



Regional systems of biotechnology innovation – The case of Taiwan



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ARTICLE INFO

Article history:

Received 27 October 2014

Received in revised form 30 September 2015

Accepted 2 October 2015

Available online 23 October 2015

Keywords:

Regional innovation systems

Biotechnology industry

Cross-RIS interaction

Taiwan

ABSTRACT

Regional innovation system (RIS) has become a key priority for policy makers in many advanced countries and regions. RIS, as a concept, has also been shown to be relevant and applicable to newly industrialized countries and developing economies. Nevertheless, very few studies discuss the issue based on the context of these countries. Thus, the study selects three biotechnology regional innovation systems in Taiwan, a representative of newly industrialized countries, as research subjects. In this research, Nankang RIS of new drug developments, Hsinchu RIS of medical electronics, and Southern Taiwan RIS of medical devices are studied. Additionally, as more and more organizations within the regional cluster interact with other actors outside the region, previous literatures scarcely address the interactions between different clusters. Consequently, this study also investigates the issue of cross-RIS interactions.

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1. Introduction

Innovation is a key for the competitiveness for both industrial firms and nations. Whether a country has a solid national innovation system, it has become one of the most important indicators illustrating the degree of its competitiveness and growth potential. Besides that, we are living in a globalizing world with more and more interactions in terms of trade and flows of capital and information occurring beyond national boundaries and between different continents (Storper 1997). Therefore, one might argue that research concerning innovation activities and the competitiveness of firms or industries should shift its focus to a wider horizon in a parallel manner and concentrate its attention on interactions, transactions and exchange on a global scale.

On the other hand, it has been increasingly acknowledged that a considerable amount of innovation activity takes place in the form of local or regional agglomerations in the past decades (Cooke et al. 1994). This is ascribed to competencies of firms and learning processes within these regions and leads to regional competitive advantages. Furthermore, regional specialization on certain products and production processes increasingly occurs throughout the world (Storper 1992). Some of the most notable examples are Silicon Valley in California (Saxenian 1994), Emilia-Romagna in Northern Italy (Belussi et al. 2010), Baden-Württemberg in Southern Germany (Heidenreich and

Kraus 1998), Bangalore in India (Chaminade and Vang 2008), Beijing–Tianjin–Hebei region, Yangtze River Delta, and the Pearl River Delta in China (Liu and Chen 2012).

The regional innovation system concept has been widely used by current researches to generate implications for policy-makers and firms' managers (Cooke et al. 1997; Cooke et al. 1998; Boekholt et al. 2000; Braczyk et al. 2004; Isaksen 2001). An innovation system comprises elements in consequence to innovation relationships among them (Cooke et al. 1997). These elements are individuals or organizations, including firms, research institutes, universities, and technology transfer agencies. A regional innovation system is mostly conducted by an evolutionary approach and emphasizes process, learning and co-operative, as well as competitive dimensions of interfirm relations (Cooke et al. 1997). Interactive learning and tacit knowledge spillover take place in the region leading to unique knowledge being created and absorbed in a way that promotes competitiveness for local firms (Storper 1997). While concerning tacit knowledge, the regional innovation system approach acknowledges that learning is a localized process. Agglomeration of firms and organizations is a very efficient basis for interactive learning.

Cooke (1992) pioneered the research in the concept of regional innovation systems. The study adopts the framework based on Cooke's longitudinal and serial research results and uses three biotechnology clusters in Taiwan as research subjects. In addition, the paper addresses the issue of cross-RIS interaction which is scarcely discussed in the former literature. The structure of the paper is as follows. Section 2 conducts a literature review on systems of innovation, regional innovation systems and RIS with biotechnology embedded. The content and results of case studies are described in Section 3. Section 3.3.3 outlines the key findings of this study.

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2. Literature review

2.1. System of innovation

The region is as a spatial dimension of innovation. Researchers increasingly recognize that many innovative activities take place in the form of local or regional agglomerations (Cooke et al. 1994). Economic performance of regions was often not solely due to an increase in operation efficiency, rather a great part of regional economic growth will largely depend on the interactive learning and the generation and exchange of knowledge. As most of companies can no longer afford to innovate on their own, they often have to interact with other external organizations, such as suppliers, customers, competitors, research institutes, banks, and government agencies, in order to acquire, develop and exchange diverse knowledge, information and resources. With increasing disintegration, outsourcing, and modularization, regional innovation system is becoming more important for the companies in the regional economy nowadays.

Innovative companies are not independent of the society and their innovative behaviors will be affected by the institutional setting. There may be different institutions in different regions that may result in different innovative behaviors and interactive modes between organizations. Institutional factors include laws, cultural norms, social rules and technology standards. The so-called System of Innovation comes from the combination of these interactive actors and a variety of institutional factors.

