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The Basic Elements and Framework of the National Innovation System of Big Country

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Abstract. The National Innovation System of Big Country is the source to enhance national innovation competence and economy development. Following the connotation and elements of the National Innovation System and aiming at the characteristics of Big Country, the paper breaks the traditional innovation framework which includes enterprises, universities and research institutions at the core of enterprises, and constructs a new framework of the National Innovation System at the core of government which gives full consideration to all kinds of social organizations and environmental factors by introducing qualitative and comparative research methods. It hopes to provide a scientific basis to promote the continuous development of the economy of Big Country.

Keywords: Big Country; National Innovation System; Element; Framework

1. Introduction

National Innovation System (NIS) is an "engine" of economy development of a country. National Innovation System includes knowledge innovation system, technology innovation system, innovation support system, and so on. Big Country with expansive dimensionality, large population, huge domestic market and abundant resources can construct an integrated National Innovation System more easily. Firstly, the large population can result in a large number of R&D personnel, complete departments of university & research institutions and powerful basic research forces, and thus an integrated knowledge innovation system can be constructed more easily. Secondly, the stable market demand can ensure enterprises a steady revenue stream, so that enterprises have more capital investment in research and development; the huge market demand can also increase product varieties, promote high-level supporting industry clusters to take place, and form a complete range of industrial sectors, and thus an integrated technology innovation system can be constructed more easily. In addition, Big Country has rich resources, technologies and a wide range of industrial sectors, which can make Big Country build a strong base of industrial technology and a supply system of industrial common technology. And then by creating a kind of social culture of encouraging innovative and an intermediary service system of supporting innovation, we can construct an integrated innovation support system more easily. The integrity of the National Innovation System makes the technology competition power of Big Country in higher position. "Global Competitiveness Power Report (2009-2010)" showed that the competitiveness power of science and technology in China rose to No.29 from No.30 of last year. Among the other three countries of "BRIC", India rose to No.49 from No.50, Brazil rose to No. 56 from No. 64, and only Russia dropped to No.63 from No.51.

Thus it can be seen that innovation capability and competitive advantage of a country increasingly depend on whether the country has built an integrated and efficient National Innovation System. Also just because of this, the academe has done a lot of research on the source, connotation, character, element, international comparison of the National Innovation System and made commendable achievements. But there is still a little

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research on the National Innovation System of Big Country. With the rapid development of the economy of the Big Countries such as “BRIC”, “the phenomena of the economy of Big Country” has increasingly become the focus of academic research. Based on this, following the connotation and elements of the National Innovation System, the paper will try to construct a network framework of the National Innovation System of Big Country at the core of government.

2. The Basic Connotation of the National Innovation System

What is the National Innovation System? There are many views. According to Freeman's view, the National Innovation System was a network of institutions in the public and private sectors whose activities and interactions initiated, imported, modified and diffused new technologies[1]. Lundvall further pointed out that the National Innovation System was a complex set composed of the elements and relationships which interacted in the production, diffusion and use of new, and economically useful, knowledge ... and were either located within or rooted inside the borders of a nation state[2]. Subsequently, after Nelson compared the National Innovation System of 15 countries, he thought the National Innovation System was a set of institutions whose interactions determined the innovative performance ... of national firms[3]. Patel and Pavitt thought that the National Innovation System was the embodiment of the national institutions, their incentive structures and their competencies, which determined the rate and direction of technological learning (or the volume and composition of change generating activities) in a country[4]. OECD put forward in the research report named “National Innovation System” that the National Innovation System was an organizational structure network in the public and private sectors whose activities and interactions determined the capacity of the diffusion of a country's knowledge and technology, and affected the performance of a country's innovation[5]. China indicated in the “National Middle-Long-Term Development Plan of Science and Technology (2006-2020)” that the National Innovation System was a social system in which government was leading, the fundamental role that market allocated resources was fully played, and all kinds of actors of technology innovation were closely contacted and efficiently interacted [6].

