

**SPACES** online

Spatial Aspects Concerning Economic Structures

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A relational-evolutionary perspective  
of cluster dynamics



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Issue 2011-02 | Volume 9  
[www.spaces-online.com](http://www.spaces-online.com)

Please quote as	Li, Peng-Fei and Bathelt, Harald (2011): A relational-evolutionary perspective of cluster dynamics. SPACES online, Vol. 9, Issue 2011-02. Toronto and Heidelberg: www.spaces-online.com.
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Keywords	Cluster dynamics, evolutionary economic geography, relational economic geography, relational-evolutionary perspective
JEL codes	D83, L26, R11

## Abstract

In the past decade, economic geography has encountered increasing interest and debates about evolutionary and relational thinking in regional development. Rather than comparing both approaches, this paper investigates how they can complement one another and be applied to specific research fields in economic geography. A comparison would be difficult because the approaches address different levels of the research process and are in a relatively early stage of their development. To demonstrate the potential of combining the two approaches, this paper aims to conceptualize cluster dynamics in an integrated relational-evolutionary perspective. In recent years, research on clusters has experienced a paradigmatic shift from understanding their network structure to analyzing dynamic changes. Within this context, inspired by relational and evolutionary thinking, a comprehensive tri-polar analytical framework of cluster evolution is developed that combines the three concepts of context, network and action, allowing each to evolve in interaction with the others. Through this, the paper argues that, rather than viewing relational and evolutionary accounts as competitive approaches to economic geography, they can, in an integrated form, become fundamental guides to economic geography research.

Editors: Harald Bathelt, Johannes Glückler

External Advisor: Heiner Depner

ISSN: 1612-8974

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# A relational-evolutionary perspective of cluster dynamics

## 1 Introduction: New relational and evolutionary perspectives in economic geography

After vivid conceptual debate in economic geography in the 2000s, two approaches have received substantial attention in the academic community that will be discussed in this paper: i.e. relational and evolutionary perspectives. While some scholars compare both perspectives as competing conceptualizations (e.g. Sunley 2008; Hassink and Klaerding 2009), we believe that such a comparison is not easily possible. There are two reasons for this: First, relational economic geography is a broad term which encompasses a number of approaches that relate to different research traditions stretching out from critical-realist and post-structuralist to actor-network theorizations – which makes it difficult to critique this work as a homogenous body of research – while evolutionary economic geography has more narrowly developed out of evolutionary economics. Second, relational perspectives address meta-theoretical aspects of how to position analyses in economic geography, which questions to ask and how to conceptualize specific problems. In contrast, evolutionary approaches are situated at the concept level and often involve a specific quantitative methodology to analyze a problem. Both approaches are also in a relatively early stage of their development.

Relational perspectives were designed as a multidisciplinary alternative to conventional narrow regional science approaches which were primarily based on neoclassical economics. Such work aimed to explain economic landscapes by introducing spatial variables into economic models. Although conventional analyses did not always strictly follow this line of thinking, much of the work was characterized by a meso-/macro-perspective, the treatment of spatial entities as if they were actors (while neglecting the real actors, i.e. individuals, firms and other organizations), a neglect of wider social relations and a lack of process analysis. Relational approaches instead view economic action as social practice, conduct a micro-level reasoning, investigate the way how institutions stabilize economic relations, explore social and economic processes and analyze the effects of global production and the connection between local and global scales (e.g. Dicken and Malmberg 2001; Boggs and Rantisi 2003; Ettliger 2003; Yeung 2005).

In the conceptualization of Bathelt and Glückler (2003, 2011), which provides the reference point for the arguments presented here, relational economic geography is a meta-conceptualization for formulating research questions and conducting research in economic geography. This conceptualization provides a bottom-up logic of how economic action unfolds in a spatial perspective and leads to wider spatial patterns that can differ from place to place. This includes a structural and an evolutionary component: The structural component refers to the role of *context*. Accordingly, economic agents are situated in structures of social relations from which they cannot easily separate (Granovetter 1985). Firms in clusters and global value chains are, for instance, embedded in networks of knowledge flows and supplier-producer-user relations which are key when making decisions about product changes. The evolutionary component refers to the fact that economic action is *path-dependent*. Past decisions and traditions of social relations provide preconditions for today's actions and thus impact contemporary decision-making (Dosi 1988). At the same time, the relational approach rejects the assumption that such patterns can be extrapolated to the future. Economic action is seen as fundamentally open-ended and *contingent*, since agents are free to deviate from pre-existing structures and development

paths (Sayer 2000). From this, it is suggested that the complex underlying structures of organization, interaction, innovation and evolution in a spatial perspective are at the core of enquiries in economic geography.

