geographical clusters, which are also known as industrial clusters or hot spots (Pouder and St. John, 1996) are attractive to firms, since if firms can locate themselves in geographic proximity to the right cluster, they have a strong opportunity to enhance competitive advantage.
their competitive advantage (Porter, 1990, 1998; Krugman, 1991). Most of the studies from economics and management assume that firms within the same cluster are homogeneous and achieve similar levels of performance. But the fact is that firms within a cluster display varying degrees of success (Saxenian, 1994). This raises the interesting question of what factors underpin the differential success of firms in the same cluster.

Economic geographers have noted that knowledge exchange is a critical element that defines performance in clusters (Tallman et al., 2004). This is not due to geographic proximity per se (Beaudry and Breschi, 2003). The argument is that firms located inside the geographical cluster have higher incentive capacities to perform information exchange than firms located outside of it. From the resource-based view (hereafter RBV), idiosyncratic resources are determinants of firm performance (Barney, 1991). Such resources consist not only of relatively immobile internal resources, but also of external resources such as relationships. For instance, McEvily and Zaheer (1999) have argued that external resources, especially knowledge organized through inter-organizational networks, may play a crucial role in the generation of competitive advantages. Frequent knowledge exchange among firms located in a cluster is a prominent characteristic of a geographic cluster. Though firms in the same cluster have better opportunities to conduct information exchanges than firms located outside of it, these opportunities will not be realized without trust between the firms. Only when the embeddedness of firms’ network relationships localized in this cluster has been realized can the diffusion of knowledge and collective learning among firms be triggered. Through a close inter-organizational network with others, firms may obtain valuable complementary resources from other firms as well as build trust with them. As trust grows, firms become more willing to engage in knowledge exchange.

This study applies the concept of social networks to the studies of geographic clusters to explain why firms in the same cluster will differ in their performance. We propose that firms within a cluster possess different degrees of networking, so that their competitive advantages will be different as well. Establishing network relations is the key to the survival of small- and medium-sized enterprises (SMEs), since they are always an integral part of one large industrial network. As a newly industrialized country, Taiwan has enjoyed an enviable economic performance in the last few decades. There are several important geographic clusters in Taiwan, most of them are occupied by numbers of SMEs. Wang (2007) found that frequent sharing of orders, production facilities and key personnel among these Taiwan SMEs enables them to gain competitive advantage against even large global corporations.

Most studies have focussed on either the relationship between clusters and competitive advantage or on the relationship between interfirrm networks and competitive advantage. Though a few studies have linked these three constructs (Bell, 2005; McEvily and Zaheer, 1999), most remain at the conceptual development stage. This study, using clusters in Taiwan as the setting, investigates how firms’ network relationships in a geographic cluster affect their competitive advantages. We propose that mere location in the right cluster does not necessarily lead to the firm outperforming its rivals.

In this study we developed two multi-dimensional measurement scales, based on the extant literature, to measure the focal firm’s degree of networking and its competitive advantage. Collected data come from two different geographic clusters in Taiwan, one a high-tech cluster, the other a traditional industry cluster. Our analysis shows support for our ideas about the causal relationship between the geographic cluster, the degree of networking and firms’ competitive advantages.
The paper is structured as follows. Following a literature review, we construct our hypotheses. We then introduce our study setting and methodology. Finally, we offer discussions and conclusions based on our findings.

2. Literature and hypothesis

2.1 Geographic cluster and firms' competitive advantages

In this study we define a geographic cluster as a geographically proximate group of interconnected companies, suppliers, service providers, and associated institutions in a particular field, linked by commonalities and complementarities (Porter, 1998, 2003). We treat firms' competitive advantage as a multi-dimensional scale including cost (production cost per unit, cost of goods sold, selling price to end-users overseas; Kaleka, 2002; Miller and Roth, 1994; Wheelwright, 1984), quality (surpass rivals in features or performance characteristics; Kaleka, 2002; Miller and Roth, 1994; Wheelwright, 1984), flexibility (handle difficult or non-standard orders and lead in new product introduction, and response to product or volume changes; Miller and Roth, 1994; Wheelwright, 1984), service (product accessibility, technical support/after-sales service, product line breadth; Kaleka, 2002; Miller and Roth, 1994) and delivery dependability (delivery on time, and response time to correct failures; Kaleka, 2002; Miller and Roth, 1994; Wheelwright, 1984).

There are many discussions about the economic advantages of geographic proximity and the external economies of geographic clusters. Porter (1990) argued that firms within a cluster benefit from agglomeration effects via common infrastructure which includes pools of skilled labor, qualified suppliers, available capital, professional service firms, and R&D labs (Saxenian, 1994). Access to any one of these factors can enhance resident firms’ competitive advantage. For example, resident firms can hire employees conveniently and quickly in response to sudden needs. This, it appears, that firms inside a cluster achieve greater cost advantages as well as greater flexibility in production adaptation than firms outside the cluster. The cluster also provides access to a stock of professional service firms such as attorneys, bankers, and universities, whose knowledge about industry-specific competitive dynamics can contribute to the resident firms’ competitive advantages (St. John and Pouder, 2006).

