Cluster Competitiveness: The Six Negative Forces

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Regional clusters have gained great popularity with international development agencies, local authorities, planners, and corporate strategists, as a means of achieving greater competitiveness and economic growth. A considerable body of work has rendered strong theoretical and empirical support to the cluster approach and governments have poured in enormous amounts of funds to promote and facilitate cluster strategies. Yet, not all clusters are sustainable. This paper pulls together insights from knowledge management, strategic management as well as social network, social identity, and social exchange theories to provide a comprehensive understanding of the socio-political dynamics of clusters. Specifically, it is argued that the competitiveness of regional clusters can be compromised by the development of a homogeneous macroculture, social identity discrepant, power imbalance, market rationalization, lack of untraded interdependencies and overwhelming negative externalities.

Introduction

Regional clusters have been touted as a way of achieving growth through increased operational efficiency, faster innovations and more successful entrepreneurial startups (Krugman, 1991; Scott, 1998; Martin & Sunley, 1998; Porter 1998). Many case studies show that clustering enhances competitiveness because of collective efficiency and cohesive network relationships that develop (Bartelman, Caballero & Lyons, 1994; Martin & Ottaviano, 2001; Nadri & Schmitz, 1999; Rabellotti, 1999; Schmitz, 1995). The agglomeration literature generally underscores positive cluster dynamics that generate positive self-reinforcing feedback loops, leading to further growth and higher profitability. As such, many governments try to promote the development of regional

clusters by offering tax benefits, financial incentives, and infrastructural facilities to encourage foreign multinational corporations and entrepreneurial firms to relocate in favor of their clusters (Schmitz, 2000; World Bank, 2000).

Spatial competitiveness is the ability of a regional economy to not only attract and keep viable business enterprises with stable or increasing market shares, but also to sustain or enhance the living standards of its residents (Storper, 1995; Begg, 1999). Regional economies compete among themselves based on their competitive advantages such as superior technology, state-of the-art infrastructure and institutional capital, or comparative advantages such as wage flexibility and exchange rate favorability (Camagni, 2002). As such, the competitiveness of regional economies may change over time (Gardiner, Martin & Tyler, 2004).

To ensure sustainable inflow of resources, clusters compete with one another to attract finance, entrepreneurial talent and managerial capabilities by developing cluster-specific knowledge assets, creating superior market value, offering promising innovative capability, and providing up-to-date infrastructure. Clusters do not stand in splendid isolation. Rather, they are pitched against one another by dynamic competitive forces in an ongoing battle for scarce resources. Regional economies that face competitive or comparative disadvantages may become trapped in "spirals of relative decline" when their firms find it increasingly hard to access export markets (Greene, Tracey & Cowling, 2007, p. 5).

We know empirically about the decline of two well-known clusters: viz., the minicomputer cluster at Route 128 in Boston, Massachusetts and the mainframes cluster in Minneapolis, Minnesota. They painfully illustrate how rapid decline and economic devastation may follow on the heels of phenomenal growth (Pouder & John, 1996). In Europe, the cluster of closely-linked specialized Swiss watch producers and that of iron and steel producers in the Ruhr region of Germany, also adapted poorly to external technological changes and overlooked new market opportunities (Grabher, 1993; Glasmieir, 1994).

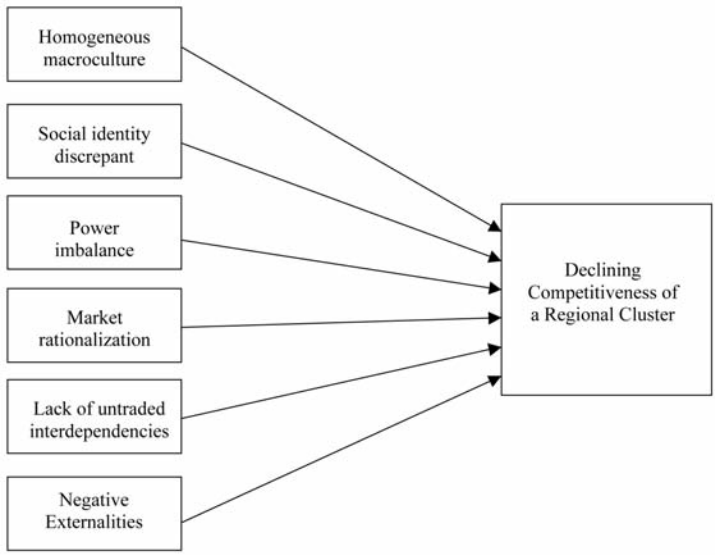
While most studies emphasize how positive intracluster dynamics enhance the competitiveness of firms located therein (Bennett, Graham & Bratton, 1999; Håkanson, 2005; Martin & Ottaviano, 2001; Porter, 1998; Smith & Ibrahim, 2006), not enough attention has been given to dysfunctional cluster dynamics which may jeopardize cluster competitiveness (Martin & Tyler, 2003; Staber, 2007). That is, much of the literature tends to "ignore broader, non-output related modalities of regional competition which may tend to have rather more negative than positive connotations" (Bristow, 2005, p. 300). I attempt to fill this void by examining the forces at work that could negatively impact the competitiveness of clusters.

