How can clusters sustain performance? The role of network strength, network openness, and environmental uncertainty

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ABSTRACT

This paper draws on social network theory to develop a model of regional cluster performance. We suggest that high performing regional clusters are underpinned by (1) network strength and (2) network openness, but that the effects of these on the performance of a cluster as a whole are moderated by environmental uncertainty. Specifically, the positive effects of network openness on cluster performance tend to increase as environmental uncertainty increases, while the positive effects of network strength on cluster performance tend to decrease as environmental uncertainty increases. Our findings have theoretical and practical implications for social network research in general, and cluster research in particular.

1. Introduction

There is increasing recognition that clusters of co-located firms play a key role in supporting innovation and wealth creation. For example, Schmitz and Nadvi (1999, p. 1503) concluded that clustering helps firms to 'overcome growth constraints and compete in distant markets', while Porter (2000) has argued that the economic performance of regions and ultimately nations is contingent upon the innovativeness of their industrial clusters. The upshot, as St John and Pouder (2006, p. 142) noted, is that "virtually every state in the US has a cluster development strategy as part of its economic development plan". These strategies are not confined to the US or other developed economies, however; they are also evident in many emerging markets (Bell and Albu, 1999; Bell and Giuliani, 2007; Giuliani and Bell, 2005; Parrilli, 2004).

Consequently, there has been growing academic and policy interest in the factors that underpin high performing clusters, and a substantial body of scholarship has emerged in geography, economics, and more recently strategic management, which considers the social and economic processes that drive processes of agglomeration. Broadly speaking, three sets of partly overlapping arguments within this literature can be identified.

For some scholars, high performing clusters are underpinned by the *economic efficiencies* they confer on constituent firms, including increased specialization, reduced transaction costs and enhanced reputation. From this perspective, spatial proximity allows firms to take advantage of scale and positive externalities such as an abundance of highly skilled labor, specialized subcontractors and rapid flows of information (Aharonson et al., 2007; Hirschman, 1958; Kaldor, 1972; Krugman, 1991; Marshall, 1920; Rosenthal and Strange, 2003). Moreover, proximity is thought to facilitate the profitable de-integration of value chains by allowing greater specialization of inputs and outputs, leading to improved efficiency and greater speed to market (Feldman, 2000; Herrigel, 1993; Storper, 1997).

A second strand of scholarship focuses upon the distinctive *dynamics of knowledge* transfer among co-located firms as the main determinant of cluster performance (Bathelt et al., 2004; Tallman et al., 2004; Tallman and Phene, 2007). This work posits that the key advantages of clustering are to be found in processes of knowledge creation and learning within geographical regions. Specifically, through shared conditions and experiences, clustering is thought to increase the speed and ease with which members can find, access and transfer valuable knowledge that is difficult to codify – because of its 'stickiness' (Nelson and Winter, 1982) tacit knowledge may be exchanged more effectively through frequent interpersonal contacts that are facilitated by proximity (Lawson and Lorenz, 1999).

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A third strand in the literature, and the one with which we are concerned in this paper, considers that cluster performance is rooted in the *social networks* that bind co-located firms. This work draws heavily on ideas from economic sociology, and in particular Granovetter (1985) and Uzzi (1996, 1997). From this standpoint, it is the nature of the relationships that emerge across organizational boundaries, both within and outside a given cluster, which is the key distinguishing feature of clustered economic activity (Aydalot and Keeble, 1988; Cohen and Fields, 1999; Harrison, 1992). The social network perspective has been used to explain the success of many clusters and regions around the world, the most notable of which are the Italian industrial districts (Best, 1990; Goodman et al., 1989; Piore and Sabel, 1984), and American cases such as Orange County (Scott, 1986) and Silicon Valley (Larsen and Rogers, 1984; Saxenian, 1994).

Two network characteristics are thought to be especially important for high performing clusters (Schmitz and Nadvi, 1999; Rugman and D'Cruz, 2002): (1) strong network ties, which are assumed to facilitate the transfer and assimilation of knowledge within clusters; and (2) openness to new network, which are assumed to provide cluster members with access to new knowledge and ways of operating. More fundamentally, implicit in this scholarship is the assumption that successful clusters exhibit these network characteristics regardless of external circumstances or market-related factors.