Similar to relational perspectives, evolutionary approaches are based on a critique of conventional research that is mostly static. In contrast, evolutionary approaches to economic geography aim to analyze dynamic changes in economic landscapes, often based on conceptualizations from evolutionary economics (Boschma and Lambooy 1999; Boschma and Frenken 2006; Martin 2010). Focusing at the regional (or national) level, much of the work analyzes the effects of processes of selection, mutation, variation and change on the development of firm populations. Within the context of 'generalized Darwinism' (Essletzbichler and Rigby 2010), recent work investigates processes of establishing regional variety and selecting alternatives from this variety. The idea behind this is that 'related variety' between local/regional industry sectors enables spillover processes, supports innovation and produces regional advantage (Frenken et al. 2007). Over time, selection processes lead to specific regional development paths. While research on the establishment of new trajectories is still at an early stage, an older stream of the literature analyzes path-dependent regional development and potential lock-in processes (Grabher 1993).

Although offering new insights for studies in economic geography, both perspectives have shortcomings: Much of the empirical work using a relational framework aims at understanding why specific economic networks exist, what the nature of social relations is and why this differs from place to place, while neglecting the dynamics of such structures. *Vice versa*, evolutionary approaches focus on regional economic dynamics and the identification of trajectories at a meso-/macro-level, while neglecting the underlying structures of social-economic relations. In fact, although evolutionary approaches are often based on a firm perspective, the actual analysis addresses aggregates, such as regional structures and developments, and derives general statements about, for instance, the persistence of regional distributions. These differences are illustrated further in the next section which directs attention to industrial clusters as the unit of analysis.

## 2 Segmented cluster paradigms

Arguably, empirical and conceptual analyses of industrial agglomerations and clusters have been at the core of much of the work in economic geography over the past three decades. Within this context, relational and evolutionary approaches have developed in two successive stages of the discussions of industrial clusters: Initially, academic interest was attracted by the robust growth of certain industrial districts, clusters or regional innovation systems (Brusco 1982; Piore and Sabel 1984; Porter 1990; Cooke and Morgan 1994).<sup>1</sup> A consensus about the structure of these competitive regions was that they combine economic activities and culture at the local level through untraded (aside from traded) linkages, echoing with the social-embeddedness argument in economic sociology (Granovetter 1985). It was argued that networks of local agents, which are often associated with mutual trust, provide a third way of governing economic relations beyond the dual structure of market and hierarchy. They generate regional prototypes of tacit knowledge where new knowledge is constantly being created and successfully shared (MalMBERG and Maskell 2002). In more recent research, due to changes in regional configurations, such as the Third Italy (Hadjimichalis 2006), Silicon Valley (Saxenian and Hsu 2001) and Hollywood (Scott and Pope 2007), a transition has taken place from a static to a more evolutionary view of clusters. This has given rise to a new evolutionary approach on clusters that focuses on dynamic changes, drawing inspirations from concepts such as path-dependency, lock-in and industry-life cycles (Frenken et al. 2007; Martin 2010; MacKinnon et al. 2010).

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<sup>1</sup>/. This early stage of cluster research is, in fact, only partially relational since much of this work lacks dynamic components. This may explain why some scholars interpret relational approaches as static (Martin and Sunley 2006; Hassink and Klaerding 2009).

Until now, the two dimensions network and evolution have remained relatively unconnected in the literature on industrial clusters. In both perspectives, broader levels of change in social networks and local culture and their impact on cluster evolution have rarely been discussed. This paper argues that a close linkage between network dynamics and cluster evolution needs to be established to develop a coherent conceptualization of clusters. Without changes in networks and conventions, regional renaissance would barely be a 'flash in the pan', induced by temporary increases in demand. Signs of recovery would not lead to a succession of the evolutionary path or life cycle of a cluster. Without an evolutionary perspective, regional success would be determined by the existing local manufacturing culture (Saxenian 1994; Gertler 2004), which would also provide a partial understanding.

To bridge the gap between narrow relational and evolutionary perspectives in cluster research, this paper formulates a tri-polar framework for the analysis of cluster dynamics through contextualized theoretical construction (Li et al. 2011). The tri-polar framework builds on the pillars of context, network and action, integrating them in an organic way at the local/regional level. By contextualizing social networks, we emphasize the possibility of network dynamics and, hence, varied effects of networks on local agency over time. As such, contextualized networks help explain and understand deeper transformations inside clusters. Furthermore, by placing networks in dynamic context-action configurations, we indicate how new cluster paths can be created through structuration processes that are initiated by local agents (Giddens 1984).

Following this agenda, this paper is structured as follows: The next section discusses relational cluster conceptions that focus on the network paradigm, drawing particularly from the knowledge-based buzz-and-pipeline model. Then, we present an overview of evolutionary cluster conceptions. From a critique of both types of approaches, we develop a re-conceptualization of cluster dynamics in an integrated relational-evolutionary way, before presenting concluding remarks.

### **3 Network relations and the knowledge-based conception of clusters**

Traditionally, work on industrial agglomerations or regional industry clusters has emphasized the role of cost advantages, especially low transportation and transaction costs and close material linkages within such settings. Krugman (1991), for instance, stressed the importance of cost incentives for suppliers to locate close to an existing industrial agglomeration and advantages of agglomeration from a labor market perspective. As contributions by Storper and Salais (1997), Maskell and Malmberg (1999) and others have emphasized, however, it is necessary to go beyond cost factors to more fully understand the processes underlying regional specialization and concentration. In drawing on 'localised capabilities' and 'untraded interdependencies', broader conceptualizations of regional clusters acknowledge the importance of socio-institutional settings, inter-firm knowledge flows and interactive learning in regional innovation and growth.