I suggest a theoretical framework in which six negative forces generate self-reinforcing feedback loops which may lead to declining competitiveness. The six forces are: (1) a homogeneous macroculture, (2) a negative identity discrepant, (3) an intracluster power imbalance, (4) the introduction of new market rationalities, (5) the lack of untraded interdependencies, and (6) the presence of negative externalities.

I define the key concepts used below as follows: first, homogeneous macroculture is the existence of common mental models, shared pools of knowledge, and accepted sets of competitive behavioral norms that bind cluster firms together as a collective

entity. Second, social identity discrepant is the undesirable gap between a cluster's identity when it is seen as being less attractive and that of competing clusters. Third, power imbalance is a state of unequal resource dependence. Fourth, market rationalization occurs when novel market rationalities generate new competitive dynamics by changing the rules of competition or even by transforming a market's organizing logic. Fifth, untraded interdependencies are informal exchanges of information in the form of knowledge or technological spillovers that are not regulated by contracts signed or transactions negotiated. Finally, negative externalities are the adverse impacts of congestion, under-concentration and lack of intracluster rivalry.

Figure 1: *A Theoretical Framework on the Threats to Cluster Competitiveness*



This paper is organized into three major sections. Section 2 provides a quick overview of the literature on regional clusters, focusing on the positive forces of clustering. Section 3 discusses the conceptual framework presented in Figure 1 and argues that six negative forces may counter the positive forces leading to declining competitiveness of clusters. In the final section, I will explore the practical and research implications of the six negative forces.

Cluster Competitiveness

Positive Forces of Clustering

The agglomeration of firms in a geographical locality has been variously described in the literature as regional clusters (Porter, 2000), industrial districts (Storper, 1995; Amin, 2000), neo-Marshallian nodes (Amin & Thrift, 1992), and innovative systems (Niosi & Zhegu, 2005; Zhou & Xin, 2003). There are also different definitions of clusters (Martin & Sunley, 2003). For example, Porter (2000) defined regional cluster

as a group of colocated, interconnected firms and associations that are bound by commonalities and complementarities. Becattini provided a slightly broader definition to an industrial district, a concept popular among economic geographers, as "a socio-geographical entity characterized by the active presence of both a community of people and a population of firms in one naturally and historically bounded area" (1990, p. 39).

Regardless of terminology, most researchers acknowledge that intracluster firms gain higher competitiveness from a confluence of several positive forces. According to the industrial district tradition and based on Alfred Marshall's studies, an agglomeration of small and medium-sized companies in the same or related industries can benefit from three externalities. These are the economies of specialization of suppliers, of labor markets and of shared knowledge (Niosi & Zhegu, 2005; Meardon, 2001). Krugman (1986) highlighted external scale economies and low transportation costs as those that make clustering flourish.

According to Porter (1998), regional clusters create value and enhance their competitiveness by benefitting from linkages established horizontally and vertically with colocated firms and associated institutions. Such linkages facilitate the creation of tightly linked input-output systems. This comes from integrating suppliers of raw materials and of parts and components with some dominant industry players, as well as drawing venture capitalists closer to promising entrepreneurs. This tight integration of firms and institutions facilitates interfirm coordination as to their various supply chain roles.

The development of specialized clusters like high-technology and biotechnology clusters in the late 1980s questioned the need for colocation of value chain-related firms. Unlike traditional clusters, these firms did not colocate to fulfill upstream or downstream production requirements. Rather, they did so to capture knowledge externalities flowing from public and private research institutions and laboratories. Technologically complex pharmaceutical, aerospace, and telecommunication products were being designed, developed, and manufactured at different specialized clusters situated in different geographical regions around the world (Taggart & McDermott, 2001). The aerospace industry, for instance, is made up of numerous specialized agglomerations such as engine clusters, civil aircraft assembly clusters, and commercial aircraft clusters (Niosi & Zhegu, 2005).

To understand the competitive dynamics of these new clusters, researchers began to focus attention on the capture of knowledge externalities through strategic tie-ups and collaborations, knowledge spillover from universities, research institutes and laboratories, interfirm knowledge transfer, and the movement of managerial and technical personnel among firms and institutions (Tallman et al., 2004). Some chose to investigate accepted cluster norms and practices that facilitate systematic and interactive learning among firms (Storper, 1995; Asheim, 1999).

