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Global connectivity and the evolution of industrial clusters: From tires to polymers in Northeast Ohio

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ABSTRACT

Industrial clusters are a critical component of the competitive viability of economies around the world. However, clusters are not static but evolve in response to technology and competition. This process has garnered interest from scholars and from practitioners, with the focus primarily on local linkages and networks. Although global knowledge ties have the potential to fuel innovation, scant attention has been given to global knowledge connectivity in the context of cluster evolution. We analyze a comprehensive 30-year patent dataset (1975–2005) associated with the Akron industrial cluster in Northeast Ohio. The results also show that innovation in the cluster has survived in spite of a long-term decline in manufacturing activity and employment. The survival of innovation in the Akron cluster is driven by increasing specialization at the local level with an emphasis on technologies rather than products and growing connectedness to global innovation systems. A key implication of our study is the importance of anchor tenant multinational enterprises and research institutions in ensuring the persistence of local innovation through two key processes (a) orchestrating knowledge networks; and (b) spawning startup activity. We provide support for recent work in industrial marketing suggesting that network evolution has both deterministic and strategic aspects.

1. Introduction

Industrial clusters form the backbone of the economy due to their ability to support and sustain economic growth (Casper, 2007). The ability of a geographic location to reinvent itself can depend on the flexibility of that backbone and the strength of system connections. This is a critical area for new research, since in many advanced economies, the manufacturing clusters that supported their growth and prosperity in the nineteenth and twentieth centuries are not as robust as they once were. Some of these clusters have declined, while others have evolved in terms of the nature of the activities that are undertaken locally.

The importance of connectivity and collaboration to the economic viability of industrial clusters is well established (Hannigan, Cano-Kollmann, & Mudambi, 2015), but relatively few studies have measured global knowledge connections or assessed their role in cluster evolution. To illustrate and analyze the phenomenon of industry cluster evolution in a global knowledge-sharing context, we study the automotive tire cluster located in Akron, Ohio, and its evolution to become a polymer cluster. The transformation of Akron has been the subject of other recent studies (e.g., Scalera, Mukherjee, Perri, & Mudambi, 2014). We add value to this literature by examining multiple dimensions of cluster performance, and pay particular attention to the technology dimension and the role of global connectivity. This approach leads to new insights, not just about Akron, but more generally about industrial marketing management and industrial cluster evolution.

Clusters can evolve and change in surprising ways. Clusters have been defined as "geographic concentrations of industries related by knowledge, skills, inputs, demand, and/or other linkages" (Delgado, Porter & Stern, 2016, p. 38). The "driver industries" of a region are a cluster's main source of competitive advantage (Carlsson & Mudambi, 2003). Within such industries, clusters often exhibit a dependence on a few lead firms. However, while clusters are geographically immobile, firms are not. The immobility of locations, coupled with the mobility of firms, creates a conceptual and practical divergence between cluster evolution and industry evolution (Cano-Kollmann, Cantwell, Hannigan, Mudambi, & Song, 2016). Technological advancements push industries to evolve, but not all firms and geographic locations are able to create and leverage new technology. The forces of innovation can enable old industries to feel and act younger, with more knowledge creation, start-ups and new product development. Industry evolution occurs through intertwined technological and organizational processes (e.g., Van Assche, 2008). Along the technological dimension, industries

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typically emerge through a process of radical product innovation, and become established through continuing or incremental process innovation. For a mature industry to evolve, multiple firms in the industry need to be involved with generating innovation, and adopting innovation.

Along the organizational dimension, processes can encourage or discourage innovation. The continuing conversion of tacit into codified knowledge through process standardization often lead to outsourcing, offshoring and increased geographic mobility (Mudambi, 2008; Vernon, 1966). As firms and their key employees are pushed to adapt, this sometimes means a move of firm activities to a new location, and falling spatial transaction costs have stimulated such firm mobility. Firms can widely disperse their activities over geographic space (Cantwell & Mudambi, 2005). This can spark new ideas and tap new sources of innovation, but an increase in coordination and communication costs can also hurt innovation (Meyer, Mudambi, & Narula, 2011). When the leading firms geographically disperse important activities, this has important implications for industry evolution and cluster viability. As industries change, these technological and organizational processes underpin the rise and decline of clusters, and complicate the measures of cluster success.

In order to thrive – or even to survive – clusters in advanced market economies must lead rather than follow the processes of innovative change. Clusters act as conduits of knowledge diffusion (Corsaro, Cantù, & Tunisini, 2012; Felzensztein, Stringer, Benson-Rea, & Freeman, 2014), and offer firms and regions the potential to better compete in the modern, globally connected knowledge economy (Romanelli & Khessina, 2005; Simmie, 2004; Tallman & Phene, 2007). The continuing disaggregation of global value chains has highlighted the phenomenon of constituent activities following different evolutionary paths. For instance, Menzel and Fornahl (2010) identify local employment and the "heterogeneity of accessible knowledge" as two distinct metrics of cluster success. Along similar lines, Awate, Larsen, and Mudambi (2012) distinguish output capabilities from innovation capabilities. In the case of the Detroit, recent evidence indicates that the automotive cluster's failures have been confined to the sphere of manufacturing and output, while innovative capabilities and performance have continued to thrive in the region (Hannigan et al., 2015). This line of argument suggests that in the context of clusters, success and decline are multidimensional constructs. Success along one dimension, such as innovation, is often accompanied by decline along another dimension, such as manufacturing or employment. While this is not inevitable, the nature of these inter-relationships is unclear.