From this understanding, a research tradition has developed that stresses the importance of network linkages and producer-user relations in clusters (McCann 2008). Building on Porter's (1990) original work, Malmberg and Maskell (2002) emphasize the vertical and horizontal dimensions and relationships in clusters. While the former relationships refer to firms that are linked through input-output linkages and value-chain-based relations, the latter relate to firms that produce similar products and compete against one another. They learn by monitoring and comparing themselves with other firms (Li 2011). Other studies have addressed further dimensions of clusters, especially associated with the institutional set-up (Gertler 2004), power relations and the linkages to external markets, partners and knowledge pockets (Bathelt and Taylor 2002).

Although Malmberg and Maskell (2002) point out that in order to establish a theory of clusters it would be necessary to understand which factors support the continued growth of clusters and how they are reproduced, much of the existing work has not developed a dynamic or evolutionary perspective. This is also reflected in

the buzz-and-pipeline model of clusters (Bathelt et al. 2004), which suggests that the growth of a cluster depends on systematic linkages between its internal networks, conceptualized as 'local buzz', and its external knowledge and market environment, referred to as 'global pipelines'. Within the cluster, specific information about technologies, markets and strategies is exchanged in a variety of ways in planned and unplanned meetings. Based on a shared institutional background, firms learn how to interpret local buzz and make good use of it. Participation in this buzz does not require specific investments, since the firms are surrounded by a tight web of gossip, opinions, recommendations, judgments and interpretations (Grabher 2002; Storper and Venables 2004).

While local buzz supports internal coherence, a cluster's competitive success and growth strongly depends on its external linkages (Owen-Smith and Powell 2004). Since access to global or trans-local markets and knowledge is not free, considerable search efforts have to be undertaken to find the right partners – a process that entails high investments and uncertainties. External relationships also require building trust, which is a timely and costly process. The buzz-and-pipeline model suggests that the local information and knowledge ecology is of only limited effect in the absence of trans-local connections (Bathelt et al. 2004). The more strongly the actors in a cluster are involved in establishing and maintaining external partnerships, the more information about new markets and technologies is pumped into the cluster's networks (Fitjar and Rodríguez-Pose 2011). Without this influx of external knowledge, there is a danger that firms miss out on new opportunities or pin their hopes on the wrong technologies. *Vice versa*, without local buzz, the cluster's external pipelines are also of little use. Local buzz enables firms to rapidly filter out from the mass of external information those elements that are particularly important for the development of technologies (Bathelt and Glückler 2011).

Although related cluster approaches often draw on dynamic concepts, such as growth and reproductivity, they are mostly static in character. Such approaches focus on network aspects and do not conceptualize the genesis and evolution of clusters (Maskell and Malmberg 2007).

#### **4 Regional path dependence and cluster-life cycles**

The growing interest in cluster dynamics originates from the failure of conventional static models in explaining local crises and structural changes. A dilemma of such research is that localized benefits are expected to happen once clusters exist. The question of how cluster structures emerge in the first place is neglected in this work or viewed as an 'individualistic' process (Krugman 1993). Since the factors that support a cluster's genesis may differ from those that support its ongoing growth (Bresnahan et al. 2001; Henn 2006), a systematic conceptualization of clusters requires a dynamic component.

One strand of the literature on cluster dynamics focuses on the concepts of path-dependence and lock-in related to evolutionary theories. A conceptual challenge when applying metaphors from evolutionary economics or evolutionary biology to economic geography is, of course, to justify the transferability of path-dependence explanations – originating from micro-level analysis of organizational behavior – to the aggregate local/regional level (Penrose 1952). A natural way of justifying the use of evolutionary ideas at the local level is to demonstrate that geography matters in the realization of path-dependent processes. Such processes – be it related to technological lock-in, externalities or institutional inertia – do not occur in a spaceless world. The idea that a firm's interactive-learning processes, strategic choices and organizational routines are shaped by the local cultural and institutional environment has been repeatedly pointed out in the network tradition of cluster research and in studies related to the institutional turn in regional development (Amin 1999). In this view, path-dependence is associated with a place-dependent evolutionary process (Martin and Sunley 2006). Various empirical studies add to this argument by illustrating that regional path dependence can persist over a very long time period (Grabher 1993; Saxenian 1994, 2006; Rigby and Essletzbichler 1997).

Further theoretical exploration of evolutionary thinking in economic geography goes beyond preliminary claims of regional stability. History matters, but does not determine future trajectories of clusters (Bathelt and Glückler 2011). Related to this, it appears that path dependence over-accentuates the continuity and stability of regional developments while discontinuities and structural crises, which are equally if not more important, are rarely conceptualized (Bathelt 2009). To conceptualize structural change and path dependence in a consistent manner requires a different interpretation of clusters.