In examining Silicon Valleys-type clusters located in different parts of the world, Bresnahan, Gambardella and Saxenian (2001) found that different sets of forces accounted for cluster success at different stages of development. At the initial stage of cluster formation, four determinants were critical. These were: founding and growth

of new enterprises, ready availability of managerial skills, abundant supply of skilled labor, and connection to major external markets. Once a cluster had successfully taken off, the development of positive feedback dynamics became important not only in sustaining growth, but also in enhancing its competitiveness. This helped to sustain the interest and attention of venture capitalists, entrepreneurs, and skilled labor. Positive feedback dynamics can facilitate the exchange of strategic technical information and market knowledge among collaborative firms, hastening the accumulation of agglomeration benefits, and generating network synergies.

Many published journal articles on clusters, whether case studies or empirical analyses, lent strong support to the idea that spatial agglomeration improves economic performance and employment growth (Fingleton, Igliori & Moore, 2004). However, whether agglomeration also promoted innovation as postulated by Porter (1998) and Krugman (1991), remains an unsettled research question (Baptista & Swann, 1998; Suarez-Villa & Walrod, 1997). Moreover, agglomeration does not assure sustainable wealth generation as there are instances of cluster decline and loss of competitiveness. In the following sections, drawing insights from knowledge management, strategic management, social network, social identity and social exchange theories, I describe how various sociopolitical dynamics in the cluster environment may negatively impact the relative competitiveness of clusters.

Negative Forces of Clustering

I suggest that six negative forces may lead to declining cluster competitiveness. The six forces are: a homogeneous macroculture, a negative identity discrepant, an intracluster power imbalance, the introduction of new market rationalities, the lack of untraded interdependencies and finally, the presence of negative externalities.

Homogeneous Macroculture

Macrocultures are characterized by shared metaphors or world views (Huff, 1982), the homogeneous application of constructs (Spender, 1989), the presence of a common pool of knowledge specific to a group of people (Hambrick, 1982), the sharing of idiosyncratic beliefs among senior managers of a related set of organizations (Abrahamson & Fombrun, 1994), and industry-based shared assumptions, values and behavioral patterns (Jones, Hesterly & Borgatti, 1997). In clusters, interlinked value-adding networks among firms and institutions can set in motion a dynamic that may lead to the development of a homogeneous macroculture that stabilizes the exchange structure within the cluster.

However, when a homogeneous macroculture develops within a regional cluster, its competitiveness may decline for several reasons. This is because clusters are not completely isolated. Rather, clusters have a certain degree of openness and of closure to the external environment. Openness denotes the degree to which intracluster firms have significant ties with extra-cluster firms; closure denotes the degree to which intracluster firms have significant bonds with one another. How open a cluster is depends on how thick the linkages among intracluster firms and extracluster firms are. Thick internal bonds encourage norms of trustworthiness to emerge that engender the proliferation of obligations and expectations (Coleman, 1988).

Thick internal bonds mean a greater embeddedness of firms within a cluster. This, in turn, promotes economies of time as trust that helps to displace the need for excessive monitoring and protracted negotiations for collective action (Granovetter, 1985). Cluster-specific architectural knowledge also speeds up the flow of knowledge within a cluster and enhances the learning and absorptive capacity of cluster firms (Belussi & Pilotti, 2002; Gertler, 2003; Pinch et al., 2003). Fine grain information exchange speeds up decision making, and real-time joint problem solving arrangements come about more easily (Uzzi, 1997). Meanwhile, intracluster movement of people across firms speeds up the transfer of tacit technical and managerial knowledge (Almeida & Kogut, 1999).

However, too much embededness may occur when firms within a cluster fail to achieve a suitable degree of openness to extracluster ties. Overly thick internal bonds can promote an excessive tendency toward looking inward. This can lock out extracluster firms from participating in intracluster social networks, resulting in thin extracluster ties. Over-embedded firms may just resort to a "deep" search for ideas inside the cluster instead of a "broad" search for ideas outside. Pouder and St. John (2006) argued that geographical clustering of firms may lead to the development of a deep structure (i.e., a basic configuration of interdependence among firms within the cluster), which holds specific mental models and competitive behavioral patterns. This development of a homogeneous macroculture may create an unhealthy paranoia about internal competition, desensitize the cluster from threats in the larger competitive environment, and cause it to engage in unproductive efforts to innovate. Isolated clusters can get stuck with certain path-dependent technological trajectories and become constrained by the limitations of their own worldviews. This may transform their collective competencies into competitive disadvantages and strategic inertia (Abrahamson & Fombrun, 1994). Such clusters could become more vulnerable to environmental jolts because of resource diseconomies, insular competitive practices, ineffective and infrequent innovation (Pouder & St. John, 1996).