Yet previous research suggests that the networks of successful clusters that specialize in different industries and that are located in different regions may vary considerably (Aharonson et al., 2008; Robinson et al., 2007; Stuart and Sorenson, 2003). For example, the network processes that underpin the entertainment cluster in Hollywood are clearly far removed from those that underpin Route 128 Boston (cf. Porter, 1998a; Saxenian, 1994). More concretely, Gordon and McCann (2000), Markusen (1996) and St John and Pouder (2006) have identified analytically distinct types of cluster networks, and have argued that network interactions across clusters, both successful and less successful, are far from homogenous. This suggests that the network characteristics of high performing clusters may vary considerably, and that more work is needed to understand the relationship between network configuration and cluster performance.

In this paper we address this ambiguity in the literature by examining the social network properties of industrial clusters and their effects on cluster performance. We follow Gulati et al. (2000) and define an organization's network as its set of relations, both horizontal and vertical, with other actors that are of strategic significance for the exchange partners. More specifically, we study eight clusters in the automotive, information technology, chemical, and biotechnology industries in two different countries in order to explore: (1) the effect of network strength on cluster performance; (2) the effect of network openness on cluster performance; and (3) the effect of environmental uncertainty on the relationships between network strength, network openness and cluster performance.

Consistent with the extant literature, we find that network strength and network openness are both positively correlated with cluster performance. Indeed, these network characteristics arguably constitute the building blocks of competitive advantage in clusters. However, we also find that the relationships between network openness, network strength and cluster performance vary according to environmental uncertainty: as environments become more uncertain, the relative importance of network openness for cluster performance increases, while the relative importance of network strength decreases. By showing that the social network characteristics of successful clusters are more diverse than has been portrayed in much of the literature to date, and that the social network properties required for cluster success are contingent on the

environmental uncertainty faced by constituent firms, we offer new insights into the performance of regional clusters.

The remainder of the paper is structured as follows. The next section gives a description of our conceptual framework which connects social network theory to cluster performance, and considers the influence of environmental uncertainty. We then outline the procedures we used to collect and analyze our data and provide background information on the clusters in our sample. This leads to a section in which we present our results. In the final section we discuss how our model adds to the clusters literature, and draws implications for managers and future research.

2. Network strength and openness, environmental uncertainty, and cluster performance

In this section, we formalize our expectations about the impact of network strength and network openness on cluster performance. In summary, both the strength and openness of networks are expected to have a positive effect upon cluster performance. However, we consider that the relative importance of these two network characteristics will vary in their impact on cluster performance according to different environmental circumstances. We therefore introduce the concept of environmental uncertainty as a potential moderator of the relationships between network strength and network openness on cluster performance. We expect that as environmental circumstances become more uncertain, network openness will have an increased effect on cluster performance, while the positive effect of network strength is expected to be reduced.

We recognize, of course, that the notion of cluster performance is not straightforward, and there is no consistently applied definition or set of measures that has been used to conceptualize the term. This is evidenced by the myriad of ways that the concept has been operationalized in the literature. For example, scholars have considered cluster performance in terms of innovation (Audretsch, 1995), rates of technology transfer (Audretsch and Feldman, 1996), employment growth (Piore and Sabel, 1984), and local wage growth (Porter, 2003). In this paper we conceptualize cluster performance as the growth in new firms, jobs and (financial) output in a given cluster, controlling for the national growth rate of these measures in the relevant industry. We believe that this conceptualization captures the key economic benefits of clustering which underpin the high levels of interest in the concept. It is also a practical approach as it allowed us to draw upon data collated by government statistical services in order to reliably measure and compare cluster performance.

We also recognize that defining and clearly delineating a given cluster is a difficult and ambiguous task. Following Porter (2000, p. 254), we define a cluster as 'a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities'. As Porter (2000) noted, the geographic scope of clusters may range from a city or region to neighboring countries. Along the vertical axis of the value chain are customers and suppliers of specialized inputs. Along the horizontal axis are producers of complementary products and specialized infrastructure, including financial services organizations and firms in related industries. Some clusters may also include other key factors such as universities, public research centers and trade associations. Because of these variations in scope, the boundaries of a cluster are seldom defined by standard industrial classification systems. The automobile industry, for example, relies heavily on specialized suppliers (Dyer, 1996; Dyer and Nobeoka, 2000), which are not necessarily in the automotive parts industry as measured by national statistical services, but may belong to the engineering and machinery, electronic equipment, information technology and steel industries. Indeed, 'equating a cluster with