The traditional path-dependence model treats clusters as homogenous entities that form the unit of analysis. Even though social relations of firms are acknowledged in the localization process of a new path (Storper and Walker 1989), the central focus is the overall intensity of local networks, rather than their internal structure, let alone changes in the network structure of social relations. Since the position in a network impacts the kind of knowledge an agent can receive, a diversified set of agents is likely associated with more diversified structures of local knowledge flows and networks. Therefore, new path creation of clusters – an outcome driven by the interaction between agents – is more likely to occur in regions with varied structures (Frenken et al. 2007; Boschma and Iammarino 2009). The focus on the heterogeneous and diverse nature of regions revitalizes evolutionary thinking in economic geography. In focusing on the relations of local agents in a transformational context, it has been demonstrated that re-bundling processes in a region without diversified networks may lead to the development of hollow, instead of renewed clusters (Bathelt 2009). By viewing regions as composite systems and drawing inspirations from evolutionary ideas in political science, Martin (2010) puts forward an alternative model of path-dependence to highlight dynamic path processes. By inspecting interactions of agents in different network positions, Sydow et al. (2010) make an effort to combine conceptions of path dependence with Giddens' (1984) structuration theory, thus trying to disentangle the underlying agency processes of new path creation in clusters. The tri-polar framework, developed in the next section, draws from a similar conceptualization.

Although contributions to new path creation complement interpretations of clusters as quasi-permanent structures, evolutionary perspectives are, thus far, still limited by a relatively narrow focus of analysis. In views of path-dependence, singular interpretations dominate whereby cluster dynamics are restricted both theoretically and empirically to industry, technology or institutional structures. In contrast, aspects of the co-evolution of interrelated economic, technological, institutional and socio-cultural arenas – “a key issue for further research” (Martin and Sunley 2006: 413) – are remarkably under-conceptualized. Singular views of evolutionary dynamics are also strong in regional analyses. In conventional studies, the evolution of clusters has primarily been explained at the local level, leading MacKinnon et al. (2010) to criticize evolutionary economic geography as neglecting social structure, labor relations and capital accumulation at a broader macro level. In globalized competition, especially in capital-intensive industries, influences at the national and international scale are indispensable to understand evolutionary processes (Eich-Born and Hassink 2005). To go beyond a regional theorization of cluster evolution is also propelled by international technical communities that promote cooperation and competition between clusters (Saxenian 2006).

Other conceptualizations of cluster evolution draw on industry- or product-life cycle theories (Vernon 1966; Abernathy and Utterback 1978; Klepper 1997). Industry-life cycle theories suggest that a dominant product design does not exist during the early stages of industrial development and that new technologies only flourish in selected areas. With increasing maturity, markets become more stable, knowledge gets codified and dominant technologies emerge. Since communication of tacit knowledge and technological innovation are key features of innovative clusters, a natural corollary of life-cycle theories is that innovative clusters most likely develop in an early rather than a mature stage of industrial development (Staber 1997; Iammarino and McCann 2006). The point of this argument is that the evolution of clusters corresponds with and follows from the technological paradigm of those industries that form their bases.

Cluster-life cycles are often a regional version of industry-life cycles. Strong emphasis on the role of technology in cluster dynamics in these approaches, however, adds an element of determinism to the explanation. When using technological paradigms to explain the rise or failure of industrial clusters (Kenney and von Burg 1999), there is a danger of *a-posteriori* reductionist reasoning (Saxenian 1999). It is easy to explain technological changes of an industry when looking back, but difficult to foretell what will happen in the future. Accordingly, only after clusters succeed or fail can the rationality of a technology regime be fully understood. In practice, however, a change in technology is not an external factor that determines the cluster's evolution, but the outcome of the interconnected nature of the firms' choices and actions along the dynamics of cluster development. Cluster-, industry- and product-life cycle theories predict technological change in a deterministic manner, rather than explaining the origins of technologies as resulting, for instance, from cluster innovation.

Other cycle conceptualizations are different in that they presume that cluster-life cycles are existent, rather than constructed. Related research pays attention to uncovering the characteristic forces at each stage of a cluster cycle. Accordingly, different forces have been identified, through which clusters move from one stage to another (Pouder and St. John 1996; Swann 2002; Maskell and Malmberg 2007; Menzel and Fornahl 2009). Early discussions of this type of cluster cycles implied that clusters experience a uni-directional stage-to-stage development. To free clusters from such deterministic reasoning, Menzel and Fornahl (2009) add feedback loops allowing clusters to jump back to earlier stages during the sustainability or decline stages. However, such relaxation of stage rigidity only alleviates the mechanical characteristics of cluster cycles. It is problematic to assume that a single life cycle could cover the diverse trajectories of clusters in different real-world contexts. Even Martin and Sunley's (2011) recent attempt to conceptualize cluster dynamics as an adaptive-cycle model drawing on evolutionary ecology does not fully overcome the idea of a 'natural' development trajectory. They suggest that cluster evolution proceeds through different stages that can lead to continuous cyclicity, but also get stuck in stages of ongoing adaptation, stabilization, re-orientation/renewal or decline and disappearance of existing clusters.

Although evolutionary and life-cycle conceptualizations of cluster dynamics draw from different origins, they share two aspects in their theoretical construction. First, in both discussions cluster dynamics are typically conceptualized from model assumptions, rather than derived from within their regional or national contexts. Forces driving cluster evolution are, in many models, situated at aggregate levels beyond the individual agent. Such a way of conceptualization risks over-abstraction, potentially losing sight of interesting insights happening 'on the ground'. Studies may thus dismiss the diversity of trajectories of cluster development (Popp and Wilson 2007).

