Theoretical Perspectives on Industry Clusters

By

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Abstract: The concept of industry clustering has generated much discussion in regional economic development theory and practice in recent years. Yet it is fair to say that an accepted definition or a unified theoretical framework has failed to emerge from the discussion, as the concept often seems to enliven itself under divergent theoretical approaches, including but not limited to work on agglomeration economies, industrial districts, business networks, knowledge spillovers, and regional innovation systems. This paper provides a review of the major theoretical propositions that seek to explain the clustering of economic activity and its presumed link with regional economic development. While there is undoubtedly some overlap on some of the explanations offered by various theoretical perspectives, the concept of clustering has been used so widely in varying contexts and in a multifaceted manner that it risks creating more confusion than clarity, especially in empirical research.

Key Words: Industry clusters, agglomeration, industrial districts, regional innovation systems, knowledge spillovers, competitiveness

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Introduction

Industry clusters have generated an extraordinary amount of interest in contemporary debates on regional economic development theory and praxis across a wide range of academic disciplines and policy circles. Particularly, in view of the greater influence that global competition has on regional and national economies, the cluster concept has gained prominence by policy makers concerned with promoting regional and urban economic growth, for there is a widely accepted claim that regional economies that are successful at nurturing industry clusters can create the foundation for sustained competitiveness (Porter 2000).

There are a number of perspectives that seek to explain the clustering of economic activities, and in turn provide the theoretical foundation for the claim that the structuring of an economy in terms of networks and clusters of industries can be a key source of competitive advantage. This paper reviews these theoretical perspectives by considering first, the classical work in agglomeration as it relates to industrial location analysis and external economies of scale, as the process of clustering is often explained by the presence of externalities that give economic advantages to firms agglomerating in a certain locality and the concept of agglomeration economies is often employed as a theoretical framework. This is followed by a detailed review of subsequent theoretical developments in the literature towards encompassing untraded interdependencies and a growing focus on knowledge spillovers, in view of the apparent shift towards a knowledge based economy. The paper then provides a discussion of recent theoretical developments on the presumed link between industry clustering and regional economic development. Finally, a short summary of the theoretical perspectives, covering key arguments and propositions, is presented along side with a critical remark that provides an indication as to possible directions for further research.

Classical Agglomeration Theory

The concept of agglomeration, which refers to the spatial concentration of people and economic activities, has attracted research interest over extended time periods at least as far back as Alfred Marshall's Principles of Economics, which was first published in

1890. In addition to Marshall (1890), other prominent scholars in this field of research include Weber (1929) and Hoover (1937, 1948). Marshall (1890) offers an explanation for the localized concentrations of economic activity using the concept of external economies of scale. According to Marshall, agglomeration advantages arise from three sets of localization economies, namely a pooled market for workers with specialized skills, the availability of specialized inputs and services, and technological spillovers. This triad of localization advantages first pointed out by Marshal has been at the core of the discussion on industry clustering and agglomeration ever since.

Drawing upon the work of Marshall (1890), Ohlin (1933) and Hoover (1937, 1948) systematically define the benefits that accrue to firms located with other spatial clusters of economic activities as agglomeration economies. They offer a variety of plausible explanations for agglomeration economies, including economies of scale and scope within the firm, the development of varied labor markets and pools of specialized skills, enhanced interaction between local suppliers and customers, savings on transport costs and shared infrastructure. Ohlin and Hoover also made a distinction between urbanization economies, which are related to the advantages gained by all firms from overall size and diversity of the city and localization economies, which are related to the benefits that firms within the same industrial sector derive by gathering from co-location.