Porter (1990, 1998) argues that knowledge sharing among firms with a common geographic background could provide competitive advantages to the group of firms as a whole. Knowledge may be simple or complex, explicit or tacit. It is also sticky and place specific. RBV theorists argue that only complex, embedded, tacit, and firm-specific knowledge resources (Grant, 1996) can be treated as sources of competitive advantage. Firms with geographic proximity to each other will have a greater opportunity to learn such knowledge through face-to-face interactions. Thus, better opportunities for knowledge sharing may be the most important reason for the enhancement of competitive advantage conferred by the geographic cluster (Porter, 1990, 1998).

Furthermore, since the quality of information transferred will decay with distance (Saxenian, 1994), firms inside the cluster also have better opportunities for transferring high-quality knowledge than outsiders (Porter, 1990; Pouder and St. John, 1996). These characteristics of knowledge sharing promote a virtuous cycle by reinforcing the knowledge base of the cluster, making it a location that attracts other firms (McCann and Arita, 2006).

However, a better opportunity does not equal a realized opportunity. There are many obstacles to the realization of opportunities from locating in an industrial cluster.
An important one, as many social network theorists have argued, is distrust between firms (Das and Teng, 1998; Granovetter, 1973; Larson, 1992; Powell et al., 1996). According to the arguments of these theorists, only when a network (which will be explained further in the next section) has been implanted deep enough in the first place can mutual trust be cultivated, enabling greater realization of opportunities. Thus, we propose the following hypothesis:

**H1.** After taking into account the degree of networking, the direct effect of geographic proximity to a cluster on a focal firm’s competitiveness will be not significant.

### 2.2 Degree of networking and firms’ competitive advantages

The concept of a social network has its origins in sociology (Granovetter, 1973). The structure of a network is formed by a several nodes and connections which would account for much of the social behavior of the actors in the network (Lincoln, 1982). The application of this concept to the business world has led to interesting and insightful findings for business behavior as well (Hansen, 1999; McEvily and Zaheer, 1999; Rindfleisch and Moorman, 2001).

Sociological theory has developed a variety of quantitative measures to depict the actors and patterns of networks, including density (the proportion of observed links to all potential links in a network; Kenis and Knoke, 2002; Paccagnella, 1998; Tichy et al., 1979), intensity (either to the strength of the relation between members, or the number of contacts in a unit of time; Hoffmann, 2007; Tichy et al., 1979; Whetten, 1982), reciprocity (along a link between firm A and firm B, A has sent at least one message to B and B has sent at least one message to A, the link is defined as a reciprocated link; Kenis and Knoke, 2002; Tichy et al., 1979), multiplexity (the extent to which a pair of members is linked by a diversity of other units; Saxenian, 1994; McEvily and Zaheer, 1999; Porter, 2003) and betweenness (firms in the network lie between many firms in their ties with each other, enabling control, or the capacity to interrupt communication; Freeman, 1979). All these measures not only show that the network is a multi-facet concept, but also implies that this concept is not simple dichotomy, but rather, different actors will display different degrees of involvement.

**Firms can create sustained competitive advantage by using their own internal resources** (Barney, 1991) or leveraging external resources (Dyer and Hatch, 2006). The advantages originating from inter-organizational networks may include mitigating environmental uncertainty, reducing transaction cost, promoting social learning of adaptive responses between firms (Kraatz, 1998; Tallman and Chacar, 2011), and providing access to complementary resources or information for the development, production, and marketing of products (Deeds and Hill, 1996; Lamin and Dunlap, 2011; Yang and Liu, 2012).

Network relationships with high degree of density will affect the quality of resource flows (Gnyawali and Madhavan, 2001). Interacting densely lessens the difficulties in propagating messages and minimizes the potential for distorted communication which in turn facilitates faster and more efficient resource flows. Next, a relationship with high reciprocity enables firms to diminish information asymmetry and fosters the commitment of their resources (Lee et al., 2001) so to encourage the opening of channels of knowledge exchange. This in turn causes new information to circulate more rapidly and reliably (Kenis and Knoke, 2002). Furthermore, firms with more intensive relationships with other firms will generate in-depth communications and
trust with each other which will encourage knowledge sharing (St. John and Pouder, 2006) so as to facilitate transmission of tacit knowledge (Cross et al., 2001). Taken together, these enhance understanding of buyers’ service requirements (Kim and Lim, 1988), alignment of product features for meeting customer demands (Bello et al., 1991), more effective customer service responses (Souchon and Diamantopoulos, 1996), rapid adaptation to product and volume changes, and simplification of coordination (Ancona and Caldwell, 1992) which will lead to increasing dependability and quality of delivery, and greater cost economization. Relationships with both higher density and multiplexity offer multiple alternative routes for filtering and assessing information quality and reliability (Kenis and Knoke, 2002; McEvily and Zaheer, 1999), resulting in optimization of cost minimization, quality conformance, delivery reliability, and customer service improvement. Closer relationship ties promote dissemination of tacit knowledge in terms of product knowledge and critical technology. Although betweenness is an important measure for networks, it will not vary with the other four (Burt, 1992). We treat it separately. Based on the foregoing discussion we construct the following hypothesis:

\[ H2. \] The higher the degree of networking of a firm, the greater its competitive advantage.