Second, there is an inclination to disregard changes in the underlying social structure. In cluster-life cycles, different stages are mainly distinguished by observable indicators, such as firm size and number of employees, or by indicators that are less easily measurable, such as technology and diversity of local knowledge pools. In terms of the institutional dimension, it is institutional inertia rather than reforms of institutions that are captured by lock-in processes. Local business culture and social networks, which have been extensively discussed in the network paradigm of clusters, are deliberately excluded in these theoretical frameworks of cluster dynamics. It is suggested that path-dependent evolution leads to long-term stability in or irreversibility of spatial industry patterns (e.g. Boschma and Frenken 2006; Boschma and Iammarino 2009). The problem of this view is that the seeming stability of aggregate patterns hides changes in the social structure and network relations underlying these meso-macro patterns.

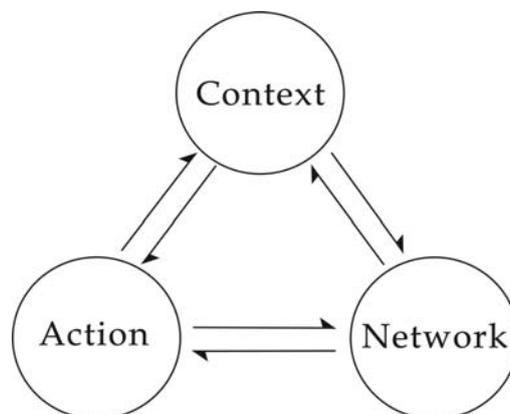
As significant as evolutionary and life-cycle conceptualizations may be, their concentration on normative descriptions of cluster dynamics draws away attention from the analytical concerns of cluster theories. In a different approach, the theorization developed in the next section aims to frame the relationships of those

forces enabling and shaping diverse trajectories of clusters. Based on observations of the economic agents' behavior at the local level, as well as beyond, this conceptualization aims to extract key influences of cluster dynamics in the long run. Instead of asking how clusters will evolve, our analytical framework gives priority to the question of why clusters change. This does not presume the existence of a general theory that extracts the critical forces behind the dynamics of clusters.

## 5 Toward an integrated relational-evolutionary model of cluster dynamics

Any conceptualization of clusters presumes an interpretation of what a cluster is. In our view, a cluster is neither an organism, which can grow and decline *per se*, nor an entity, which can be described by a single rationality or technology. In the tri-polar framework, a cluster is a group of agents and firms that are bound together geographically, technologically and relationally. In this vein, trajectories of clusters are aggregate – planned as well as unanticipated – outcomes of the individual choices and actions of local agents, as well as the synergies that derive from them. Analytical frameworks of cluster dynamics need to be formulated in relation to the actions and motivations of local agents. From the contingent, relational and accumulated characteristics of the local agent's behaviors (Bathelt and Glückler 2011), three important pillars are identified as central analytical categories in the tri-polar framework. These are context, network and action (see, also, Hayter 2004), bound together in a reflexive manner that stimulates an evolutionary dynamic (Figure 1).

**Figure 1:** A tri-polar analytical framework of cluster evolution (Source: Li et al. 2011)



*Context.* Actions of local agents are contingent, which makes it hard to predict such actions. Contingency is directly related to the first pillar of our framework: the specific context in which actors are situated (Bathelt and Glückler 2003). By context, we mean the economic and institutional structures influencing local actors in the process of making and fulfilling decisions. This influence also includes the results of previous actions of other agents. The economic structure of clusters involves industry and market characteristics, technological patterns, intra-firm organization and the dominant inter-firm linkages inside and beyond the region. The institutional structure, in turn, refers to the local and non-local political regimes, routines, conventions and value and belief systems. The economic and institutional settings, which are structured by the division of labor and the geographical distance between activities (Storper 2009a), influence the local actors' knowledge base and their interaction. When applied to cluster evolution, the economic and institutional dimensions of

context are often blurred since long-term inter-firm connections can form powerful interest groups, stabilizing the local institutional context (Grabher 1993).

Context both constrains and enables action in clusters. From a psychological and pragmatic perspective, Storper (2009b: 13) proposes an informational interpretation of context, the structural component of which “is defined by the division of labor in which the actor finds himself, which has a decisive influence on the information environment for the individual, hence his ‘input’ structure of cues and reference points”. In this sense, context has an impact on the ways how actors find and apply information and knowledge, leading them to choose certain actions over others. The relationship between context and action is neither pre-determined nor normative. A specific context does not determine what actors do, but limit ways of coordinating actions in a given situation. In other words, there are different frameworks of action in possible worlds of production, yet, in a certain context, some coordinated collective actions are more likely than others (Storper and Salais 1997). The effects of context on performance are not pre-determined as they can be positive or negative (Storper 2009a). On the negative side, the practical environment of actions restricts what kind of knowledge local actors may receive. On the positive side, context enables what agents in clusters can do by creating a bias towards certain kinds of knowledge. Therefore, for local agents the question is not how to escape restricted contexts and/or enter more beneficial environments, but how to reflexively interpret practical situations and make appropriate adjustments. Context becomes an important influence once it has been internalized into the actors’ motivations and behavior. In sum, the constitution of context reflects the duality of structure, both as a medium and an outcome of the agents’ practices (Giddens 1984).

