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Knowledge patterns and spatial dynamics of industrial districts in knowledge cities: Hsinchu, Taiwan

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ABSTRACT

In the era of a global knowledge economy, urban regions that seek to increase their competitive edge and become destinations for talent and investment have little chance of achieving these goals without forming effective knowledge-based urban development strategies. Hence, the development of clusters of knowledge-based corporations has become an important strategic factor in increasing the competitiveness of knowledge cities. Whereas previous studies have tended to focus on the characteristics of local clusters and the causes of their success, empirical studies of the long-term development of local knowledge-based industries are few. Accordingly, this investigation takes the knowledge city region-Hsinchu as its subject, and quantitatively analyzes the correlation between the spatial dynamics of knowledge in major industries and innovation based on empirical data. This finding shows that steadily developing industries in the Hsinchu region have continued to strengthen their new knowledge of product development and innovation. An overview of innovative activities of firms also revealed that their knowledge patterns have been changing from patterns of internal dependency to a locality-based, broader networking and agglomeration pattern.

1. Introduction

In a growing knowledge economy talent and creativity are becoming increasingly decisive in shaping economic opportunity and knowledge based urban development. Prosperity now depends less on access to physical resources and more and more on the ability to create economically useful new ideas (Yigitcanlar, Baum, & Horton, 2007). In knowledge economy and knowledge based urban development the contribution of knowledge workers and knowledge-based corporations is often mentioned as strategic and valuable (Baum, O'Connor, & Yigitcanlar, 2009; Florida, 2005; Hu, Lin, & Chang, 2013). Most significantly, knowledge-intensive industrial districts are proactively approaching or seeking links with sources of new knowledge production, with the objective of facilitating new knowledge transfer and thus achieving competitive advantage of knowledge cities (Hu, Lin, & Chang, 2005). Accordingly, why some countries or regions experience faster economic growth is difficult to determine and the question has attracted the attention of several researchers and institutions. In answering this question, Porter's (1990) industry cluster theory, presented in his book, "the Competitive Advantage of Nations" is very influential. His core argument is that clustering prompts the flow of goods in a geographically limited region, supporting intensive interactions among services, ideas and skills, supporting technological development, increasing production efficiency, and accelerating innovation. The ultimate effects are improvements in the generation, circulation, diffusion and application of knowledge in a cluster. Hence, a local cluster is characterized by the benefit that is afforded to firms that are located in a region by a particular regional structure and organization, which provides opportunities for innovation and success (Becattini, 1990; Camagni, 1995; Lawson, 1999). Consequently, local clustering enhances the regional knowledge base. It supports companies and startups that are better able to innovate and are more successful than they would otherwise be, thereby reducing unemployment and promoting economic growth.

Most of the pertinent literature considers the existence and emergence of local industry clusters, and the factors that govern their greater success than is achieved elsewhere. It focuses on the reasons for the existence of local clusters. Relatively few studies have examined clusters beyond this initial stage, or focused on the negative effects of local clusters and the reasons for their failure (Grabher, 1993; Isaksen, 2003). Restated, previous studies have not explicitly answered several questions, such as "how long the

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positive effects of industry clusters last?" or "after some time, will a positive effect turn into a negative one?" Clearly, research on the implications of the long-term development of local industry clusters is very limited – and especially weak in the analysis of knowledge patterns and the spatial dynamics of such clusters.

This investigation considers a high-tech industrial district–Hsinchu, which is a knowledge-based urban region.[1] Since Hsinchu Science-based Industry Park (HSIP) is Taiwan's knowledge hub. Besides a huge science and industry park, six universities were established in Hsinchu. This empirical study identifies major industries in the Hsinchu region of HSIP and its surrounding industrial districts by referring to the relevant literature. The study also clarifies what changes this region has undergone. Based on these findings, this study will explain the implications of the long-term development of an industrial district in the framework of knowledge-based urban development, with a special focus on the evolution of knowledge patterns and spatial dynamics.

2. Literature review

In the era of a global knowledge economy, in order to increase their competitive edge and become destinations for talent and investment, urban regions seek to form effective knowledge-based urban development strategies. Hence, the development of clusters of knowledge-based corporations has become an important strategic factor in increasing the competitiveness of knowledge cities. This investigation reviews the literature on the development of an industrial district and dynamic evolution of spatial knowledge, then explores the implications of the long-term development of an industrial district in the framework of knowledge-based urban development.