### 2.3 Geographic cluster and degree of networking

Extant research notes that geographic proximity will help firms to develop strong relational ties (Granovetter, 1973; Porter, 1998), which enable firms to exchange critical resources and achieve their goals (Gnyawali and Madhavan, 2001). Given spatial proximity to a cluster, firms can know and find each other with lower transaction costs (Johansson and Quigley, 2004). Thus, as a consequence of geographic proximity, firms will contact each other more easily, increasing the number of relations between them. Hence the network relationship between geographically proximate firms will be denser and more multiplexible than for isolated firms. McEvily and Zaheer (1999) note that firms located in spatial proximity are more likely to communicate face-to-face which may result in more frequent, or more routinized interactions (Johansson and Quigley, 2004), strengthening the relationships between them. Furthermore, Kenis and Knoke (2002) observed that a key characteristic of geographic closeness is that formal and informal communications will occur between both firms and their employees, and will deepen the relationship between them. The logic described above suggests the following hypothesis:

\[ H3. \] The closer a focal firm to a geographic cluster, the higher the degree of networking of the firm.

### 2.4 Geographic cluster, degree of networking, and competitive advantage

We have argued that firms cannot gain the benefits of knowledge circulation in the cluster based on mere geographic proximity itself. As a metaphor, the presence of a library nearby A’s house do not guarantee A will be rich in knowledge. There are full of industrial-specific knowledge in geographic clusters. Usually, such knowledge is more valuable than physical or financial resources for residential firms’ competitive advantages (St. John and Pouder, 2006). However, it is always hard to transfer knowledge from its source to potential users since it often has tacit aspects (Szulanski, 1996). In addition, transferring knowledge to firms’ supply networks may risk dissipation of its
competitive advantage through transfer of valuable knowledge to competitors who use the same suppliers (Dyer and Hatch, 2006). If firms perceive that their knowledge resources are jeopardized by knowledge spillovers, they will decide not to share valuable knowledge.

In \( H3 \), we propose that geographic closeness offers an opportunity for firms to build high degree networking relationships with others. A high degree of networking not only improves mutual familiarity but also fosters mutual trust between firms (Barnes, 1999). Mutual familiarity facilitates the transfer of tacit knowledge (Granovetter, 1973; Uzzi, 1997). With higher mutual trust, willingness to engage in the sharing of valuable knowledge will be encouraged (Becattini, 2004; Sorenson and Stuart, 2001). Thus, valuable knowledge can be fully diffused throughout the geographic cluster via the web of relationships (McEvily and Zaheer, 1999), in turn enhancing competitive advantage for firms in the web. The logic described above suggests the following hypothesis:

\( H4. \) The degree of networking has a mediating effect on the relationship between the geographic cluster and a firm's competitive advantage.

2.5 Betweenness and firms' competitive advantages

Favorable positions are viewed as network resources (Granovetter, 1985; Burt, 1992; McEvily and Zaheer, 1999). A key insight developed in the network literature is the "structural hole" (Burt, 1992). A structural hole exists between firms when one firm has ties to other firms that are not tied directly to each other. Bridging structural holes confers advantages to the firm by offering entrepreneurial opportunities for information access, timing, and control (Burt, 1992). Thus, firms that occupy key positions in more sparsely connected networks would obtain competitive advantages (Giuliani, 2013; Tsai, 2001). Similarly, centrality is the extent to which a given firm occupies a strategic position in the network because of its involvement in many vital ties (Wasserman and Faust, 1994).

Betweenness is strongly related to structural holes (Pitt et al., 2006) in that the betweenness of a point measures the extent to which a firm can play the "broker" or "gatekeeper" with a potential for control over others (Scott, 1991). Not only are go-betweens frequently located on the information paths between firms of the network, they can enjoy more effective and efficient flows of assets and information (Burt, 1992) so that they generally have access to more and better resource and opportunities (Gulati et al., 2000) in terms of production, quality, and customer service. Further, go-betweens can gain control over resource flows between disconnected firms, be informed more rapidly about the actions of others, and can assess their motives and behaviors more accurately and quickly (Gnyawali and Madhavan, 2001). Finally, with go-betweens, one can obtain a richer and more varied set of resources as well as novel and diverse information (Tsai, 2001), all of which will help the entrepreneur to launch innovative activities. Furthermore, Burt (1992) has argued that having a dense, intensive, reciprocal, and multiplexible network is not always accompanied by a good go-between position. Thus, we propose the following hypothesis:

\( H5. \) The higher the degree of betweenness of a firm, the greater its competitive advantage.
3. Methodology

3.1 Research setting

According to Porter’s (1998, 2003) definition, a cluster is geographically proximate group of interconnected companies, suppliers, service providers, and associated institutions in a particular field, linked by commonalities and complementarities. The electronics industry in the Hsinchu Science Park (HSP) was chosen as the data set because it is a prominent geographic cluster that has achieved a remarkable worldwide reputation. There are several institutes of higher education around HSP, including National Chiaotung University, National Tsinghua University (NTHU), the Industrial Technology Research Institute, and three national laboratories, that provide HSP firms with plentiful technological and labor resources. Because the park is merely the core of a very large cluster of firms in this industry that sprawls across the northern part of the island, the research setting of this paper extends over both Hsinchu City and County.