There has been a long-standing debate concerning the relative importance of localization and urbanization economies. Numerous studies, which attempt to measure the impact of urbanization economies and localization economies using city size and industry size as measures of concentration, find a positive relationship between city size and productivity (Shefer 1973, Segal 1976, Moomaw 1981, Tabuchi 1986). Nakamura (1985), who examine the impact of localization and urbanization economies on productivity using data from Japan, finds an increase in productivity through doubling industry size to be higher than that through doubling the city population. While Henderson (1986) finds evidence for the existence of localization economies for some manufacturing industries in the U.S. and almost no evidence of urbanization economies, Moomaw (1983) finds evidence of both. A recent study by Ciconne and Hall (1996) finds that a twofold

increase in the density of economic activity results in a 6% increase in productivity across U.S. states. The urbanization-localization debate, which has been a bone of contention for many years has not been resolved, as there is still a heated debate on whether localization or urbanization are important for knowledge spillovers.

Early agglomeration theorists not only address the central question of how firms benefit from agglomeration economies, but also the implications of agglomeration economies on the spatial patterns of economic activity. Weber (1929) introduces agglomeration in location theory and recognizes that agglomeration will result in transportation cost savings. Agglomeration economies are given a key position in studies of the location of economic activities in space, for they are considered as a major factor in the location decisions of industries, which attempt to minimize distance, transportation and production costs, obtain cheap labor, and minimize risks (Dicken and Lloyd 1990). Even though the important role of localization and urbanization economies on industry location and city formation has been widely discussed, economic advantages may not provide sufficient explanation for the locational choice of industries or the existence of agglomerations. This is because in some cases agglomeration may result from "natural advantages" such as climatic and topographic suitability, proximity to raw materials, and locations with access to natural or manmade transportation routes (Dicken and Lloyd 1990, Glaeser *et al.* 1992, Gordon and McCann 2000).

While early classical agglomeration theorists focus on spatial concentrations of firms, later work on industry agglomeration and clusters bring attention to the different kinds of linkages, including production, service, and marketing linkages that exist between industries (Myrdal 1957, Hirschman 1958). Drawing upon classical work on agglomeration, regional scientists have developed theoretical as well as methodological approaches that deal with the transmission of external economies to firms through direct and indirect linkages. For instance, the system of linkages and interdependences among industries exchanging goods and services has been at the core of the growth pole/center policy, which was a very popular economic development policy during the 1960s and 1970s. A common feature of the growth pole policy is the deliberate focusing of

investment at a limited number of locations and sectors in an attempt to encourage economic activity and raise the level of welfare in a regional economy (Perroux 1950, Parr 1999). The policy is viewed in terms of a complex of buyer-supplier industries dominated by propulsive industries or key sectors in input-output sense whose structure of backward and forward linkages creates above-average impacts on the rest of the economy (Sonis *et al.* 2000).

 The focusing of investment on propulsive industries at a planned growth pole is anticipated to make a region locationally attractive to firms that are related to the industry in terms of backward and forward linkages (Cella 1984). The unevenness of benefits that stem from implementing this strategy arouses the balanced and unbalanced growth debate in economics. While Hirschman (1958) expected that "trickle down effects" could lead to regional convergence over time from key sectors that produce more linkage effects, Myrdal (1957) concluded that regional divergence prevails, for polarization (backwash) effects are stronger than the trickle down (spread) effects. This debate is also alive today with industrial clusters, for the impact of cluster-based development on regional economic disparity has not been discussed.

The importance of interindustry linkages in restructuring a regional economy has also prompted regional scientists to develop techniques to identify not only key sectors but also industry clusters and complexes using input-output data (Isard *et al.* 1959, Richter 1969, Streit 1969, Czamanski 1971, Czamanski and Ablas 1979, Campbell 1972, 1975, Roepke *et al.* 1974, Latham 1976, Howe 1991). The major focus is identifying "industrial complexes", which are seen primarily as geographical clusters formed by inter-firm input-output trading links.

In general, classical work in agglomeration focuses on the external economies of scale, industrial linkages and the mechanisms that give economic advantages to the individual firm located in close juxtaposition to other similar and related firms. Even though the classical body of work on agglomeration based on location theory and external economies of scale is very different in focus and method from recent studies of industrial

clustering, it has not only dominated the theoretical and empirical inquiry into the subject for many years but also has far-reaching implications to new business formation in the clusters of today (Feser and Sweeney 2000). In fact, contemporary work on industry clusters draws heavily from this strand of work.