From a structural perspective, actions are structured by contexts. At a particular time for a specific local actor, context is a given constraint. Over a long time span, however, contexts are constructed by actions and are thus variable. Routines and conventions of doing business are formed based on foreseeable expectations about the mutual behavior of others as an outcome of recursive interaction. Ongoing inter-firm relations are consolidated through the success of series of transactions. Competitive patterns of industries are shaped by the choices and practices of actors in comparison with those of their competitors. Context is thus not a pre-destined background against which agents make choices and take actions; rather, it is constructed and sustained by ongoing practices of *all* agents. This means that the context, in which all agents are situated, usually cannot be controlled by single or exclusively local agents. At the cluster level, actors can modify their context in several ways, but there are also important components that are out of the hands of local agents. Although firms in clusters may engage in collective action to alter the supply conditions of a specific industry, they cannot easily change the demand of customers directly or influence national macroeconomic policies, legislative frameworks and education systems.

*Network.* Network refers to the contextualized social relations of agents and firms within, but not limited to, the local production system. The wider structure of input-output linkages of firms also becomes part of the economic context of agents in clusters. In practice, social and economic relations are inseparable indicating that traded and untraded interdependencies (Storper and Salais 1997) are closely interwoven. As to trade linkages, the incompleteness of contracts leaves room for the development of trust (or distrust) between related partners in the negotiation and during the course of economic transactions (Williamson 1985). Mutual trusted relations become indispensable for traded interdependencies. Social networks in some places also originate out of economic rationales. Although not originally part of economic transactions, new personal relationships may be established over time through repeated economic transactions. In the end, however, it is the compellability and inspiration of personalities that trigger the formation of new social networks at a person-to-person level. Economic transactions offer opportunities for interaction and communication based on which some personal relationships develop, and not others. At the regional level, personal social networks may exist before the formation of clusters. Such networks can become a key mechanism in the diffusion of market and technology information and develop into a cluster later on (Meyer 1998).

Changes in value and belief systems, advances in telecommunication technologies and the intensification of inter-firm competition can trigger a transformation of personal interaction toward a broad societal level beyond the region. In Giddens' (1990) reflection of trust and ontological security systems between different societies, kinship relations provide a stable mode of organizing personal relations in the pre-modern societal context. These relations have been substituted by relationships of friendship or emotional intimacy in modern society. It is thus reasonable to assume that for clusters in developing or transitional economies, structures of social networks at the personal level will also change in the modernization process. Such a change of basic personal networks also impacts strategic actions within clusters, yet to maintain personal relations requires regular interaction and communication. Networks in this sense are "as much process as they are structure, being continually shaped and reshaped by the action of actors who are in turn constrained by the structural positions in which they find themselves" (Nohria 1992: 7). By viewing networks as dynamic connections within heterogeneous contexts that are shaped by actions, the context-network-action framework conceptualizes deeper changes in the socio-economic structure of clusters.

*Action.* Even though context and network offer powerful insights into the behavior of local agents, action still needs to be treated as a separate pillar in our framework because experience from action develops in a cumulative fashion, and agents learn based on their absorptive capability (Cohen and Levinthal 1990). At both the individual and organizational level, prior related knowledge helps and directs agents to use and assimilate new knowledge. The more specialized knowledge agents have previously acquired, the faster they can learn within their context or network. The role of absorptive capability of agents suggests that learning is a cumulative and path-dependent process with self-reinforcing characteristics. A conceptualization of cluster evolution without action would bear the risk of over-emphasizing exogenous variables. Action refers to the individual level of decision-making that depends on specific personal and internal organizational structures, as opposed to the external context.