Another observed industrial cluster is the textile industry, of great historical importance in Taiwan’s economic development. Hemei Town in Changhua County played a critical role in Taiwan’s textile industry. We selected this industry as the research subject not only because of its success but also because the particular structure of the industry, in which textile firms have formed closely linked networks (Chen, 1999).

We tested the proposed model with a survey data set, as most research on network measurement has focussed on data collected via surveys and questionnaires, particularly in the study of inter-organizational relations (Marsden, 1990). A list of 265 firms from the HSP Administration for the HSP cluster and a list of 239 firms in the Hemei cluster from Industrial Development Bureau of the Ministry of Economic Affairs were selected as our samples.

3.2 Data collection

Two pretests guided the questionnaire development. The first pretest was given to scholars to help modify a preliminary version of the survey instrument which we developed by identifying scale items used in previous research. The second pretest consisted of interviews with five current top executives of manufacturing firms found through personal contact. We used feedback from the interviews to refine the survey wording and improve the overall presentation of the survey instrument. The survey instrument was endorsed by a well-known the National Science Council executive in order to elicit a higher response rate. Two trained graduate-level research assistants administered the respondent surveys in the two geographic clusters. In the HSP, we contacted the respondents by telephone to obtain agreement to answer the questionnaire prior to sending the survey instrument. In order to raise the rate of response, work-study students at the College of Technology Management in NTHU were also chosen as a sample. Such students were provided by the EMBA program of NTHU and the Tze Chiang Foundation of Science and Technology. We joined the work-study programs because they contained the continuing education programs for top managers of HSP firms. The final questionnaire was mailed to 206 respondents within the HSP cluster. To avoid sending multiple questionnaires to the same firm, we checked and eliminated repeated questionnaires from the two sample sources. In the textile cluster in Hemei, executives operated on site frequently and were reluctant to respond to our questionnaire by e-mail or fax. In view of this, we visited respondents personally and interviewed them orally to promote higher response rate and assure accuracy of data. Questionnaires from
a total of 101 firms within the HSP cluster and 55 firms within the Hemei cluster were received and a final usable sample of 90 (response rate = 43.69 percent) and 48 (73.85 percent) firms were obtained, respectively. To further confirm the representativeness of our sample, we conducted a $\chi^2$-test comparing respondents with the total population on both firm size and sales. We found no significant differences ($p$-values were 0.11 for the HSP cluster and 0.15 for the Hemei cluster) which suggested that the two samples were sufficiently representative of the population on key demographics.

3.3 Measures
3.3.1 Cluster. Both the dichotomy method (e.g. Bell, 2005) and geographic dispersion (e.g. McEvily and Zaheer, 1999) are the predominant measure of geographic cluster in extant research. We modified the measure of this variable from the latter method and gauged distant proximity of the subjects. Following the extant work, there are seven types of relationships within the cluster which included up-stream link, down-stream link, rival firms, professional service firms (transport, business agency, legal, and other services), academic or research institutes, available capital (banks, venture capital, and other financial services), and other organizations (chamber of commerce, HSPA, Taiwan Textile Federation). The respondents of the seven types of relationships were asked to indicate the degree to which their corporate members reside in the cluster. The seven items used a Likert-type seven-point scale ranging from 1 (“strongly disagree”) to 7 (“strongly agree”).

3.3.2 Degree of networking. Using previous work on quantitative evaluation of networks from sociology (Knoke and Kuklinski, 1982), we selected a set of network properties depicting degree of networking. Degree of networking is a term created in this research to measure the degree to which firms possess network relationships. Four dimensions comprise degree of networking: density, intensity, reciprocity, and multiplexity. Following the definition of density from Kenis and Knoke (2002), Paccagnella (1998), and Tichy et al. (1979), the respondents were asked to evaluate the perception of the relationship concerning the density in light of seven types of relationships. We summed the scores of the seven items:

$$D = \sum_{i=1}^{n} d_i$$

where, $d$ is the density item which used a Likert-type seven-point scale ranging from 1 (“strongly disagree”) to 7 (“strongly agree”) and $n$ represents the seven types of links (labeled 1-7). We then computed the average of the total score to obtain the value of the density. The higher the value obtained, the higher the network density.

