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A regional perspective on the structural transformation of China's national innovation system since 1999

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ABSTRACT

Observing the structural transformation of China's National Innovation System (NIS) since 1999 is useful for understanding the rapid economic growth experienced in China and for adjusting the development strategies of other late-industrializing countries. The following article uses the regional specialization coefficient (RSC) method to analyze the structural transformation of China's NIS from the perspective of eight large economic regions (8LERs) from 1999 to 2006. The NIS has achieved its initial objectives and two of the three major characteristics of China's NIS identified in Sun's (2002) [1] paper have changed since 1999: the funding structure — from a government- to an enterprise-centered model; and the performing structure — from a double-centered model divided into enterprises and research institutions, to one solely led by enterprise. The regional structures of China's innovation system conform to the macro structure on a national level, while regionally, a wide variety of changing models of RSC affect different locales. The Chinese central government remains the leading force in reforming its innovation system with "Chinese Characteristics".

1. Introduction

In the late 1980s, the concept and essential meaning of "National Innovation Systems (NIS)" was widely discussed in the international community [2]. This attention attracted various policymakers to the issue, who in turn helped to further define both the notion itself and the policies derived from it [3]. Innovation systems and governance have been shown to be of particular importance for economic development [4]. There are several models of NIS and economic development, the differences being influenced by the histories and traditions of different nations, and their different sizes and development levels.

Historically, the Asian Newly Industrialized Economies (NIEs) have shared common characteristics with many other developing countries insofar as, within the global economy, they were all rather late-industrializing. Some scholars have presented an analysis of the generic evolutionary paths for rapid technological catch-up by late-industrializing countries. The result is that there are divergent evolutionary patterns among these distinct innovation systems [5,6]. It means each country has its own evolutionary pattern, and China is no exception.

Underpinned by economic reforms and its "open-door" policy, China's economy has performed extraordinarily over nearly three decades. As the biggest developing and late-industrializing country, China is rapidly catching up to other dynamic Asian economies and the Triad economies on a score of indicators related to knowledge-based economies [7]. China's economy is now the fourth largest in the world and its macroeconomic performance remains strong [7,8]. Both economic and S&T reform in China have been effective in motivating universities and research institutions (URIs) to build up the innovative capacities of enterprises and promoting URI-to-industry linkages [9].

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Until 1999, China's NIS was identified by three major characteristics. Firstly, government-sponsored laboratories occupy a far more central position in China than in Western countries. Secondly, universities in China play a far less significant role in R&D activities than the universities in developed Western countries. Finally, the Chinese central government has been the leading force in reforming its innovation system, which it directly controls and directs [1]. In 1999, China's leader Jiang Zemin initiated the goal of establishing China's own scientific and technological innovation system.[1] What was the effect of this project? Have the structural transformation taken place in China's NIS since 1999? What is the evolutionary pattern of the structural transformation on China's NIS? The experience of China's innovation system is useful for understanding the rapid growth in China and adjusting development strategies in other late-industrializing countries.

Until now, much of this literature [1,5,6,9] has insisted on the central importance of national systems, but a number of authors have argued that globalization has greatly diminished or even eliminated the importance of the nation-state's role in innovation activity. Alternatively (or in addition), other critics have stressed that sub-national entities, such as provinces, industrial districts, cities or "Silicon Valleys," are becoming, or have already become, more important than the nation-state [10]. The concept of a state, however, is far more complex than that of a geographical space, as it also embraces the prime unit of public policy. The roles of nation-states are as those of containers of distinctive institutions and practices; regulators of economic activity and transactions; competitors and collaborators with other states [11]. While the majority of public policies influencing innovation processes or the economy are designed and implemented at the national level, to analyze national innovation systems at the state level and overlook the role of region in the development of an NIS would be an inefficient and broad oversight.

According to an innovation system, a state consisting of regions is not an inseparable unit. An NIS includes different clusters, with each cluster representing a distinct regional structure. Each region is a key cell for national development, and regional innovation systems have proved to be a useful tool in generating an effective NIS based on their capacity to create different sector-based innovation systems in variable regions [12]. From this perspective, a new approach linking national and sectional innovations systems has been created [13]. One result that has been discovered by many academics is the importance of regional resources in stimulating national innovation capability and competitiveness [14–17]. By examining the structural transformation of China's NIS from a regional perspective since 1999, current paper seeks to change the analysis viewpoint of NIS from the national level to the regional level.

2. What are the "Chinese Characteristics" of a National Innovation System?

Most authors agree that the concept of an NIS comes from researchers like Freeman [18], Lundvall [19] and Nelson [20]. The first person to use the expression NIS was Lundvall, who is also the editor of *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*, a highly original and thought-provoking book on the subject [19].

There is no single definition of what an NIS is [21]. The concept of an NIS rests on the premise that understanding the linkages among the actors involved in innovation is a key to improving technological performance [21]. Thus, an NIS can been seen as a new structural model similar to the technology-push model, the demand-pull model, or that of university–industry cooperation. According to innovation system theory, innovation and technology development is the result of a complex set of relationships among actors in a system. Such actors include enterprises, universities, governments and research institutions. The NIS model focuses more on the relationships and processes between various innovation actors, which emphasize the systemic characteristics of innovation, rapid technological change and globalization. It is a system of analytical framework, which serves as both model and tool.

China's NIS differs from those in other developed countries, not only in the content of its innovation system [1], but also in what the innovation system represents [2]. In 2006, the State Council presented "Medium-to-Long-term Plan outline for the Development of National Science and Technology (2006–2020)" (MLP) to strengthen China's scientific and technological progress.[2] A goal of the MLP is to "push forward the comprehensive establishment of a national innovation system with Chinese characteristics," but the precise meaning of "Chinese characteristics" remains undefined. A clear definition of the concept will help to demonstrate the policy and transformation of China's national innovation system.

In the post-Mao era, S&T development in China has evolved through four main phases, marked by the strategic National S&T Conferences (1978, 1985, 1995, 1999 and 2006), from which strategy decisions were issued. These five National S&T Conferences clearly reflect the development process of innovation systems in China (see Table 1). Having undergone the economic reforms and the "open-door" policy from 1978 to 2008, both the Chinese economy and society have been subject to dramatic changes. Table 1 demonstrates that the reform of China's NIS is a gradual process, consisting of many successive policy changes and adjustments. China's R&D intensity[3] decreased greatly after 1991, reaching a low point in 1996, rising to the 1991's level in 1999, and has since steadily increased (see Fig. 1). The NIS construction project of 1999 has been a key factor during this time, as it was an important phase from 1999 to 2006 for the reforming of S&T system.

[1] In the context of China's development, S&T systems are equivalent to innovations systems, so the term "innovation" is used within this article in a broad sense.

[2] "Medium-to-Long-term Plan Outline for the Development of National Science and Technology (2006–2020)" (MLP): Ministry of Science and Technology of the People's Republic of China, China Science and Technology Newsletter, no. 456, February 9, 2006.

[3] R&D intensity means Gross Domestic Expenditure on R&D (GERD) as a percentage of GDP.