The development of corporate atherosclerosis and blind spots can impact the absorptive capacity of firms within a cluster. Through intracluster socialization, firms develop sets of criteria for evaluating the efficiency and effectiveness of alternative means of reaching their goals. These may differ significantly from those adopted by extracluster firms. For example, intra and extracluster evaluations of the costs and benefits of a new business arrangement may differ greatly because of differences in cost-benefit calculations, cost projections, and value commitments (Rueschemeyer, 1977). Overly strong intracluster relationships may cause complacency by promoting conformity to norms which discourage innovation, blinding firms to external challenges and hindering the integration of extracluster firms into the social network.

These arguments find empirical support in Florida, Cushing and Gates' (2002) study of metropolitan areas in the United States. Comparing the levels of social capital with the levels of innovation (based on technological intensity and the number of patents filed), they found that areas with low levels of innovation were associated with high scores on social capital. Conversely, areas with high levels of innovation were associated with below-average levels of social capital. This study showed that overly strong intracluster ties could be detrimental to innovativeness.

Given the theoretical argument and empirical support discussed above, one could argue that deeply embedded clusters are especially vulnerable to radical technological change. While homogeneous macroculture facilitates interfirm interactions, interactive learning, and incremental improvement, it is less likely for such a cluster to promote or endorse revolutionary technological change since technological development is path dependent (Bathelt & Boggs, 2003). If shared knowledge holds a cluster of firms together, then radical changes in the technological regime could loosen exchange ties within cluster. Firms may then find it necessary to relocate to other clusters where knowledge of alternative technological trajectories and paradigms reside. Therefore,

> *Proposition 1:* Cluster competitiveness may be jeopardized when intracluster firms become so deeply embedded within a homogeneous macroculture, that they are constrained by embedded logics or rationalities to fully appreciate threatening extracluster developments.

Social Identity Discrepant

Social identity is about one's sense of belonging to a social group. Social identity theory emphasizes social categorization, identification and construction of self-image. Social categories are distinct perceptual classes that confer meanings on constituents by emphasizing similarities within groups and differences between groups (Tajfel & Turner, 1986). Where there is social mobility, members of a social category may change their social identities by moving to other social categories. Thus, the social identity conferred by one's group membership can be a major reason for defection when the status of one's original group is perceived to have fallen relative to a competing social group.

Likewise, the social identities of organizations are arguably also derived from their membership in formal groups. Organizations want to maintain and sustain a positive social identity. Where there is mobility, organizations seeking to enhance their social identities may choose to move to more socially desirable groups (Rao, Davis & Ward, 2000). Thus, defections by a critical mass of firms of a regional cluster may undermine the social identity of non-defecting firms. Cluster sustainability would thus be threatened when identity discrepant cues accumulate with increasing defections. Since social identity is affirmed by social comparison, defections of important cluster firms to other clusters may confuse the remaining firms (Rao, Davis & Ward, 2000). In sum, the competitiveness of a regional cluster is compromised when a large number of firms defect elsewhere in the search of higher cluster status.

External ties may well prevent parochial mindsets from developing, but social identity theory suggests that the more external ties firms in a cluster have, the weaker their social identities derived from their membership in that cluster. There would then be a bigger likelihood of defecting. However, the concept of superordinate social identity may explain otherwise. A superordinate group may take the form of virtual communities, discussion groups, industry associations or professional societies. Superordinate social identity is a shared social identity that people develop when they perceive themselves to be members of a higher-level category encompasses various

groups. Research affirms that shared superordinate identity helps to reduce intergroup bias (Allport, 1954; Sherif, 1966) and ingroup favoritism (Gaertner & Dovidio, 2000). Thus, it can help create more positive attitudes towards outgroups that are brought in under the same umbrella (Gaertner, Dovidio & Bachman 1996). This can increase the likelihood of intergroup knowledge transfer (Kane, Argote & Levine, 2005).

Extending this rationale to firms in a cluster, the development of a superordinate social identity may arguably promote cluster survivability, not only by reducing intracluster parochialism, but also by increasing knowledge sharing across clusters. Conversely, a failure to develop a superordinate social identity may predispose to cluster decline as firms could defect to other clusters in an attempt to enhance their individual social identities. Hence,

> *Proposition 2:* Cluster competitiveness may be threatened if the social identity firms derive from its membership is perceived to be less desirable than that conferred by a competing cluster unless firms also develop superordinate social identities that lower the perceptual differentials.