Drawing on the definition of intensity from Granovetter (1973) and Tichy et al. (1979), we asked the respondents to rate the perception of the intensity of relations. Similar to the density calculation, the sum of scores of the seven items was obtained, where $i$ is the intensity item, using a Likert-type seven-point scale ranging from 1 (“strongly disagree”) to 7 (“strongly agree”), while $n$ ranged from 1 to 7:

$$I = \sum_{i=1}^{n} i_i$$

We then calculated the average of the total score to obtain the value for intensity. The higher the value, the higher the network intensity.
For reciprocity we followed previous studies (Kenis and Knoke, 2002; Paccagnella, 1998; Tichy et al., 1979). Reciprocity means symmetrical exchange of resources between firms. This variable was measured by a pair of items. The respondents were asked to gauge the degree to which they perceived the tie they had with each other. The score of each pair[1], which equaled the difference between an average of the sum of two scales \( r_{1i} \text{ and } r_{2i} \) and the absolute value of the difference between two scales, ranged from \(-2\) to \(7\). We summed up the scores of the seven pairs as follows:

\[
R = \sum_{i=1}^{n} \left( \frac{(r_{1i} + r_{2i})}{2} - |r_{1i} - r_{2i}| \right)
\]

where \( r_{1i} \text{ and } r_{2i} \) are the pair of reciprocity items which used a Likert-type seven-point scale anchored at 1 (“strongly disagree”) to 7 (“strongly agree”). We computed the average of total scores to gain the value of the reciprocity, the higher the value, the higher the network reciprocity.

Following prior research (Granovetter, 1973; Kenis and Knoke, 2002; Marsden, 1990; Tichy et al., 1979), multiplexity was adopted using dichotomous indicators of its presence or absence in light of above seven types of links that the presence of a given type was coded “1” and the absence was coded “0.” The value of the multiplexity ranged from 1 to 7.

3.3.3 Betweenness. Referred to the definition of Freeman (1979) and Kenis and Knoke’s (2002), the betweenness item was developed using a Likert-type seven-point scale ranging from 1 (“strongly disagree”) to 7 (“strongly agree”). We asked the respondents to indicate their perception of the degree of betweenness among its relationships.

3.3.4 Competitive advantage. The source of competitive advantage typically includes cost, flexibility, quality, and delivery in previous studies (Wheelwright, 1984; Chen, 1999). Recent research also includes innovativeness and customer service as important competitive dimensions (Kaleka, 2002; Miller and Roth, 1994; Orr, 1999). We thus selected innovativeness, cost, flexibility, quality, accuracy in delivery, and customer service to measure competitive advantage. A firm has achieved competitive advantage when it provides more value for its customers than rival firms. In view of this, all items asked respondents to compare their own firm with other firms using a Likert-type seven-point scale ranging from 1 (“strongly disagree”) to 7 (“strongly agree”). To gauge innovativeness, we adapted the scale of Bell (2005) and Kaleka (2002) to use two items to measure the degree to which respondents appraised the relative advantages arising from innovativeness. Following the scale of Chen (1999), Miller and Roth (1994), and Wheelwright (1984), we asked the respondents to indicate the degree to which they assessed the relative advantages stemming from accuracy in delivery via two items. Flexibility was referred to prior research (Chen, 1999; Kaleka, 2002; Miller and Roth, 1994; Orr, 1999; Wheelwright, 1984) and made up of four items that measured the degree to which respondents evaluated the relative advantages in terms of production flexibility. Drawing on Chen (1999), Kaleka (2002); Orr (1999), and Wheelwright (1984), we asked the respondents to rate their advantages stemming from low total cost. To gauge quality, we followed Miller and Roth (1994) and Wheelwright (1984), and used three items to measure the degree to which respondents gauged their product quality. Customer service consisted of four items based on past research (Kaleka, 2002; Miller and Roth, 1994).

3.3.5 Control variable. There was a significant positive link between firm size and performance and a significant negative link between firm age and performance in the previous work (Bell, 2005). We included these factors as control variables. Firm age
was measured on a five-point scale in terms of the number of years since the firm's inception. Firm size was measured by the number of employees using a five-point scale.

4. Analysis and results
Companies in this study were drawn from two industries. An independent-sample t-test across all of the variables was undertaken and it was found that ten of 12 showed no significant differences in means (p < 0.05) except for multiplexity and cost, and so were judged to be acceptable for further analysis. The means, standard deviations, and intercorrelations for all variables used in the study were shown in Appendix 1. Cronbach’s α coefficients can be calculated to test internal consistency reliabilities for each variable. The Cronbach’s α coefficients for network and competitive advantage were 0.81 and 0.85, respectively, indicating adequate levels of internal consistency. However, the self-report measure of network ties should be assessed by longitudinal studies which examine the stability of responses to network items, especially for data collection with single items (Marsden, 1990). A three-week sample of the returned surveys for test-retest reliability was examined by administering cluster and network scales to a group of ten firms at random. The Pearson Correlations were found to be 0.87 for cluster scale and 0.88 for network scale, scores considered sufficient for the further use of each scale in research.

