Session 1 (Plenary)

China's National Innovation System as an Ecosystem: Investigation through Input and Outcome

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This paper summarizes developing pattern of China's national innovation system, in terms of ecosystem point of view. An ecosystem in economic context is usually considered as a balanced developing body between its resource input and output performance, with a rather steady improvement characteristics. Innovation system, in this view, should be considered as a self-supported changing system in a positive sense, through a highly effective way not only to capture various kinds of innovation resources, but also to inspire and improve the resources, or in another words, through a sustainable way to host innovation activities.

This paper will focus on two basic parts of innovation system: resource input and outcome of the system, in China's case, and the research findings are divided into three sections, namely, innovation policy environment in China, major driving forces for innovation in China, and finally the possible pattern for China's innovation ecosystem.

I. Innovation policy environment in China

The paper will firstly discuss policy environment for Chinese innovation activities. Innovation policy apparently would provides an overall infrastructure for certain country or district to guide local innovation in a certain pattern. Policy as a major part of the so called visible hand, usually characterized as longer term focus, in most of the cases, functions as another kind of market for attracting business firms and also social resources to operate against the normal free market, so called invisible hand, usually characterized as short term focus.

A innovation policy framework is studied in this paper and a general picture is provided under China's science and technology development context, as follows. The framework indicates that there are generally two kinds of policy target: policy to encourage new ideas and policy to improve applications of the new ideas. Apparently, to encourage and to improve application of new ideas, or spin-off, is more emphasized. This can also be reflected through various kinds of beneficial policies for high tech firms, or organization focused pattern. (Please refer to Figure 1)

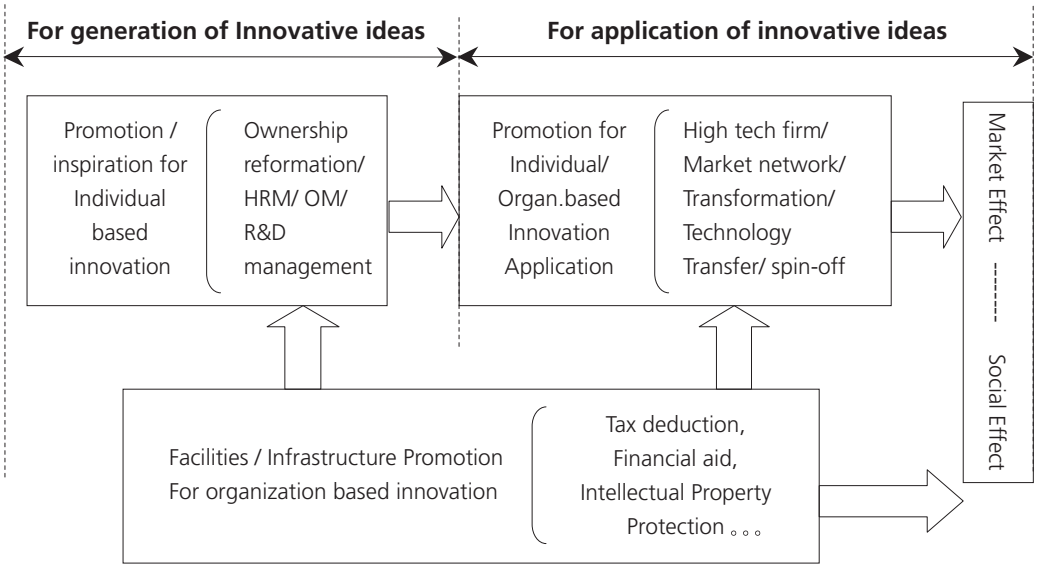

Figure 1. Innovation Policy: Input / Output Structure in China

The paper includes a practical survey conducted by the author on 151 documents of Chinese technology innovation related policy between 1985 and 2000, and provides a general picture about China's national innovation system.