Power Imbalance

Clustering is not just about geography. It also involves dynamic sociopolitical processes, specific structures of dependencies, institutions and individuals. Firms and institutions are dependent on each other for the exchange of valued resources. Dependence is a source of power for those on whom others are dependent (Emerson, 1972). There are two determinants of that dependence: resource value and resource availability (Emerson, 1962). The more valuable one's resources are to others and the fewer the alternative sources for them, the more power one has over their dependants. As such, a person, firm or institution's position within networks of dependencies will determine its relative power. Network theory posits that the more centrally located one is within a social network, the more power one has. Thus, centrally located firms are more influential because they wield greater control over the flow of resources and information (Cook & Emerson, 1978; Cook & Gilmore, 1984). Conversely, peripheral firms have less power because of their dependence on centrally located ones for resources and information given their lack of alternative sources of resources.

Power asymmetries result from unequal resource dependence relations among participating producers, suppliers and customers (Molm, Takahashi & Peterson, 2000). For example, Nokia dominates the telecommunications cluster in Helsinki to the extent that it employs more than half of Helsinki's technical university graduates and serves as the major client for most firms in the cluster (Van den Berg, Braun & Van Winden, 2001).

That power asymmetry may manifest in two forms of imbalances: (a) relational imbalance within an exchange relationship and (b) structural power imbalance within the exchange network (Cook, 1990; Cook & Emerson, 1978; Emerson, 1981; Molm, 1989). Either form of power imbalance may lead to cluster instability as powerful firms may decide unilaterally to undermine other firms in the cluster when it profits them to do so. For example, if centrally-located firms relocate, this may cause

dependent firms to suffer and the cluster to become less competitive.

Such power asymmetries are seen in many regional clusters found within developing economies where clusters are developed around production plants of multinational companies (MNCs) attracted by tax concession, grants, and low labor costs (Clancy et al., 2001; Zhou & Xin, 2003). Within such clusters, the relationships between MNCs and local firms tend to be hierarchical. To reduce power asymmetry, less powerful local firms may try to innovate to create value. For example, while MNCs are important sources of new technology at Zhongguancun high-technology cluster in Beijing, local firms there try to create value by acting as important sources of local market knowledge and fulfilling subsidiary needs along the value chain. There, while MNCs are involved in product development at the high end and local firms at the low-end, the latter are also involved in system integration.

The Zhongguancun cluster remains attractive by keeping up with the latest technological advances and, more importantly, by pioneering new technologies through its indigenous R&D base, diversity of firms, skilled labor force, and entrepreneurial culture (Zhou & Xin, 2003). Likewise, in Singapore, local small and medium-sized firms are able to reduce power differentials and create a perception of interdependence, rather than create dependence by enabling a reverse flow of technology through complementary innovations in its hard disk cluster around Seagate (Chew & Yeung, 2001).

In sum, cluster competitiveness may be threatened by power asymmetries as dominant firms may choose to exit. This could lead to an exodus of dependent firms, thereby disrupting social networks in the cluster and leading to declining expectations of reciprocity. Hence,

> *Proposition 3:* Cluster competitiveness may be threatened by disproportionate power assymetries among firms if dependant firms are unable to counter such imbalances with incremental and complementary value-creating innovations.

Market Rationalization

The global marketplace is in a constant state of flux as competitors look out for the next big thing. New entrants unencumbered by past practices, mental models, or legacy technologies are incentivized to introduce new business models that can radically transform the competitive dynamics among clusters. The introduction of new market rationalities in this manner may destabilize a cluster as new cost profiles or new technological imperatives can potentially trump those existing ones, rendering them obsolete and less competitive (Uzzi, 1997).

In regard to cost rationality, the product life cycle theory postulates that firms tend to move from high-wage regions to low-wage regions. These regions do so in order to compete on the basis of price when process technology becomes more standardized and also to act as new markets for the emergence of mature products (Vernon, 1966). Thus, declining cost competitiveness may lead firms to relocate to another competing cluster in order to remain competitive. A case in point is the Bingo garment cluster in Japan which started out as a garment center for the production of factory uniforms and a special fabric. Some garment producers chose to relocate their production base to

northwestern Kyushu in the 1970s in order to reduce their labor costs by 20 to 30%. They then moved to China in the 1990s to reduce their wage cost by 92%. Bingo could not have survived as a garment cluster if it had not innovated by moving on to the design and marketing of high-quality fashionable products or developed new markets (Yamamura, Sonobe & Otsuka, 2003).

In regard to technological rationality, advancements may introduce new technology-based rationalities by altering the minimum efficient scales of operation and input requirements. These can upset the prevailing competitive dynamics of clusters by lowering entry barriers and encouraging new entrants (Henley, 1994). Since firms situated within an existing cluster generally operate under similar cost structures and draw resources from the same labor pool, suppliers, and stocks of knowledge, they will be at a disadvantage should the embedded organizing logic become inferior to the emerging logic of a competing cluster.