In despite of the above different statements, but their common grounds are as follows: (1)The flow of science and technology knowledge is placed in a very important position in the National Innovation System. The efficiency of the flow of knowledge is the key that the National Innovation System can operate well. (2) The interaction of the actors of the system is emphasized, and the innovation performance of a country largely depends on how the actors interact to promote the rapid flow of knowledge.

From another perspective, the National Innovation System is not a mere theory, but a system about the progress of science and technology and the development of the national economy. Therefore, the National Innovation System has the attribute of institution. So, as Professor Wang Chunfa says, the National Innovation System is an institutional arrangement how science and technology promotes economy to develop. Its core content is how to establish a good mechanism which can help producers, disseminators, users of science & technology knowledge and government to interact, and help scientific and technological knowledge to flow and apply in the whole country [7].

In practice, the National Innovation System is embodied by a network mechanism which helps actors to interact to promote the rapid flow of the knowledge in the national frontier. Under the role of the network mechanism, the actors carry through technological, commercial, legal, social and financial activities to protect, support, regulate and develop the new scientific and technological knowledge. Although the definition varies, but the nature of the national innovation system theory only has one meaning, namely, the circulation and application of the scientific and technical knowledge in the national economic system. Here, “System” means an institution arrangement to promote the interaction of different actors, and “National” means that the circulation flow of the scientific and technical knowledge mainly happens within the boundaries of a country.

3. The Elements and Functions of the National Innovation System of Big Country

The elements of the National Innovation System are all the elements which participate in and impact innovation activities, and they affect the operation of the National Innovation System in different ways.

According to the views of Lundvall, Metcalfe and OECD, the National Innovation System is composed of government, enterprises, education and training institutions, research institutions, intermediary organizations, infrastructural facilities etc. Lu Yongxiang thinks that the National Innovation System is composed of national research institutes, universities, enterprises, social institutions etc [8]. Wu Guisheng and Xie Wei propose the elements of the National Innovation System include hardware and software [9]. Liu Yulin proposes that government, enterprises, research institutions, universities and their interaction constitute the actors of the National Innovation System[10]. He Shuquan considers the National Innovation System is a network made up of a country's public and social institutions [11].

Thereout there is not an unified understanding about the elements of the National Innovation System in the academe. Generally it is believed that the National Innovation System is made up of main elements such as enterprises, universities, research institutions, government and intermediary organizations. But some scholars consider the National Innovation System includes not only main elements (agencies and organizations of innovation) but also non-subject elements (environmental conditions required for innovation), and they agree that non-subject elements are in a subordinate position. As mentioned earlier, for Big Country, the integrity of the National Innovation System comes not only from the functions of main elements such as enterprises, universities, research institutions, government and intermediary organizations, but also from the support of the environments such as expansive dimensionality, large population, huge domestic market and abundant resources of Big Country, which can not be matched in the small country.

Based on the above views, we believe that the National Innovation System of Big Country includes two types of elements: main elements and environmental elements. Between them, the main elements are the core, and the environmental elements are the basis.

The main elements, namely the implementing mechanisms of innovation, are actors of the National Innovation System of Big Country, including enterprises, universities, research institutions, government and intermediary organizations. Among them, enterprises are the actors of technology innovation and market development. As the important providers of innovation knowledge, universities and research institutions are the actors of knowledge innovation and transmission. As the embodiment and actor of country functions, government guides innovation goals, allocates innovation resources, sets down innovation policies and constructs innovation environments. Intermediary organizations are the important carriers of market mechanism and play the important role as a bridge in the course of the transfer and application of knowledge and technology.

Environmental elements include innovation resources, innovation mechanisms, innovation environments, international interaction etc which restrict whether the National Innovation System of Big Country can be carried into execution. Innovative resources include talent, knowledge, patents, information, natural resources and funds. They are the basis and source of the innovation activities. Innovation mechanisms include market operation mechanism, incentive mechanism, fair competition mechanism, and so on. They are the key factors to ensure the effective operation of the innovation system. Innovation environments include software and hardware environments such as national policies and regulations, macroeconomic conditions, infrastructural facilities, social culture psychology. They are the guarantee to maintain and promote innovation. International interaction means the cooperation and exchange among the actors in the different National Innovation System, which is the key that the National Innovation System is internationalized increasingly.