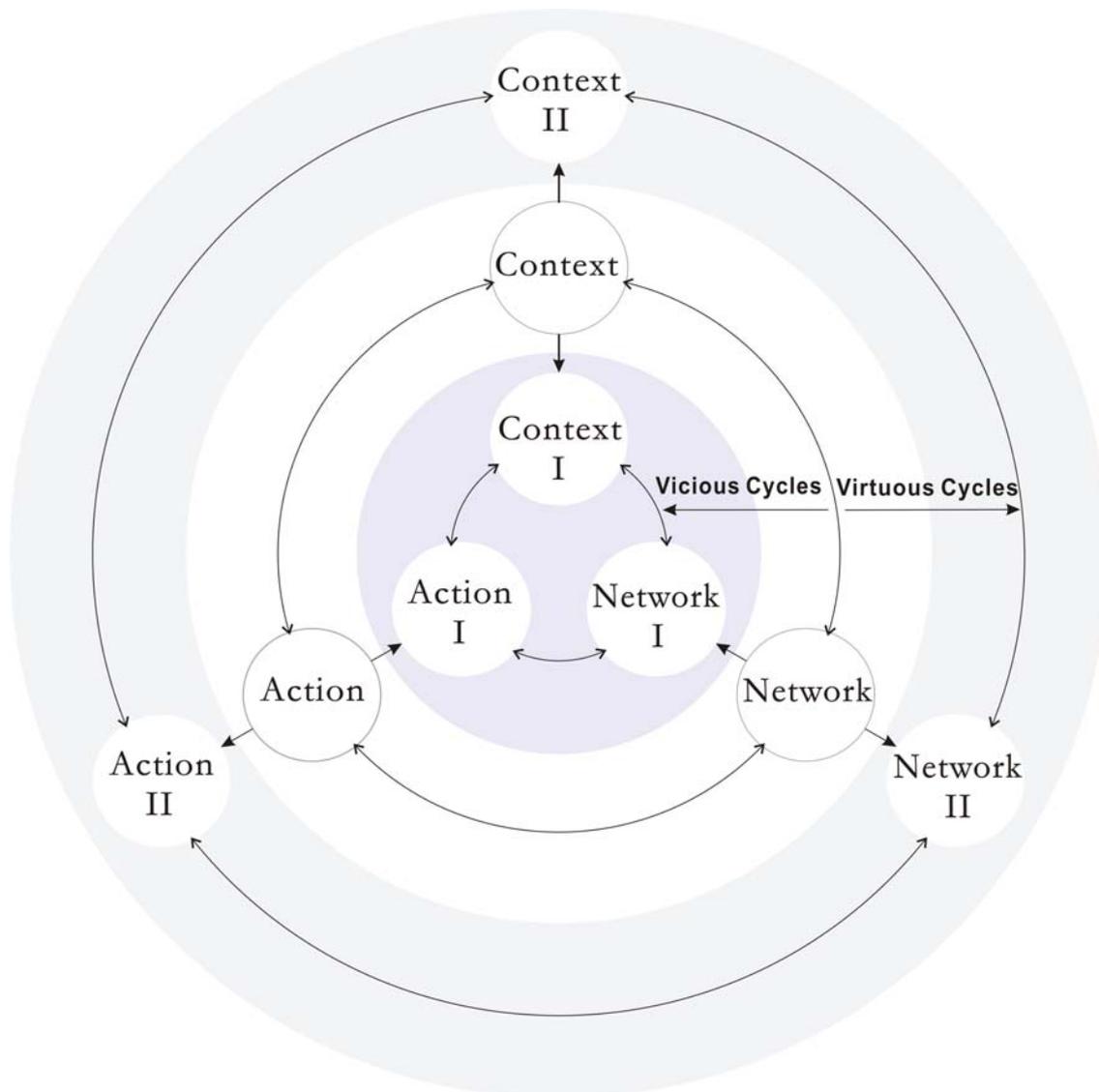
In our framework, context, network and action are equally indispensable. Conceptualizing cluster dynamics without recognizing all three pillars provides only a partial understanding. Merely emphasizing the role of stable networks in local actions risks failing to understand diversifying patterns with transitional or developmental background. Conceptualizations, which limit themselves to emphasizing the importance of external contexts for actions, conversely neglect the role of human agency in regional practices (Scott 2006; Henn and Laureys 2010). Also, the theorization of actions that are withdrawn from the agents' network and context would lead us to view clusters as organisms or groups of unrelated agents, neither of which would reflect real-world structures.

In sum, the tri-polar framework offers a systematic way of studying and interpreting the evolution of clusters. At the regional level, it is the interaction of these pillars that explains the evolution of clusters, yet the framework does not produce ideal-type cluster visions since the dynamics of the three pillars can work in both vicious and virtuous ways:

(i) *Vicious cycles.* We refer to interrelationships between the pillars as being vicious if they produce lock-ins and result in regional decline, as illustrated by the contractive interactive movement of the three pillars in Figure 2. In the literature, economic crises in industrial districts are often explained by changes in economic contexts, such as a sharp drop in demand or the appearance of new technologies. But a transformation of the external environment accounts for only one part in the overall stagnation of clusters. Weaknesses within the networks of a region can also be responsible for the rigidity of old industrial areas. Reasons for regional failure can be classified as different forms of lock-ins (Grabher 1993; Eich-Born and Hassink 2005), which are consequences of interrelationships between the three pillars. First, decades of cooperation (action) in infrastructure projects and subsidy programs may stabilize intensive relations between people and firms (network) in an industry and corresponding policy field, thus strengthening a local conservative regime (context) that

constrains further adjustment of local agents. The ossified institutional context may result in 'political lock-in'. Second, long-term personal networks of local agents can result in similar reactions (action) to demand changes and technological opportunities. A homogeneous view of the world caused by intensive social networks in clusters may be the consequence of 'cognitive lock-in'. Third, the stable demand for products may fixate the localized social division of labor and support a rigid economic context. The enduring fragmentation of activities among firms can result in shortcomings in the local agents' learning processes and investment decisions regarding R&D. By exclusively concentrating on certain activities, the local agents' accumulation of knowledge becomes biased and absorptive capabilities with respect to new knowledge may become more restricted. In Grabher's (1993) classical typology, this rigidity of inter-firm connections (economic context) generates 'functional lock-in'.