'New Economic Geography' or 'Geographical Economics'

'Geographical Economics', which seeks to account for the continued agglomeration of economic activity at regional and national scales, recapitulates early agglomeration theory in its focus on spatial externalities as key drivers of the geographic concentration of industry (Krugman 1991, Venables 1996, Fujita and Thisse 2002). New geographical economists point out that the observed spatial configuration of economic activities is the result of two opposing forces, namely agglomerating (centripetal) forces and dispersion (centrifugal) forces. Agglomerating forces are basically Marshall's externalities that tend to lead to the clustering of economic activity, including labor market pooling, technological spillovers, intermediate goods supply, and market size. Centrifugal or dispersion forces include immobility of labor, increases in land rents and external diseconomies such as congestion and environmental problems that develop with increased concentration (Krugman and Venables 1996, Martin 1999).

The focus of this recent work on agglomeration is on market, technological and other externalities, which arise through a process of regional or local economic agglomeration. Transportation costs, labor (im)mobility and the relative size of pecuniary externalities (market size effects) are the key determinants of spatial agglomeration or dispersion, which subsequently have major impacts on the regional distribution of income and wealth. The lower the transport cost and the more pecuniary externalities and labor mobility, the more the forces of spatial agglomeration will prevail over those of dispersion (Krugman and Venables 1996, Martin 1999). These studies also indicate that not all industrial locations or agglomerations that we see today are a result of optimal allocation or decision, for the initial pattern could simply be "an accident of history". Once established, however, the initial regional pattern tends to become "locked in"

through a cumulative process based on increasing returns, as a result of forward and backward linkages (Krugman 1991).

A major contribution of the new geographical economics to agglomeration theory is the introduction of models involving monopolistic competition and increasing returns. The development of such models has been considered a great advance in the agglomeration literature because the constant returns-perfect competition model is incapable of explaining the emergence and growth of economic agglomerations in particular and the geography of economic activities in general (Fujita 1988, Krugman 1991, 1995, Venables 1996, Fujita and Thisse 2002).

The Flexible Specialization School

While the focus of many industry agglomeration studies has been and continues to be on the economic advantages that firms derive from co-location with other similar industries, a different line of work has come into the picture since the late 1980s. To approach the changes in the spatial organization of production, this strand of work calls for a more detailed analysis of industry agglomeration that embeds the economic within the social and the cultural and gives due consideration to macroeconomic theories of capitalist development.

The economic crisis of the 1970s has been seen in many places as the time of crisis for capitalism that marked the end of the rigid production principles of mass production or Fordism and an increase in externalization of production processes and subcontracting relations to smaller, specialized, and flexible firms (Brusco 1982). Attempts to determine the form of organization of production that succeeded Fordism led to a focus on the clusters of small firms, typically located in some communities in Italy, Germany and other countries, which managed to compete successfully in international markets while a considerable number of industries experienced economic crisis at the time. The success of these small clustered industries in international markets as opposed to larger integrated plants that enjoy internal scale economies indicates that a fundamental shift has been

underway in the form of organizing production from mass production to smaller scale flexible production (Piore and Sabel 1984, Scott 1988).

According to Pyke *et al.* (1990), many of the small-localized economic constellations, which exhibited economic growth in the 1980s, have sufficient similarities in their mode of economic operation to be categorized under the general heading: "New Industrial Districts". The new industrial districts are characterized by smaller scale production, specialization, and more cooperation and social networking between contracting firms to make vertically-disintegrated production possible (Piore and Sabel 1984, Pyke *et al.* 1990). Central to the debate about the crisis of Fordism and the emergence of flexible production systems is the important role played by social and cultural networks in providing competitive advantage to small and medium-sized firms. Several studies highlight the strong presence of social networks, inter-personal relations, face-to-face encounters, casual or tacit information flows and culture (norms of trust and reciprocity) among local actors as invaluable assets for their success (Piore and Sabel 1984, Pyke *et al*. 1990, Lawson and Lorenz 1999, Malmberg and Maskell 2002).