In terms of technological development, clustering need not be consistently positive through the life cycle of a cluster. The development of a strong homogeneous macroculture is an advantage in the early phase of cluster growth as it promotes collective efficiency and speeds up the development of a chosen technology regime through incremental innovations. However, once the chosen technology developmental path becomes entrenched within a cluster, further development will entail achieving higher efficiencies at the cost of innovation (Abernathy & Utterback, 1978). If this happens, the cluster will be constrained by legacy technology choices. Its ability to respond to radical technological innovations going on outside the cluster becomes curtailed.

The development of a disruptive technology can cause much market disequilibrium when it overrides the existing dominant technology, transforms the way firms compete in the marketplace, and rewrites the rules of the game. When a disruptive technology's organizing logic begins to reconfigure competitive dynamics among clusters, firms located in "weakening clusters" will be incentivized to relocate. A rapid declustering of firms can disrupt the industrial base of an existing agglomeration dramatically (Fingleton et al., 2004; Fingleton, Igliori & Moore, 2005; Suarez-Villa & Walrod, 1997). Studies in Brazil, Korea and Japan have documented industries and workers moving en masse within two to three years to nearby satellite towns, suburban areas, or hinterlands (Chun & Lee, 1985; Henderson, Lee & Lee, 1999; Townroe, 1981). With globalization, this can even proceed across borders and continents, which can lead to the declining competitiveness of existing clusters. Therefore,

> *Proposition 4:* Cluster competitiveness may be threatened when its organizing logic becomes inferior to a new one emerging in competing clusters.

The Lack of Untraded Interdependencies

Porter (1990) argued that the twin forces of proximity and affinity are critical in enabling the flow of information and knowledge among buyers, suppliers and associated institutions. While proximity does provide ample opportunity for face-to-face human interaction, it is affinity developed through shared experiences in school,

clubs, professional associations and other enduring social relationships that establish channels for interpersonal communication. Thus, clusters promote the development of mutual relationships and interdependencies only if both forces of proximity and affinity prevail.

This came about after a study comparing California's Silicon Valley to Route 128 outside Boston. Saxenian (1994) found that the entrepreneurial success of the former was attributable to its tradition of interorganizational knowledge sharing, while the latter's entrepreneurial activity was stifled by a tradition of secrecy. The technical and business communities in Silicon Valley were able to respond to changes in technologies and market conditions through their strong professional linkages with the academic communities of Stanford University and the University of California at Berkeley, as well as the venture capitalist community.

For Storper (1995), "untraded interdependencies" described technological spillovers and informal exchange of strategic insights, knowledge, and interpretations. Tallman et al. (2004, p. 258) called it "knowledge exchanged informally and without explicit compensation." According to Storper (1995), untraded interdependencies which cannot be captured by input-output transactions or contract exchanges explain the spatial patterns of regional clusters. He asserts that the Silicon Valley shows no sign of weakening as a cluster because "geographically-constrained untraded interdependencies outlive geographically-constrained input-output linkages," the former emphasizing informal or tacit ties, the latter formal contracts and relationships (Storper, 1995, p. 209).

Untraded interdependencies emerge from networks of conventions, rules, common understandings, and shared language. Below the surface of local industrial cultures is an ethos of innovation through informal, collective interactions (Bellandi, 1989; Antonelli, 2000). This close link is perceived to exist in industrial districts of north-east and central Italy where firms share equipment and technical information, take on larger orders cooperatively, subcontract jobs to competitors who lose out on orders and also refrain from wage competition.

In such cultures, there is collective learning and the poaching of workers is frowned upon (Brusco & Sabel, 1981; Lorenz, 1992; Sabel & Zeitlin, 1985). In the development of a shared knowledge base among people, colocated geographically can help reduce dynamic uncertainty. It facilitates the coordination of actions and problem solving (Camagni, 1991). Collective learning takes place through informal interaction among people and organizations as well as the mobility of skilled labor and managers within the cluster.

Thus, if untraded interdependencies fail to emerge in a locality, then linkages among firms will be weak, and the larger industrial culture will be less than supportive. If linkages are weak, collective learning and the shared knowledge base will be also. According to Bell and Albu (1999), the mere existence of a cluster of production systems does not imply dynamic knowledge flows among cluster firms are necessarily present. They argue that production systems and knowledge systems are not identical because they tend to involve different sets of people. For example, input-output linkages facilitate transactional exchanges but do not to promote the generation or diffusion of knowledge.