As suggested by Anderson and Gerbing (1988), convergent validity was assessed by examining using confirmatory factor analysis (CFA). The results revealed that all of standardized factor loadings were statistically significant (p < 0.05) on their respective constructs, and the goodness-of-fit indices reported acceptable levels ($\chi^2 = 79.520$, df = 50, CFI = 0.960, GFI = 0.910, NFI = 0.910, NNFI = 0.940, IFI = 0.960, RMSEA = 0.066, SRMR = 0.058). Hence, convergent validity was achieved. Discriminant validity was examined by computing confidence intervals for the estimates of the inter-construct correlations. The results showed that none of the confidence intervals for the $\phi$ values in the measurement model included a value of 1.0; moreover, discriminant validity was also established by constraining the correlation between a pair of constructs in the measurement model. The $\Delta \chi^2$ statistics (see Appendix 2) showed that all of inter-construct correlations were significantly different from unity except the correlations between betweenness and degree of networking ($\Delta \chi^2 = 0.49$, df = 1). Additionally, we included betweenness among degree of networking and launched a CFA to examine the convergent validity of degree of network. The findings showed that the factor loading of betweenness was non-significant ($\beta = 0.11$), which suggested that betweenness should be removed from the concept of degree of networking. All in all, the measurement model exhibited an adequate level of discriminant validity.

Drawing on the Anderson and Gerbing (1988) decision tree framework, the theoretical model was investigated by $\chi^2$ difference tests. Referring to previous studies, we fitted three nested models (see Appendix 3). The result of $\chi^2$ difference test demonstrates that Model 3 was preferred over Model 1 and Model 2. Hence, we concluded that Model 3 should be the most acceptable and most parsimonious model.

Base on the Model 3, we proceeded to evaluate overall model fit and analyze the hypotheses. In assessing overall fit, the goodness-of-fit indices (see Appendix 5) indicated a satisfactory fit of the model with the data. With respect to the full structural model, the results showed that $H2$ is largely supported (see Appendix 4); the link between degree of networking and competitive advantage is positive and statistically significant ($\beta_{21} = 0.28$). As predicted in $H3$, the findings revealed that geographical
cluster appears to strongly influence degree of networking ($\gamma_{11} = 0.59$), which allowed $H3$ to be verified.

$H1$ and $H4$ related geographic cluster and degree of networking to competitiveness; the results provided support for $H$ predicting a non-significant relationship between geographic cluster and competitive advantage because of $\chi^2$ difference tests, which recommended the most fitted model was the complete mediation model (Model 3) rather than partial mediation model (Model 1). Therefore, the data exhibited significant statistical relationships for the indirect effect of geographic cluster on competitive advantage via degree of networking, supporting $H4$. Finally, $H5$ positively relating betweenness to competitive advantage was supported by the data, since the relationship is significant ($\gamma_{22} = 0.23$).

5. Discussions and contributions
This research develops a framework to provide an insight to the mechanisms underlying the competitive advantage of clusters described by Porter (1990). While extant research has argued geographic cluster and network relationship have positive impact on firms’ performance respectively, there is a dearth of work that simultaneously examines geographic clustering, network relationships, and competitive advantage and delineates their causal relationships. This study attempts to demonstrate firms within the same cluster that establish idiosyncratic network resources have superior competitive advantage over firms which do not. We borrow network concepts and quantitative assessment methods from sociology to create a composite measure of firms’ network relationships termed “degree of networking.” As our empirical data shows, firms are indeed more likely to establish high degree of networking in the cluster. Further, degree of networking does play a mediating role between geographic cluster and competitive advantage. Whereas several empirical studies have found that clustered firms show better outcomes than isolated firms (Bell, 2005; Porter, 1990) though some studies question these findings (Beaudry and Breschi, 2003), we argue that exploration of relationship between geographic cluster and competitive advantage while neglecting the mediating effect of network effects may be the cause of the conflicting findings of researchers. We find support for this argument that mere geographic proximity to a cluster by itself will not strengthen a firm’s competitive advantages, but instead confers better opportunities to develop network relationships with other firms proximate to the same cluster. Through the relationship being developed their competitive advantage will be enhanced. Our study also confirms that betweenness position is conducive to the pursuit of competitive advantage. The concept of degree of networking consists of four dimensions: density, intensity, reciprocity, and multiplexity. These show a given firm’s network relationships, but do not reflect the network position that firm occupy. This study provides support for the importance of betweenness position in firms’ competitive advantage and its independence both to the geographic distance and the degree of networking.

For managers, our results suggest that simply moving to the cluster may not lead to sustained competitive advantage. In effect, managers should be conscious that it is essential to explore the opportunities which clusters confer by establishing a high degree of networking in their pursuit of competitive advantage.