In fact, Pyke *et al.* (1990) argue that industrial districts should be conceived as social and economic wholes, for social, political and economic structures are intertwined in these districts and flexible production networks and communal cooperation play a very important role in their economic success. In a similar vein, Saxenian (1994) cites cultural differences in business practices between the two major technological concentrations in the U.S. as primary reasons for the success of Silicon Valley over Boston's Route 128. Specifically, although the two regions share a similarity with regard to industrial emphasis, differences in business organization and strategy, inter-firm relationship, and labor mobility are mentioned as key factors for the discrepancy in business success between the two regions (Saxennian 1994). A recent study by Rosenthal and Strange (2003) also indicates that industrial structure and corporate organization affects the benefits arising from industrial clustering.

While previous studies on industrial agglomeration focus on formal customer-supplier and servicing relationships that can be viewed in transaction costs (traded interdependencies), the flexible specialization school has added another dimension, that is the formal and informal collaborative and informational networks, interactions through local labor markets, and shared customs and rules for developing communications and interpreting knowledge, termed collectively as untraded independencies (Storper 1995, Newlands 2003). The major argument is that an attempt to characterize industry clusters using traded relationships or tangible flows fails to fully capture inter-firm relations that explain the agglomeration phenomena. Hence this strand of work attempts to put forward a more comprehensive analysis that goes beyond tangible flows and embeds the economic within the social and the cultural environment (Martin and Sunley 1996, Harrington *et al*. 2003). From this perspective, a very thick network of knowledge sharing, which is supported by close social interactions and institutions, building trust, and informal relations among actors, is considered to be beneficial in cluster-based economic development (Malmberg and Maskell 2002).

Due to the nature of untraded interdependencies, considered as region-specific assets in production localization, proximity, and networking are viewed as essential elements for collective growth (Storper 1997). However, there are inconsistent results regarding whether proximity matters to traded and untraded interdependencies, especially in today's globalized world where communication and transport costs are considerably minimized. For instance, McCann (1995) documents that firms have very limited buyer-supplier relations with other firms in their region, even in cases where there are many related firms in the same region. A similar study, based on a survey of Swedish machinery producers, also indicates that the local market (defined by a 100 km radius) is of marginal importance for the sales and purchases of these firms (Larsson 1998 cited in Malmberg and Maskell 2002).

Knowledge Spillovers and Regional Innovation Systems

Since the 1990s, it has been argued that capitalism has entered a new stage in which knowledge is the most important resource, and learning is the most important process (McKinnon *et al*. 2002). With the emergence of the knowledge-based economy, the relationship between industrial agglomeration and competitiveness is increasingly explained in terms of local knowledge and "collective learning" rather than external economies of scale and natural advantage (Hassink 1997, Maskell and Malmberg 1999, Pinch and Henry 1999, Keeble and Wilkinson 2000, Malmberg and Maskell 2002). The key argument is that the key resources for competitiveness in today's global economy are localized patterns of knowledge creation, knowledge sharing, innovation, and learning.

The knowledge spillovers approach views the innovative performance of firms as determined by the interaction of a network of actors (firms and institutions) with the environment. As knowledge creation and spillovers become important for firm competitiveness, firms embedded in the right environment or "milieu" are considered to learn faster and become more innovative and competitive than their counterparts (Martin and Sunley 2003). Hence, this approach relates the creation and sustainability of industrial competitiveness to localized social, cultural, and institutional structures with which firms are located.