A study by Hansen (1988) on the sharing of knowledge across organization subunits revealed that weak interunit ties hindered the transfer of complex knowledge. This concurred with Appleyard's (1996) finding that interfirm knowledge sharing must occur in private and public channels in order to sustain business vitality and economic growth. Many studies have highlighted the immobility (Attewell, 1992), inertness (Kogut & Zander, 1992), and stickiness (Szulanski, 1996; Grant, 1996) of knowledge. If so, the transfer of complex and ambiguous knowledge across firms within a cluster could be difficult when weak intracluster ties are prevalent. Without a shared knowledge base, a regional cluster will have difficulties sustaining its competitiveness. Hence,

> *Proposition 5:* Cluster competitiveness may be jeopardized when it fails to generate untraded externalities that promote collective learning and the development of a shared knowledge base.

The Presence of Negative Externalities

Clusters can generate both positive and negative externalities. Positive cluster externalities confer benefits of spatial proximity while negative cluster externalities confer liabilities. The nature and kinds of cluster externalities may vary as the geographical density of firms vary over time. As clusters grow and mature, over-concentration can lead to congestion as negative externalities emerge. On the supply side, congestion effects can lead to rising labor and real estates costs, and skill shortages (Bennett et al., 1999). On the demand side, external diseconomies may mean thinning profit margins as firms overcompete, which may lead to declining investments in R&D and, thereafter, downtrends in innovations.

Congestion effects can overwhelm positive externalities when cluster intensity transcends an upper threshold that is determined by location-specific characteristics (Fingleton et al., 2005).

In the Norwegian salmon aquaculture cluster, an increase in regional farm density was associated negatively with productivity, even though density correlated positively with technical efficiency. This finding implies that at some point, negative congestion externalities that had to do with fish illnesses might have overwhelmed the benefits of positive externalities related to knowledge spillovers and the use of specialized inputs (Tveteras & Battese, 2006).

Clusters may also fail to take off. Under-concentration and inadequate density can be a liability with regard to creativity and innovation if a critical mass of innovative firms is absent. Studying the impact of agglomeration on the generation of new knowledge, Varga (1998) correlated 4,000 product innovations to annual research expenditures of U.S. universities and research institutes of private companies. The level of innovative output was found to be influenced by the density and size of a cluster. Similar results were obtained by Andersson, Quigley and Wilhelmsson (2005) in a study of commercial patents granted in Sweden. Higher patent activity was positively correlated with higher workforce diversity and labor force density. In another study on the impact of clustering on innovation in Italy and United Kingdom, it was found that clustering might not be conducive to higher innovative performance.

Rather, the innovativeness of cluster firms was contingent on the presence of other innovative firms (Beaudry & Breschi, 2003). Thus, firms in clusters that are densely populated with innovative firms are more likely to innovate. Conversely, firms in clusters with mainly noninnovative firms are less likely to innovate.

Clustering does not automatically confer higher technological competitiveness. In fact, the absence of intense intracluster rivalry may negatively impact the technological sophistication of cluster firms. A study on machinery producers in Sweden found that locally embedded technology relations correlated negatively with firm technological development. However, large firms facing intense internal rivalry tended to have higher technological levels (Larsson & Malmberg, 1999). This study highlights the importance of rivalry and a competitive environment in stimulating cluster firms to achieve higher levels of technological development (Barnett, 1997; Barnett & Hansen, 1996). In sum, the absence of a critical mass of innovative activities and the presence of weak intracluster competition can be disadvantageous to cluster well-being. Hence,

> *Proposition 6:* Cluster competitiveness may be threatened when its negative externalities outweigh its positive ones.

Discussion and Conclusion

Many countries compete to attract dominant firms to spearhead the development of economic clusters within their borders. Some have succeeded in influencing the location and spatial distribution of economic activities to their benefit through a variety of policy instruments such as subsidies and the provision of free trade zones, industrial estates, and transshipment facilities. But such conventional incentives may no longer suffice. New sets of expectations associated with the emergence of new market rationalities can influence location decisions. Novel considerations may include the protection from terrorist threats, protection of intellectual property rights, the local capacity to innovate, and even clean air.

I have argued that six negative forces can be at work to threaten the competitiveness of regional clusters. If clustering leads to insular competitive practices that reduce the capability of firms to respond swiftly to global technological challenges, the cluster can become less attractive as a destination for future agglomeration. In fact, if other clusters become more attractive, this will cause an accumulation of identity discrepant cues that are large enough to trigger a relocation by cluster firms. Worse still, rapid disintegration may occur when powerful anchor firms choose to relocate.

Not all firms benefit from agglomeration. Mere spatial proximity is not sufficient for generating untraded interdependencies. Instead, the overconcentration of firms and the absence of innovative and competitive cluster dynamics may negatively impact the economic and technological performance of cluster firms. The introduction of new business models and organizing logics can destabilize existing clusters. New cluster configurations may even be critical for firms to remain competitive.