**Figure 2:** *Evolutionary dynamics in the tri-polar cluster conception*



(ii) *Virtuous cycles.* In contrast to the above, virtuous interrelations between the three pillars can develop that have positive effects, as illustrated by the expansive interactive movement of the three pillars in Figure 2.

Agents with overlapping knowledge bases are, for instance, motivated to cooperate and communicate (Nooteboom 2000). Through the action and interaction of diversified agents, knowledge circulates in clusters; ideas collide; and innovation becomes more likely. In turning innovative ideas into business successes, the agents' relationships (network) that have been established in previous interaction are reinforced. Some commercialization of innovation may fail but there are also successes, which may re-order the existing industrial structure (economic context) and change the existing cluster path. Successful cooperation of agents not only results in economic returns to innovation but may also establish new interpretations of the context within which the agents are situated while producing important knowledge about their strengths and weaknesses. Agents with enhanced reflexive capability with respect to their context are more likely to act in anticipation of, rather than react to, future changes.

At the regional level, clusters with pre-active agents across different networks are characterized by high adaptability. This can lead to dynamic processes of path creation. Along with dynamic interactions of agents, mutual expectations regarding the coordination of actions may turn into unconscious routines and norms (institutional context), which become new components of the overall intangible regional assets. In the long run, these regional assets – both social networks and routines of doing business – are thus constructed, sustained and altered through social reproduction. In Giddens' (1984) sense, the interaction of context, network and action in virtuous cycles actively drives a regionalized structuration process.

## 6 Combining relational and evolutionary perspectives to economic geography

This paper started by discussing recent relational and evolutionary perspectives in economic geography, arguing that it is useful to integrate both approaches to combine their strengths, rather than discussing them against one another. Applying these approaches to the study of regional industry clusters, it is suggested that both have shortcomings if used in isolation: While relational conceptualizations that focus on the social relations and structural dimensions of clusters tend to neglect aspects of cluster dynamics, evolutionary approaches do not sufficiently understand the underlying structure of social relations in clusters. To overcome this, we suggest a *tri-polar framework of cluster evolution* that presents a combined relational-evolutionary perspective. Some elements of this framework are also reflected in the adaptive-cluster model described by Martin and Sunley (2011) – albeit at the expense of assuming a pre-defined natural cycle. We believe that the tri-polar approach provides important insights about network dynamics and cluster evolution in a spatial perspective:

First, the concept of *network* is relational in nature and should be interpreted in a contingent way (Bathelt and Glückler 2011). Research on networks in clusters has focused on the intensity of existing linkages, generally assuming that such ties are responsible for regional success or failure. Be the ties strong or weak, a relational-evolutionary perspective is skeptical of whether such a static interpretation of network can account for multifaceted regional developments. In the tri-polar framework, network is only one pillar of the entire system and changes over time in interaction with the other pillars of context and action. One has to consider the dynamics of the *whole* framework to be able to properly evaluate the impact of strong or weak ties on cluster evolution. A specific network structure, for example, that supports a cluster's growth in one instance may turn out to be detrimental to regional competitiveness in a different setting.

Second, local traditions of action and interaction need to be evaluated in the specific *context* in which they matter for cluster evolution. Contextualized interpretations provide a perspective to understand why history matters in a non-deterministic way which is a thorny issue in evolutionary economic geography. With new political-economic contexts, for instance, new practices of interaction among individuals and organizations

can form and become new elements of local structures and traditions. But not all practices of interaction develop into key elements of 'regional assets'. The degree to which a regional path can be established by local action depends on the specific context within which the local agents are situated (Storper 2009b).

Third, the evolution of clusters is shaped by the aggregated *action* of local agents, as well as the unintended consequences of this action (Merton 1936). Since some contexts are out of the hands of local agents, action may have unintended effects that shape future settings and affect individual and collective action in the next round. Consequently, the integrated relational-evolutionary framework rejects a normative model of cluster evolution or cluster-life cycles, especially since there are also unexpected strategic actions that may, in the end, significantly alter the trajectory of clusters.

In sum, the tri-polar framework conceptualizes cluster evolution through systematic interrelationships and ongoing feedbacks between context, network and action. Focusing on the interdependencies of these important pillars, the framework demonstrates the value-added of combining relational network-focused and evolutionary approaches in cluster research. A relational component in the tri-polar framework helps explain *why* clusters evolve, thus avoiding deterministic elements in previous cyclical and evolutionary approaches. Further, an evolutionary perspective serves to extend the interpretation of local relations from a traditional static to a dynamic level of analysis. As an illustration of relational-evolutionary theorization on a specific topic, the tri-polar framework reveals the potential of combining these different approaches to deepen our understandings of turbulent regional worlds. Therefore, this paper may be regarded as an invitation to an integrated relational-evolutionary theorizing in economic geography.

## **Acknowledgements**

This paper is based on a more extensive conceptual and empirical study (Li et al. 2011). Financial support for this study was provided by the High-level University Graduate Student Overseas Study Program of the China Scholarship Council and Canada Research Chair Program.

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