Increasing emphasis is placed on "tacit" knowledge as opposed to "codified" knowledge, in that the former, which depends on localized face-to-face contacts, information spillovers, and shared cultural, linguistic and social norms and values is seen as more valuable to flexibly specialized innovative activity, while the latter is associated more with standardized mass production or Fordism (Martin and Sunley 2003). Since the cost of transmitting tacit knowledge is said to increase with distance, innovation is presumed to be strongest where high levels of interaction occur, demonstrating the importance of geographical proximity for growth and innovation (Audretsch and Feldman 1996).

This orientation not only reflects the importance of collective learning and networking, but also the increased importance of extra-economic relations and local infrastructure as sources of competitive advantage in the knowledge-driven economy (Malmberg and Maskell 2002). It is argued that smaller firms and less favored regions, which generally lack the knowledge and economies of scale, support collective learning and stimulate agglomeration (Cooke and Morgan 1998). Access to a common knowledge base is considered to be the major factor that provides competitive advantage to clustered firms. In general, the major focus is on the way in which clustering and spatial proximity enhance knowledge creation through interactive learning and innovation processes (Storper and Walker 1989, Cooke 1998, Maskell *et al.* 1998, Malmberg and Maskell 2002).

Since in the new knowledge economy learning and knowledge creation are the means by which regional competitive advantage is realized, this strand of work has also focused on learning regions, national and regional innovation systems, which are distinct from traditional industrial districts in flexibility, adaptability, and technological trajectories (Lundvall 1992, Cooke and Morgan 1998). The national and regional innovation systems approaches to innovation and technology rest on the idea that innovative performance is largely determined by the way in which firms interact with their environment (that is, other firms, organizations, and institutional structures) within a region or a nation. This work also gives due regard to specific norms, values, cultures, and institutions (formal and informal) that make it possible to transfer tacit forms of knowledge from one actor to another (Malmberg 1997).

A number of researchers have been studying regional innovation systems as opposed to national innovation systems due to the fact that there are disparities in knowledge distribution and access across nations or regions (Malmberg 1997, Cooke 1998). The new focus on regional innovation systems coincides with the resurgence of interest in regional economies (Storper 1993). Even though they are vaguely defined, regions are considered to be the appropriate scale to foster the formation of "associational economies" (Cooke and Morgan 1998). Hence, the emphasis in regional innovation systems has been on

localized patterns of knowledge sharing, innovation, and learning that help to develop and maintain competitive regional clusters.

With the emergence of a knowledge-based economy and the introduction of concepts such as path dependency, increasing returns to scale and historical lock-in, scholars have devoted considerable effort to the importance of past actions, especially accumulation of knowledge assets in a certain locality. This also involves acknowledging the importance of place-based 'relational assets' or institutional structures, social values and political cultures, which operate cumulatively over time, in the adoption and creation of new technologies. Hence, one can argue that there is a shift of emphasis from firms and industries to local or regional factors in this strand of thought.

Untraded interdependencies are mainly used to explain relations among industries, which are engaged in technology production in recent years, but relations of trust, reciprocity, and face-to-face contact can be essential elements for collaborative advantage in other industries as well. Malmberg and Maskell (2002) confirm that existing empirical studies to a large extent have failed to provide evidence for the proposition that proximity between co-located firms leads to the development of relations that are important for the exchange of information and knowledge. Thus contemporary studies share a concern with tracing the mechanisms by which knowledge is generated and circulated within localized production systems. Due to these reasons, the assumed link between localization and tacit or uncodified knowledge and its importance to business success remains an unsubstantiated and obscure proposition (Martin and Sunley 2003).

Industrial Clusters and Regional Economic Development

Classical agglomeration theory focuses on why agglomeration occurs in space and its relationship to the location decisions of individual industries. This corpus of work provides a foundation for later theoretical and empirical developments into the industrial clustering literature, which give due consideration to the important role of knowledge spillovers, social networks, and other institutions. Despite differences in conceptual approaches, scope, research focus, and methodology, the aforementioned theoretical

outlooks have been preoccupied with explaining the mechanisms involved in industry agglomeration. Even though these theories indirectly suggest that industrial agglomeration has a significant impact on industrial and regional economic performance, it is only in recent years that the existence of relationships between industry agglomeration and regional economic development has been explicitly implied, specifically due to the major works of two prominent scholars, namely Porter and Romer (Romer 1986, Porter 1990, 1998, 2000). A short review of the literature that explicitly relates industrial clustering and regional economic performance is in order.