4. A Network Framework of the National Innovation System of Big Country

On the analytical framework of the National Innovation System, the most common model is that enterprises, universities, research institutes and government are regarded as the actors of the innovation system which interact and enterprises are the core of the National Innovation System (Figure 1). The characters of this model are as follows: Firstly, enterprises are in a prominent central position; secondly, universities, research institutions and government are in the dominant position and they interact; thirdly, other social organizations are all the environmental elements. Many domestic scholars have used this model to analyze problems of the National Innovation System.

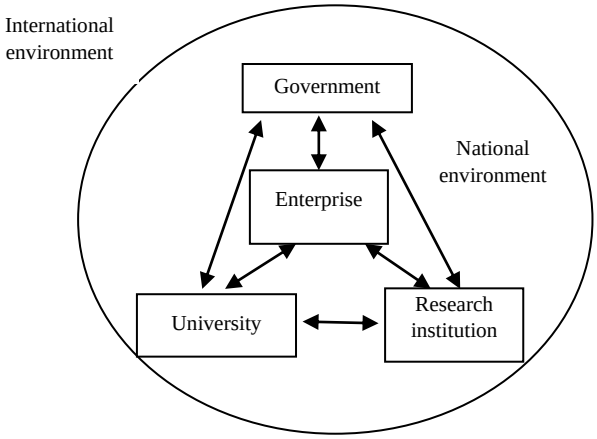

Fig. 1: The Basic Framework of the National Innovation System at the Core of Enterprises [12]

From the systemic angle, the National Innovation System regards "nation" as the analysis framework in which any individual or organization is the element of the system, and its background exists outside the national scope. In other words, the National Innovation System is a self-organized system under the background of the world stage. The aim of constructing the National Innovation System is to develop national economy and improve national competition power. However, "country is the key to economy growth, and country is also the cause of the man-made economy depression."[13] Therefore, government as the embodiment and actor of country functions, its institutional arrangements on behalf of the country become crucial to economy growth, especially for Big Country, even more important. So, it is the government rather than the enterprise that is the core of the National Innovation System of Big Country. Based on the above analyses, we try to construct a network framework of the National Innovation System of Big Country, in which government is the core, the actors including enterprises, universities, research institutions and intermediary organizations are in the kernel layer, and the environmental elements including innovation resources, innovation mechanisms, innovation environments and international interaction are in the exterior layer (Figure 2).

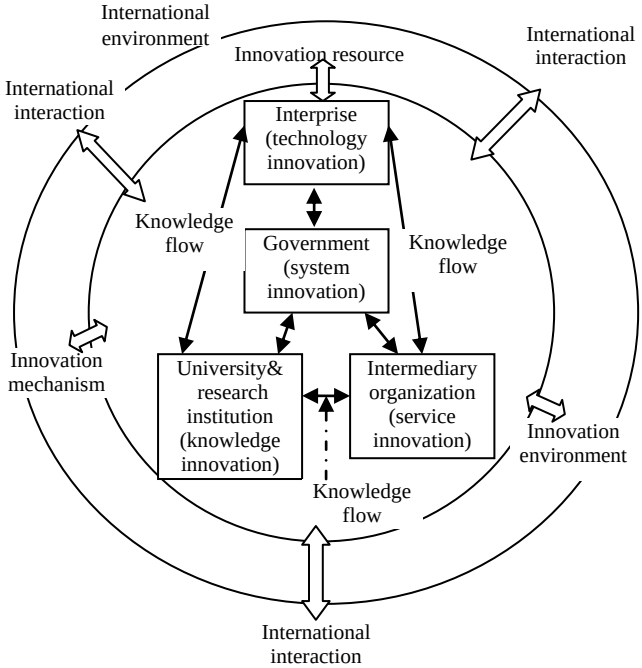

Fig. 2: The Network Framework of the National Innovation System of Big Country at the Core of Government.