2.1. Development and evolution of an industrial district

The development of an industrial district is affected by its history, culture, institutional background, and geography. An industrial area depends on interactions among local industries, technology and the environment, and is externally connected via industrial technology to a national or even global institutional environment at (Liu & Wang, 2008). Such an industrial network, based on geographic proximity, is an industry cluster. The development and evolution of an industrial region is rooted in the context of industrial clustering. The literature on cluster theory is extensive. Most studies in the field investigate clustering statically, without observing dynamic changes. Increasing global competition has motivated various studies of such issues as the decline of clusters, their dynamics and their life cycles (Andersen, 2006; Sadler, 2004; Schamp, 2005; De Propris & Lazzeretti, 2009; Menzel & Fornahl, 2009). Some of these studies have found that the transformation of clusters depends on the evolutionary interaction of two dynamics—technological dynamics and regional dynamics. However, the survivability of a cluster in a changing environment depends on its long-term evolution. Crespo (2011) suggested that viability was based on emergence conditions. Different emergence conditions produce differently structured clusters, which therefore confront threats and opportunities with various capabilities.

[1] In the era of the knowledge economy, the development of a city is a complex and multi-faceted phenomenon. To understand it, the concept of knowledge-based urban development (KBUD) has been applied to many metropolitan areas. The purpose of KBUD is to increase competitive advantage; attract talent and investment, and provide prosperity and a high quality of life to residents (Kunzmann, 2008; Yigitcanlar, 2009).

2.1.1. Conditions that affect the viability of industry clusters

Since a cluster has a complex structure and consists of heterogeneous actors who are rooted in a region, as its environment constantly changes, the activities of these actors affect its evolutionary path. In the long run, a cluster may follow various paths. In the absence of significant external impacts, a cluster will remain on a stable development path, strengthening its existing structures and by exploiting its internal process. Another possible path is the decline and ultimate disappearance of a cluster. Such a decline may be caused by the transformation of an internal positive impact into a negative one. It may also be caused by changes in external conditions, such as by the development of new knowledge and technology, policy changes, or the advent of various social and economic events to which a cluster fails to adjust and adapt. Eventually, the decline may cause a cluster to follow the trajectory of reconstruction, forming a new cluster. Internal processes of transformation and the reintegration of any levels of a cluster can contribute to this process (Martin, 2010). Restated, when a cluster is confronted with a constantly changing environment, the long-term evolution of a cluster depends on its viability (Suire & Vicente, 2009).

The viability of clusters as entities that can help local systems cohere is measured in three dimensions (Crespo, 2011). The first dimension emphasizes technology and local capacities. This begins when any new adopters are more willing than previous decision-makers to exploit similar technology or regions mainly to increase effectiveness and profitability. The second dimension is the ability of a cluster to adapt to various threats and to exploit opportunities: this can also be thought of as the ability to transform from the status quo to new technological realities, and to reconstruct regional conditions. The final dimension is the ability of a cluster to be a driving force for change. Local industry clusters are grounded in solid regional and technical capabilities that reduce potential threats to their profits. The weakening of regional and technical capabilities weakens long-term evolutionary capabilities put up barriers to the dispersing of new technologies and cause difficulties in the emergence of new industrial districts. Different regional and technical capabilities result in different survival and absorption capacities of industry clusters, whose long-term evolution depends on their ability to adapt to technical and regional threats or opportunities. The intensity of regional and technical processes depends on exogenous and endogenous factors (Crespo, 2011; Suire & Vicente, 2009). Since effective endogenous innovation depends on intensive interactions, the network model has a significant role in evaluating viability.

2.1.2. Evolution of industry clusters

Various scholars in the field of the evolution of local industry clusters have differently defined the evolutionary lifecycles of those clusters. Porter (1980) first proposed the concept of the industry lifecycle. He divided the industry life cycle into introduction, growth, maturity and decline. He characterized the introduction stage by its high degree of uncertainty. In the growth stage, competition among manufacturers increases and technology provides the main basis of competition. Decline is mostly caused by external environmental factors. Klepper (1997) and Dybe and Kujath (2000) simplified the industry life cycle into three stages, the first stage is birth, which is followed by growth, which is followed by maturity. Hill and Jones (2001) added a turbulence stage between the growth stage and the maturity stage to yield a total of five stages—introduction, growth, turbulence, maturity and decline. They noted that competition became more intense during the turbulence stage owing to the very large number of competitors, but that demand in this stage was lower than in the growth stage. In each stage of the evolutionary cycle, an industry exhibits different characteristics. The development and evolution of an