Industry Clusters and Competitiveness

In the past two decades, a vast literature has proliferated which views industrial clustering from a competitiveness perspective. This perspective sees industrial clustering as a key business strategy that strengthens regional economies in today's competitive environment. The most influential of this recent venture is Porter's work on industry clusters which seeks to explore the dynamics of industrial clustering in the context of changing business strategy and competitiveness by relating industry clusters with a broader theory of competition and competitive advantage in a global economy (Porter 1990, 2000). The main idea of the cluster concept put forward by Porter is the notion that the competitiveness of a nation or region depends on the competitiveness of the industries and other companies forming the industry clusters. Regional clusters of related industries are considered to be the sources of jobs, income, export growth, and innovation. Subsequently, a successful cluster policy is seen as a key to regional economic performance or as a model of regional competitive advantage.

According to Porter (1998, 2000), clusters capture important linkages, complementarities, and spillovers in terms of technology, skills, information, marketing, and customer needs that cut across firms and industries. These advantages allow firms in the cluster to become more productive and innovative, thereby increasing competitiveness. Competitive advantage is forged both through intensified interfirm rivalry and geographical proximity. Since Porter has rooted and promoted his cluster concept within an overarching focus on the determinants of "competitiveness" (of firms, industries,

regions and nations) in today's global economy, his work has a great influence in policy circles (Martin and Sunley 2003). In fact, the last decade has witnessed a substantial growth in the number of cluster-based economic development initiatives in many parts of the world (Waits 2000, Wolfe 2003).

Porter (1990), who has advanced the cluster concept as a business strategy to increase competitiveness and productivity, has developed a very broad definition of the cluster concept. Accordingly, clusters include buyers and suppliers of inputs, service providers as well as providers of specialized infrastructure. Clusters also include regional resources and infrastructure, governmental and private institutions (universities, vocational training providers, standards-setting agencies, and trade associations) that provide specialized training, education, information, research, and technical support. The competitiveness of industry clusters is thus derived from the concentration of related industries, suppliers and services in the same place, access to supporting economic infrastructure, rivalry and collaborative efforts between firms and other institutions, and knowledge spillovers (Porter 1990, 2000).

This broader view of industry clusters implies that many of the productivity and innovation advantages of clusters can rest on the spillovers and externalities that involve public entities. Due to such developments, a vast literature has been witnessed on the relationship between innovation, research universities and regional economic development (Jaffe 1989, Acs *et al*. 1992, Storper 1993). The important role that research institutes such as Stanford University and Massachusetts Institute of Technology and other government resources played in the success and subsequent development of the two premiere technological concentrations, Silicon Valley and Route 128, is also documented in the literature (Newlands 2003).

Even though there is so little empirical work which conclusively demonstrates that clustering actually produces increased local economic prosperity, cluster promotion policies are increasingly popular and have been adopted by a host of local, regional and national authorities. Despite the popularity of Porter's cluster theory, the empirical results

of the proposed relationship between competitive performance and industry clustering are inconsistent (Appold 1995). In fact, much of the information in support of superior firm performance is based on success stories and case studies rather than rigorous empirical work (Malmberg 1996). Local and regional development personnel are also raising the question whether the emergence of industrial clusters can be the product of policy actions or market forces.