In this network framework, government is the core of the National Innovation System of Big Country which is responsible for regulating the macro-structure of the entire system and promoting different

innovation actors to actively interact in order to play the overall function of the system. Under the government's macro-control, universities, research institutions and intermediary organizations play their respective functions and interact. Among them, the enterprises are not only the actors of technology innovation, but also the actors of innovation input, output and benefit distribution. As the actors of knowledge innovation, universities and research institutions bear a large amount of basic research work. The production of intangible knowledge is their prominent character and they provide an endless source of knowledge for enterprise innovation. Universities and research institutions also shoulder the task of training and transporting talents for enterprises, which makes it possible to transform science and technology to practical productive forces. As the actors of service innovation, intermediary organizations can provide many professional and social services by providing knowledge, technology, information, capital in the process of technology innovation and transformation.

The flow of knowledge is the focus of the activity of the elements of the National Innovation System of Big Country. The aim of the complex activities of enterprises, universities, research institutions, government and intermediary organizations is to promote innovation knowledge to flow rapidly within the innovation system. The flow of knowledge in this system is mainly embodied as follows: (1) The flow of knowledge among enterprises. This helps enterprises to obtain complementary knowledge, which can increase the likelihood of innovation success. (2) The flow of knowledge among enterprises, universities and research institutions. The knowledge from universities and research institutions to enterprises is mainly research production; the knowledge from enterprises to universities and research institutions is mainly information such as market demand. (3) The flow of knowledge among universities and research institutions. This helps the combination of different studies and the production of scientific research. (4) The flow of knowledge among enterprises, intermediary organizations, universities and research institutions. As a bridge between enterprises and universities(research institutions), intermediary organizations have important functions to promote the diversion of scientific and technological achievements, realize industrialization and transfer knowledge demand and supply, and so on. (5) The flow of knowledge inside and outside of the country. This is embodied by getting technology from abroad, buying foreign patents and licenses, technical cooperation among different countries, foreign direct investment, and so on. An important role of the government lies in the government's institutional arrangements to promote cooperation and exchange among enterprises, university and research institutions, intermediary organizations, so as to promote the circulation and application of the scientific and technical knowledge among the actors.

The environmental elements including innovation resources, innovation mechanisms, innovation environments and international interaction, as the influence factors of the National Innovation System of Big Country, affect the main elements to play the role. The influence is that the environmental elements generally give the objective conditions for the main elements to play the role. The objective conditions compulsively restrict the main elements to select combination manners and play innovative functions. The constraint of environmental elements is mandatory, but not insurmountable, because the innovation activities of the main elements can achieve the power to realize the transcendence. For example, government constantly adjust innovative policies to support and encourage innovative activities by institution innovation, which can lead to mature innovative mechanisms such as market operation mechanism; enterprises continuously improve the country's technology competition power by technology innovation, which can improve the country's macroeconomic situation; universities and research institutions can continuously change the status of the country's knowledge and talent by knowledge innovation; the intermediary organizations can constantly improve the professional and social service level by service innovation. Just because of such a series of innovative activities, the main elements of the National Innovation System of Big Country constantly change the objective conditions of restricting their innovative activities, which makes themselves get better combination manners and higher efficiency. Through the interaction network between the main elements and the environment elements, along with the active international interaction, innovation has increasingly become the source of the national progress, and the National Innovation System as a self-organizing system continuously achieves self-development, self-improvement and self-transcendence.

5. Conclusions

The National Innovation System of Big Country is the source to enhance national innovation competence and economy development. Its essence is to promote the circulation and application of the scientific and technical knowledge in the national economic system, and to promote economic development and social progress. Enterprises, universities, research institutions, government, intermediary organizations are the main elements in this system which shoulder the functions of technology innovation, knowledge innovation, service innovation and system innovation. The environmental elements such as innovation resources, innovation mechanisms, innovation environments and international interaction restrict the effectiveness of the National Innovation System. We must fully stimulate the innovative enthusiasm of the main elements and promote different actors to coordinate and exchange in the course of constructing the National Innovation System of Big Country. We should also continue to accumulate innovation resources, adjust innovative mechanisms, improve the innovation environments and promote international interaction, and thus a good macro environment will be constructed for the main actors to fully play their functions and promote the circulation and application of the scientific and technical knowledge in the national economy system.

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