Further, global innovation is naturally accompanied by obsolescence. To maintain innovation success, clusters must encourage continuous local technology creation and the diffusion of knowledge (Felzensztein et al., 2014). Today's specialized, tacit activities can become tomorrow's standardized, codified ones (Cano-Kollmann et al., 2016). In order to remain centers of innovative excellence, advanced economy clusters must be able to generate knowledge while riding the waves of creative destruction. This requires the harmonious operation of an entire system (Lundvall, 2007; McCann & Mudambi, 2005), including leveraging the basic science capabilities of area universities, the commercializing capabilities of a healthy population of startup firms, and the scale and network capabilities of large orchestrating multinational enterprises (MNEs). As evident from the definition of industrial clusters, network linkages are important, as they allow for the interaction of the entities that cooperate in the creation, integration, transfer and absorption of knowledge (Cabanelas, Omil, & Vázquez, 2013; Corsaro et al., 2012).

The literature suggests that local institutions can shape the fate of clusters (Lorenzen & Mudambi, 2013). In advanced market economies, the institutions of innovation are often deeply entrenched and resistant to change, and this can discourage technology-driven change. Yet, university, government and economic institutions also have the power to promote innovation, as the locally embedded knowledge base can represent a significant source of novel and unique knowledge resources. The collaboration of universities, entrepreneurs and local government helped transform an agricultural valley into Silicon Valley, a powerhouse of business creation and innovation (Engel, 2015). A lesser-known example is how the cluster of Waterloo, Ontario was shaped by the creation of a university that became a major knowledge generator for the region (Wolfe & Gertler, 2004). From the vantage point of both theory and practice, the nature of local institutions is immensely important for the overall success and evolution of clusters.

Beyond the role of specific local institutions, the innovative performance of advanced market economy clusters is sensitive to the link between innovation and value creation. As global connectivity and knowledge flows become increasingly important, innovation in the cluster will be successful only if activities undertaken locally follow the migration of value. Clusters need to remain focused on those activities that generate the most value, and play down those whose value is dissipating. This depends on the responsiveness and initiatives of local institutions, local entrepreneurial ventures (Felzensztein, Gimmon, & Aqueveque, 2012) and the leading MNEs in the industry.

To illustrate and analyze industry cluster evolution within a global innovation system, we study how the automotive tire cluster of Akron, Ohio evolved into a polymer cluster over the 30-year period beginning in 1975. We unpack the cluster performance along the dimensions of employment, manufacturing and innovation. We demonstrate a steady process of technology evolution in the cluster's innovation efforts and the strong role of global connectivity. The technology evolution occurred along two fronts. First, the cluster moved from its nineteenth and mid-twentieth century strengths in rubber and tire manufacturing, so that by the turn of the twenty-first century, it was steadily reapplying its expertise to cutting-edge polymer science. Second, the cluster kept up with the worldwide trend away from laboratory-science-based innovation toward more design-driven processes, led by orchestrating MNE firms with strong local ties (Scalera et al., 2014).

Past research suggests the importance of considering the extent and nature of global knowledge connectivity. Fleming, King, and Juda (2007) argue that the perfect recipe for increased innovation is the combination of dense, clustered, local, "small-world linkages" that enable trust and close collaboration, and distant and diverse relationships that provide novel, non-redundant information. However, few studies have explored both local linkages and distant global ties (Fleming et al., 2007, p. 938). Have global knowledge connections enhanced the evolution of the Akron industry cluster from tires to polymers? The transformation of Akron provides an opportunity to analyze the complex dynamics of cluster evolution and international knowledge connectivity in an advanced economy.

2. Industrial clusters: technological evolution within and across geographical boundaries

The origin of the concept of industrial clusters or industrial networks is rooted in the notion of Marshall's notion of "industrial districts" (Marshall, 1920). Such clusters form an agglomeration where local companies and institutions interact to share and generate new knowledge solutions (Cabanelas et al., 2013). Interactions among actors and innovation remain at the heart of the concept of industrial clusters. Innovation is driven by the creation of a social space that helps in the exchange of knowledge due to geographical proximity of firms and actors within a cluster. Geographical closeness allows the cluster firms to create ties and bridges, both local and distant that help in the assimilation and transformation of heterogeneous knowledge.

The next two sections are devoted to providing a theoretical framework applicable to mature high-tech industrial clusters located in advanced countries. These clusters are facing technological disruptions and operational transitions more frequently, discontinuities that can significantly alter their performance trajectories. More specifically, we apply the co-evolution model of firms and locations (Cano-Kollmann et al., 2016), to analyze the trajectories of industrial cluster evolution.

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