Dynamic Externalities and Economic Growth

As mentioned previously, the study of externalities associated with cluster formation, which includes economies of scale, availability of inputs and services, and formation of a highly specialized labor force, owes allegiance to Alfred Marshall and has a long history (Marshall 1890, Hoover 1937, Chinitz 1961). However, recent years have witnessed a substantial growth of interest in the role of externalities associated with knowledge spillovers (dynamic externalities) on local economic growth. Specifically, the idea that agglomeration and proximity have a significant impact on innovation, knowledge transfer and economic growth has taken on a greater importance since the seminal works of Romer (1986) and Lucas (1988) who models technological change and economic growth in an endogenous framework.

Romer (1986), who makes technology advance endogenous in his model, suggests that the size of the stock of ideas, the quality of human capital and the size of the labor force engaged in the production of ideas are key factors in innovation and hence economic growth. Endogenous growth theorists have highlighted the significant externality effects from education and research, the role of knowledge accumulation, and the importance of geographical proximity in the transmission of ideas, thus providing the theoretical basis for the importance of localization economies in regional economic growth. The major focus of this strand of work is on dynamic information externalities that operate over time, enhancing productivity and skill formation in the economy, and in turn enhancing innovation and hence economic growth (Romer 1986, Lucas 1988).

A large and growing literature has been built around testing the relationship between knowledge spillovers, innovation and growth using cities as "natural laboratories". The major issues revolving around a series of theoretical arguments that deal with technological externalities include whether regional diversity and/or specialization promote knowledge spillovers, on the one hand, and the effects of local monopoly versus local competition, on the other (Glaeser *et al*. 1992).

One theoretical argument, originally developed by Marshall (1890) and later formalized by Arrow (1962) and Romer (1986), the Marshall-Arrow-Romer (MAR) model, focuses on knowledge spillovers between firms in the same industry, for knowledge is considered to be sector-specific. The importance of spatial agglomeration in the transmission of ideas and technology from one firm to another within the industry has been outlined, but the dissemination of ideas through imitation, spying, and mobility of labor without compensation is argued to have an unfavorable effect on a firm's ability to appropriate the economic value of its investment and sustain its competitive advantage. Hence, local monopoly is preferred as a means of strengthening a firm's competitive position and innovative growth over local competition, for it allows technology externalities to be internalized by the innovator and prevents a firm's capabilities from being imitated by an expanding group of competitors.

Another theoretical proposition put forward by Porter (1990), also underscores the importance of regional specialization but argues that local competition rather than monopoly enhances innovation and economic growth. This approach views an increase in interfirm rivalry as the principal mechanism through which the benefits of agglomeration are realized. In a similar vein, Feldman and Audretsch (1999) find that the degree of local competition for new ideas is more conducive to innovation than local monopoly. The third theory, proposed by Jacobs (1969), is congruent with Porter's idea that competition enhances innovation and growth, but contends that regional diversity rather than specialization will result in higher growth rates. Jacobs stresses the importance of interaction between people in cities and the buildup of ideas with a variety and diversity of geographically proximate industries (Jacobs 1969).

There is conflicting evidences as to whether regional diversity or regional specialization is important in an economic growth context. Whereas Glaeser *et al*. (1992) find empirical results supporting Jacobs's argument that diversity based urbanization economies promote growth of industrial employment, Henderson *et al*. (1995) find evidence consistent with both MAR externalities and Jacobs's propositions, depending on the kinds of industries considered in the study and the stage of product development. They suggest that Jacobs's urban externalities and MAR externalities are both important for new high-tech industries, but only MAR externalities are more likely to give some benefits to mature capital goods industries. Glaeser *et al*. (1992) and Jaffe *et al*. (1993) also suggest that the benefits of localization economies could be important in earlier stages of an industry's life cycle but may fade over time. Feldman and Audretsch (1999) find that diversity across complementary economic activities sharing a common science base is more conducive to specialization.