Government policy makers must understand and manage cluster dynamics

throughout the life cycle to mitigate these six forces to forestall cluster disintegration and decline. Clearly, there is no one-size-fits-all approach that will ensure cluster survival. Different clusters have different network structures, interfirm power dynamics, organizing principles, and development trajectories (Markusen, 1996; Altenburg & Meyer-Stamer, 1999). As such, different policy instruments should be created to address different cluster-specific weaknesses.

While the chances of survival increase with the accumulation of positive knowledge and scale externalities in the cluster, there may be counteracting forces from overcrowding and from technologies locking in path dependencies. To avoid these traps, governments may help conduct extracluster surveillance to monitor the development of new knowledge in foreign clusters. They may also help to strengthen intercluster ties to enable the transfer of strategic knowledge. Governments should consider subsidizing investments in emerging alternate technologies and facilitate the diversification of the bases of firms. If there are steps they can take to mitigate the undesirable impacts of negative externalities, governments must also help out in this regard.

Governments may encourage greater intracluster cooperation by facilitating the formation of horizontal and vertical linkages for joint action and collective efficiency (Rabellotti, 1999). Since complex, ambiguous knowledge is difficult to transfer by weak intracluster ties, policymakers may need to facilitate and promote greater formal and informal knowledge exchange among cluster firms. This will also stimulate the emergence of a shared knowledge that can be attractive enough to discourage defection.

Attaining collective efficiency has been shown to be crucial for manufacturing-based and natural resources-based clusters but less so for complex products or technology clusters (Giuliani, Pietrobelli & Rabellotti, 2005). In the latter case, accessing idiosyncratic resources such as technological discoveries, entrepreneurial talent and experiences are more critical (St. John & Pouder, 2006). Moreover, the social dynamics of clusters, especially technology clusters, may include intense rivalry which may raise the sense of alertness and urgency that can help generate further improvements through more intensive innovative activities (Staber, 2007b). But they may also evoke predatory sentiments instead of cooperation, support and trust when proximity to one's rivals provides valuable opportunity to observe their competitive strategies up close.

A homogeneous macroculture that blinds cluster firms to extracluster developments would be a big negative. In this regard, there are valuable lessons to be learned from the mobile telecommunication equipment cluster at Xingwang Industrial Park in Beijing. The Nokia-Capitel, the dominant firm, and 30 major suppliers are located there. The relatively homogeneous nature of this cluster made the development of homogeneous macroculture highly probable. Recognizing the importance of external linkages in keeping suppliers up to speed with latest developments elsewhere, Nokia-Capitel requested its suppliers to have up to 60% of their net sales to external customers over a reasonable period of time. That policy has not only prevented the over-dependence of suppliers on Nokia-Capitel but has also ensured constant surveillance of extra-cluster competition and access to extracluster knowledge (Yeung, Liu & Dicken, 2005).

There is also a concern about radical market shifts or disruptive technological developments. Thus, clusters must set in place a self-renewal process to ensure timely and successful adaptation. Two cases illustrate that the adverse impact of path-dependent strategies and how external agents may trigger profound changes in clusters (Meyer-Stamer, 1998). First, the woolen knitwear cluster in Ludhiana, India survived a crisis in 1991 when its primary export market collapsed. It then set out to improve product quality through upgrading technical skills and reorganizing work processes to meet the more sophisticated demands of new markets (Tewari, 1999). Second, at the apparel cluster in Torreon, Mexico, the arrival of new and large U.S. buyers led to an upgrading in the range of production at cluster level and heightened competitiveness at firm level (Bair & Gereffi, 2001). This affirms the importance of extracluster links in transforming dysfunctional cluster dynamics.

Overall, policy makers must be mindful of the distinction between practices at the firm, network, and cluster level because decisions made at firm level may benefit the firm concerned but could jeopardize the cluster's overall competitiveness (Staber, 2007). Policy makers also need to decipher whether the level of firm concentration in a cluster is below the critical threshold level needed to enjoy efficiency gains or above the threshold where negative returns set in. Incentives could be designed to promote agglomeration at a specific site or encourage dispersion to alternate sites. Of course, the crucial question is how to identify these thresholds. Unfortunately, despite many studies on regional agglomeration, not enough has been learned about clusters at their different stages of development to answer this question. A lot more work needs to be done.

There is also a need to study empirically how competition impacts cluster composition, how roles played by different firms and institutions impact cluster sustainability, and how intracluster variability impacts its adaptability and competitiveness. Mathematical modeling could provide greater quantitative precision in delineating the dynamic interplay of various positive and negative forces at different life cycle stages. The task may be arduous, but the rewards will be bountiful.

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