Network relation is measured by dyadic data for respondents ideally; however, it is unfeasible in our research setting. Instead, this study collected network data through questionnaire for unitary measures. Even though we attempt to confirm the reliability and validity of the survey instrument for diminishing this problem, there is inevitably
limitation involved in the measurement bias. A second issue associated with network side effect is that networking building and maintenance may incur costs (Uzzi, 1997); however, the study focussed on the mediating role of inter-organizational networks on the relationship between geographic clusters and competitive advantages. Hence, there is an interesting area for future qualitative research to explore regarding the issue of negative network effects stemming from development of networks. Although, the study shows the importance of external network resources, such as the degree of networking and the betweenness position, another fruitful area of inquiry is the issue of trade-offs between the degree of networking and betweenness.

Note
1. A pair of reciprocity scores from firm A was 3 and 3 in comparison with another pair of items from firm B which were 0 and 7. The value of reciprocity for A was smaller than B; however, the reciprocity network of A was better than B. In order to resolve this problem, we deducted “the absolute value of the difference between two scales” from “the average of sum of two scales” to emphasize the degree of reciprocity.

References


<table>
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<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
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<td>0.267****</td>
<td>0.263***</td>
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<td>0.154*</td>
<td>0.128</td>
<td>0.200**</td>
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<td>0.355***</td>
<td>0.614***</td>
<td>0.648***</td>
<td>0.691***</td>
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Notes: ***p < 0.01; **p < 0.05; *p < 0.1
### Appendix 2

<table>
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<tr>
<th>Pair of construct</th>
<th>Constrained model ( \chi^2 )</th>
<th>df</th>
<th>Unconstrained model ( \chi^2 )</th>
<th>df</th>
<th>( \Delta \chi^2 )</th>
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<td>Degree of networking</td>
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<td><strong>Degree of networking</strong></td>
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<td>35</td>
<td>59.52</td>
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<td>17.31</td>
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**Notes:** 1 df with \( p = 0.001, \chi^2 = 10.827; p = 0.01, \chi^2 = 6.635; p = 0.05, \chi^2 = 3.841; p = 0.1, \chi^2 = 2.706.**

### Appendix 3

<table>
<thead>
<tr>
<th>Model</th>
<th>( \chi^2 )</th>
<th>df</th>
<th>( \Delta \chi^2 )</th>
<th>Result</th>
<th>Fit model</th>
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<td>67.11</td>
<td>50</td>
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<td>–</td>
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<td>Model 2 (no indirect)</td>
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<td>Model 3 (indirect)</td>
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<td>51</td>
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<tr>
<td>Model 2 – Model 1</td>
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<td>–</td>
<td>37.40</td>
<td>Agree</td>
<td>Model 1</td>
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<tr>
<td>Model 3 – Model 1</td>
<td>–</td>
<td>–</td>
<td>0.72</td>
<td>na</td>
<td>Model 3</td>
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</table>

**Notes:** 1 df with \( p = 0.001, \chi^2 = 10.827; p = 0.01, \chi^2 = 6.635; p = 0.05, \chi^2 = 3.841; p = 0.1, \chi^2 = 2.706.**

Model 1 was that degree of networking mediated the effect of geographic cluster on competitive advantage while betweenness influenced competitive advantage directly. Model 2 was that geographic cluster, degree of networking, and betweenness directly affected competitive advantage. Model 3 was that degree of networking acted as a mediator between geographic cluster and competitive advantage.

### Appendix 4

<table>
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<tr>
<th>Latent variable</th>
<th>Measure variable</th>
<th>Standardised parameter estimates</th>
<th>SD</th>
<th>( t )-value</th>
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<td>Geographic cluster</td>
<td>Distant proximity ( \lambda_{x_{11}} )</td>
<td>1.00 (Fixed parameter)</td>
<td>(Fixed parameter)</td>
<td>(Fixed parameter)</td>
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<tr>
<td>Betweenness</td>
<td>Go-between ( \lambda_{x_{22}} )</td>
<td>1.00 (Fixed parameter)</td>
<td>(Fixed parameter)</td>
<td>(Fixed parameter)</td>
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<tr>
<td>Degree of networking</td>
<td>Density ( \lambda_{y_{11}} )</td>
<td>0.97 (Fixed parameter)</td>
<td>0.04</td>
<td>23.64</td>
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<td>Intensity ( \lambda_{y_{21}} )</td>
<td>0.96*** 0.04</td>
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<td>Reciprocity ( \lambda_{y_{31}} )</td>
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<td>Multiplexity ( \lambda_{y_{41}} )</td>
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<td>Competitive advantage</td>
<td>Innovativeness ( \lambda_{y_{52}} )</td>
<td>0.72 (Fixed parameter)</td>
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<td>Cost ( \lambda_{y_{62}} )</td>
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<td>Flexibility ( \lambda_{y_{72}} )</td>
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<td>Quality ( \lambda_{y_{82}} )</td>
<td>0.76*** 0.11</td>
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<td>Accuracy in delivery ( \lambda_{y_{92}} )</td>
<td>0.82*** 0.12</td>
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<td></td>
<td>Customer service ( \lambda_{y_{102}} )</td>
<td>0.81*** 0.12</td>
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<td>Geographic cluster → degree of networking ( \gamma_{11} )</td>
<td>0.54*** 0.06</td>
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<td>Betweenness → competitive advantage ( \gamma_{22} )</td>
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<tr>
<td>Degree of networking → competitive advantage ( \beta_{21} )</td>
<td>0.23*** 0.08</td>
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</table>