While the importance of knowledge externalities on innovation and in turn economic growth is recognized, there is a lot of controversy on the geographic range of knowledge spillovers (Krugman 1991, Audretsch and Feldman 2004). Even though many argue that knowledge spillovers are important at the local level (Jafee *et al.* 1993, Maskell and Malmberg 1999), others argue that knowledge sharing is not necessarily restricted to the local level because there can be regional or international sharing of knowledge within and between firms (Breschi and Lissoni 2001). This draws attention to the need to understand where local clusters stand within an international hierarchy (Wolfe 2003). The nature of the relationship between the concept of an industrial cluster and other analytical units, such as national or regional innovation systems, especially the question of agglomeration boundaries, remains highly problematic at the empirical level.

Even though agglomeration is fairly common in all industries, knowledge spillovers are often used to explain the existence of industry agglomerations in high technology industries (Krugman 1991). For instance, Audretsch and Feldman (1996) find that the concentration of innovative activity relies on the relative importance of new economic

knowledge in the industry, where propensity for concentration is greater in industries that require industry research and development, university research, and skilled labor. This implies that knowledge spillovers may not be critical to explain the existence of industry agglomerations in all industries.

A Final Note

From the review of industry cluster and agglomeration studies, it is clear that there exists an abundance of theoretical concepts[2], most of which mainly attempt to disentangle the fundamental reasons behind geographical concentration of economic activities. Even though concepts such as natural advantage and external economies of scale have been used to explain the fundamental reasons for industrial agglomeration in earlier theories, recent literature has been characterized by a socially and culturally oriented analysis of localization economies and a focus on one source of externalities, knowledge spillovers. This more recent stream of analysis suggests that the underlying aspect that provides competitive advantages to agglomerated firms is ready access to a common knowledge base. Hence, contemporary theories emphasize the role of knowledge and learning processes, especially tacit knowledge flows, in enhancing the productivity and innovative capability of clustered industries.

Nevertheless, the presumed link between regional economic development and industry clustering largely remains at the stage of theoretical discussion, for there is a paucity of rigorous empirical work that substantiates the above-mentioned theoretical claims. As Malmberg and Maskell (2002), Martin and Sunley (2003), and Wolfe (2003) rightly argue, there is an imbalance between theory and empirical studies and a lack of a unified theoretical and methodological framework for cluster analysis.

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[2] A series of key points that summarize the aforementioned theoretical perspectives are presented in Table 1.

Table 1. Summary of Theoretical Approaches

Theoretical approaches	Key points	Main references

Classical Agglomeration Theory	• External economies of scale
	   o Urbanization vs. localization economies
	      ▪ Labor market pooling
	      ▪ Input sharing
	      ▪ Technology spillovers
	      ▪ Diversity
	• Agglomeration and industry location
	• Interindustry linkages and interdependencies
	   o Industrial complex analysis
	   o Growth pole/center policy
		Marshall (1890), Weber (1929), Ohlin (1933), Hoover (1937)

Geographical Economics or New Economic Geography	• Pecuniary externalities • Agglomeration economies and diseconomies • Agglomeration and regional distribution of income and wealth • Increasing returns and imperfect competition	Krugman (1991), Venables (1996), Fujita and Thisse (2002)
Flexible Specialization School	• From economies of scale to flexible form of industrial organization • Untraded interdependencies o Embedding the economic within the social, cultural and institutional structures • Industrial organization and business culture	Brusco (1982), Piore and Sable (1984), Scott (1988), Storper (1995)

Regional Innovation Systems	• New knowledge economy
	• Knowledge and collective learning
	   o Tacit vs. codified knowledge
	   o Localized patterns of knowledge creation, sharing, learning, and innovation
		Lundval (1992), Cooke and Morgan (1998), Malmberg and Maskell (2002)

Competitiveness	• Clusters and regional competitive advantage
	   o Cooperation and rivalry
	   o Partnerships with institutions
	   o Regional resources and infrastructure
		Porter (1990)

Dynamic Externalities	• Knowledge spillovers and endogenous growth theory • Ideas, education, research, and institutions • Specialization vs. diversity, monopoly vs. competition, and geographical proximity	Romer (1986), Lucas (1988), Glaeser *et al.* (1992), Henderson *et al.* (1995)

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