Freeman (1987) developed the concept of “national systems of innovation” which emphasizes tight network relationships interlaced among a variety of organizations from both public and private sectors. These relationships and interactions may lead to the initiation, introduction, modification and expansion of innovative technologies and products. After that, various innovation system related theories have been developed very rapid (Cooke 1992; Lundvall 1992; Nelson 1993; Patel and Pavitt 1994; Freeman 1995; Edquist 1997). Nelson (1993) defined that national innovation system is a system that existing organization groups with a mutual interaction relationship, and the interaction between the organizations will make a great impact on the development of a country's scientific and technological capabilities and the economic growth.

Lundvall (1992) defined innovation system actors, emphasizing that the interactive learning among government agencies, manufacturers and universities, of which includes the interactive learning between downstream makers and users. Lundvall's (1992) views of interactive learning covering new-type organizations and institutional innovation are more in line with Schumpeter's (1947) broad sense of regrouping, i.e. regrouping of new products, production method, raw materials, markets or organizational patterns. In terms of the scope of input activities, technological innovation requires combining existing knowledge with learning of new knowledge to regenerate permutations and combinations. In terms of innovative output, Nelson (1993) has a broadly innovative concept. He thought it was innovation as long as manufacturing or design process was new to a firm or enterprise. Innovation defined by Nelson was based on technological creation and expansion (Edquist 1997). Therefore, a broad definition of innovation is adopted in this paper.

2.2. The concept of “national”, “supranational” and “regional”

An innovation system may have supranational, national, and regional notions. Lundvall (1992) describes the nation with two dimensions in his book of national innovation systems: the national-cultural and statist-political. In an ideal case, these two dimensions coincide and people with common cultural, ethical, and linguistic background form a society in a single space and are controlled by a central government. In reality, these two dimensions rarely coincide and that it is sometimes even difficult to locate the borders of a “national” system of innovation.

Nevertheless, interactive learning and innovation will be more easily developed, when parties involved in knowledge exchange and originate in the same national environment, which can share its norms and culture-based system (Lundvall 1992). Lundvall (1992) discussed some limitations and arguments on studying national innovation system by naming other approaches such as supranational and regional.

Edquist and Lundvall (1993) investigated the two very different innovation systems of the two neighboring countries: Denmark and Sweden. Although these countries' people speak similar languages and are much alike in terms of culture and lifestyles, Edquist and Lundvall (1993) found striking differences in areas, such as technology diffusion and policy making. They further indicated that it is not only a matter of geographical delimitation; the state, and the power attached to it, is also important. Due to the differences between nations and the fact that many political decisions including those related to policy making are on a national level, the national approach to innovation systems seems to be a useful one and was already applied by numerous researchers.

There is the sub-national or regional approach to innovation. Carlsson and Stankiewicz (1991) believe that there are cases where a regional approach to innovation is fruitful. Saxenian (1994) uses the regional innovation systems perspective to investigate Silicon Valley and Route 128. The regional approach has become more and more popular during the previous and the current decade. One might argue that in times of globalization a supranational approach to innovation and the investigation of knowledge exchange across national borders are getting more and more important in comparison to regional systems. Nevertheless, there is still a growing perception that the region often plays a key role for innovation activities and their support by policy makers (Borras and Lundvall 1997). In this study, we discuss the scope of regional innovation system by a broader definition.

Cooke et al. (1997) indicated two different kinds of institutional evolution of regions. The first is how a regional system of innovation is being formed. Basic characteristics which distinguish a state can sometimes be distinctive in certain regions in comparison to other regions belonging to the same state. The second kind of regions is “administrative region”. These regions are not or at least not primarily results of significant cultural diversity among a country's citizens but of political reforms such as the attempt to establish regional democracy.

Based on regional agglomeration, Porter (1998) proposed competitiveness of nations, in which “business clusters” contain information linkages between firms and related innovation support organizations. The economic value of clusters is not assured by the mere presence of firms, suppliers, and institutions in a location. The institutional setting provides a certain “glue” to unhold the potential. The cooperative dimension is shaped by the institutional setting, and systemic innovation only creates advantages for firms, if their behaviors, their routines, and norms provide a basis for cooperation and systemic interactive learning. In this sense, knowledge becomes institutionally embedded and embedded in the interactions of organizations on a cooperative basis.

2.3. Regional innovation systems

Regional innovation system focused on the specific developments of innovation in certain areas. Regional cluster is a catchword for many types of industrial agglomeration, e.g. industrial districts, innovative milieus, local industrial complexes, and new industrial spaces (Isaksen 2001). The adjacent of geographic area and cluster interaction is the first necessary condition of the regional innovation system. The main reason for the formation of regional industrial clusters is that a company needs to achieve the innovative activities through an interaction and learning in the adjacent geographic space (Cooke et al. 1997).

Philip Cooke pioneered in the investigation of regional innovation systems and turned out to have a series of research outcomes (Cooke et al., 1997; Cooke, 1992, 1996, 2001a, just to name a few). Cooke (1992) created the term “regional innovation system” and had attempted to find the best practices within the sphere of regional

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