**Note:** *** \( p < 0.01 \)

### Table AIV.

Parameter estimates for structural model.
Appendix 5

Measurement items

Distant proximity (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)
(References, McEvily and Zaheer, 1999; St. John and Pouder, 2006)

(1) Your up-stream firms
(2) Your down-stream firms
(3) Your rival firms
(4) The professional service firms (transport, business agency, legal, and other services)
(5) The available capital (bank, venture capital firm, and other financial services)
(6) The academic or research institutes
(7) Other organizations (chamber of commerce, HSPA, Taiwan Textile Federation)

Density (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)
(References, Kenis and Knoke, 2002; Paccagnella, 1998; Tichy et al., 1979)
Your firm maintains ____________ with a higher number of contacts than your competitors.

(1) the up-stream link
(2) the down-stream link
(3) the link of rival firms
(4) the link of the professional service firms
(5) the link of the capital firms
(6) the link of academic or research institutes
(7) the link of other organizations

Intensity (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)
(References, Granovetter, 1973; Tichy et al., 1979)

Notes: Model statistics or Fit indices: \( \chi^2 = 67.83 \) (\( p = 0.057 \)); df=51 GFI=0.92; PGFI=0.6;
NFI=0.92; PNI=0.71; NNFI=0.97; CFI=0.97; IFI=0.97 RMSEA=0.049;
SRMR=0.059. ***\( p < 0.01 \)

Figure A1.
Results of structural equation model

Table AV.
Measurement instruments

(continued)
Measurement items

Your firm maintains ____________ with higher frequencies of contact than your competitors.
(1) the up-stream link
(2) the down-stream link
(3) the link of rival firms
(4) the link of professional service firms
(5) the link of capital firms
(6) the link of academic or research institutes
(7) the link of other organizations

Reciprocity (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)
(References, Kenis and Knoke, 2002; Paccagnella, 1998; Tichy et al., 1979)
1. ____________ are important for your firm to pursue common or complementary goals.
2. Your firm is important for ____________ to pursue common or complementary goals.
(1) Your up-stream firms
(2) Your down-stream firms
(3) Your rival firms
(4) The professional service firms
(5) The available capital
(6) The academic or research institutes
(7) Other organizations

Multiplexity (1 = yes and 0 = no)
(References, Granovetter, 1973; Kenis and Knoke, 2002; Marsden, 1990; Tichy et al., 1979)
Does your firm contact any ____________?
(1) up-stream firms
(2) up-stream firms
(3) down-stream firms
(4) rival firms
(5) professional service firms
(6) capital firms
(7) academic or research institutes
(8) other organizations

Betweenness (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)
(References, Freeman, 1979; Kenis and Knoke, 2002)
(1) Your firm plays a go-between among the seven types of contacts for communicating.

Innovativeness (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)
(References, Bell, 2005; Kaleka, 2002)
(1) Product design
(2) Access to new technologies

Accuracy in delivery (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)
(References, Chen, 1999; Miller and Roth, 1994; Wheelwright, 1984)
(1) Speed of delivering products
(2) Reliability in terms of time and volume

Flexibility (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)
(References, Chen, 1999; Kaleka, 2002; Miller and Roth, 1994; Orr, 1999; Wheelwright, 1984)
(1) Make rapid design changes and introduce new products quickly
(2) Respond to swings in volume
(3) Change product mix quickly
(4) A broad product line

Table AV. (continued)
Measurement items

**Cost (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)**
(References, Chen, 1999; Kaleka, 2002; Orr, 1999; Wheelwright, 1984)
1. Low total cost

**Quality (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)**
(References, Miller and Roth, 1994; Wheelwright, 1984)
1. Offer consistent quality
2. Provide more performance products
3. Provide higher reliability of products

**Customer service (Seven-point scale, where 1 = strongly disagree and 7 = strongly agree)**
(References, Kaleka, 2002; Miller and Roth, 1994)
1. Provide excellent after sale service
2. Provide product information and technical support
3. Provide wide distributions access to product
4. Provide products satisfied with customers

**Control variables (five-point scale)**
1. Firm age (the number of years) (1 is lower than five years, and 5 is greater than or equal to twenty years)
2. Firm size (the number of employees) (1 is lower than 100 employees, and 5 is greater than or equal to 5,000 employees)

Table AV.

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Han-Sheng Lei is an Associate Professor of Business Administration at the National Yunlin University of Science and Technology, Taiwan. He received his PhD in Strategic Management and International Business from the National Chen-Chi University, Taiwan. Before he works as a Scholar, he had been as a Professional Manager for some small and medium size business in Taiwan and China. His research interests include geographical cluster, interfirm networks, and FDI of Taiwan firms. Mr Lei has published articles in *International Business Review* and other journals.

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