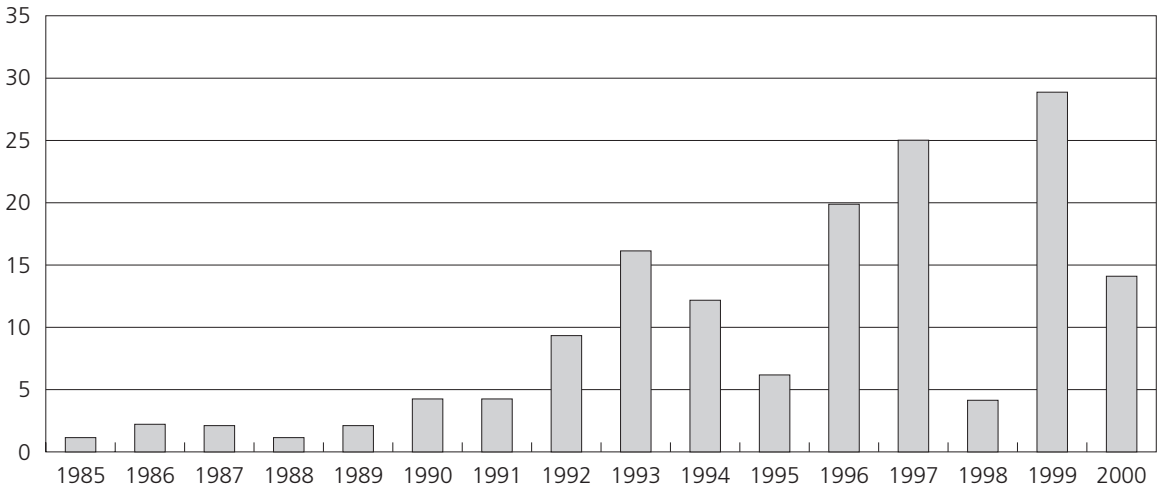

Figure 2. China's Technology Innovation Related Policy Implementation (by numbers between 1985 – 2000)

Source: edited based on <China Technology Innovation Policy 1999 -- 2000> published by Ministry of Science & Technology of China (MOST), 2000,; <Selected Technology Innovation Policy in China>, published by MOST, 1999. Science & Technology Press , China

Figure 2 shows a distribution of those policies in terms of issuing time, which can reflect in terms of quantity a stronger intention of innovation in the country, while Table 1 provides detailed distribution in terms of policy functions. In Table 1, it can be derived that although application, or transformation of new ideas or scientific achievement into business fields are more emphasized, it is the company (especially high tech companies) that attract more attention from government agencies.

Table 1 China's major innovation policy: distribution pattern.

Policy / Share	Bonus for S&T Accomplishment	Technical Diffusion based promotion	High Tech firm establishment	High Tech firm Tax & Financial support	Knowledge innovation environment		Scientific Research System Reformation	Other	Total
					regulation	Legislation			
%	7.3%	18.5%	17.9%	21.9%	9.9%	4.0%	13.3%	7.3%	100.

Source: edited based on <China Technology Innovation Policy 1999 -- 2000> published by Ministry of Science & Technology of China (MOST), 2000,; <Selected Technology Innovation Policy in China>, published by MOST, 1999. Science & Technology Press , China

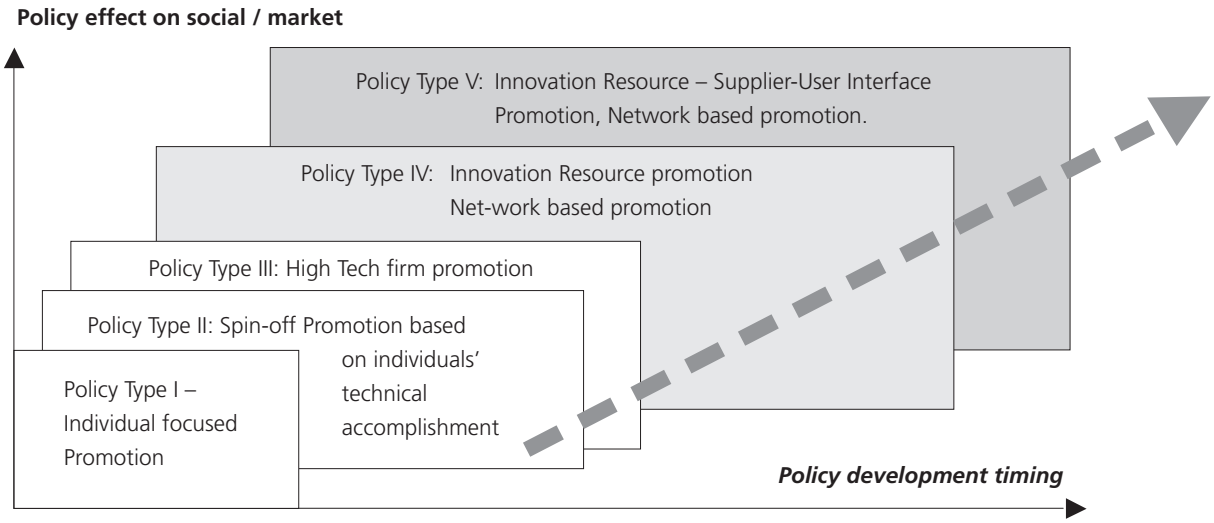

Figure 3. General development trend of innovation policy

The paper also emphasize, based upon international empirical facts and studies, that innovation policy is more and more towards a network promotion type, rather than purely one way dimension of supplier-to-user, thus government - university - enterprise relationship is highly important, and related mechanism proves to be vital. Comparatively speaking, innovation policy has not yet very much focusing on this side, this may bring some un-efficient part of new idea generation (Please refer to Figure 3).

II. Major driving forces for innovation activities in China

Numbers of Chinese scholars in innovation fields indicated that there were two major driving forces in Chinese economies that influence various innovation activities in different regions. The first group is from China's local innovation base, including funding capacity, research and development personnel, and technical & engineering organizations, while the second group is from foreign direct investment (FDI) firms. Typical research indicated that FDI forces significantly outperform domestic firms in innovation regards.

This paper also includes an empirical study which has been continually running for many years by the author, on comparison of innovation activities in FDI firms in contrast to local firms (mainly state-owned firms) in different Chinese provinces and regions.

Data are selected from China's published science and technology year book, based on 27 geographical regions (Due to very little overseas capital, some regions in mainland China are neglected in this study) over 17 different measurements concerning innovation activities in China, including 3 indicators mainly reflecting resource connection between parent companies in home country and subsidiaries or joint ventures in China, 8 indicators concerning innovation input, and another 6 indicators regarding to innovation output, altogether 18 indicators as follows:

(1) Resource connection with overseas parent companies (Input from parent companies)
- · science and technology funding from overseas;
- · expenditure for adoption of imported technology

(2) Intra-firm innovation activities: (Input)
- · intra-firm expenditure on science and technology activities
- · new product development fund
- · expenditure for in-house science & technological institution
- · expenditure on in-house technology equipment reformation
- · expenditure for technology purchase from China's market.
- · Total number of technical personnel in foreign invested firms.
- · total number of scientific & technological institutions owned by foreign investment
- · total number of enterprises that have their own technology development institutions

(3) Intra-firm innovation activities: (Output)
- · total production value by new product
- · sales revenue generated by new product
- · profit level generated by new product
- · Numbers of new product development projects
- · Numbers of patent application to local Patent House.
- · Numbers of invention patent granted by the local Patent House.

The paper adopts an indicator: $C_{ij} = (JVij - SO_{ij}) / (JV_{ij} + SO_{ij})$;
Where JVij is the value of the jth innovation measurement of FDI firms in region i, while SO_{ij} is the value of the jth innovation measurement of local firms (usually state-owned) in region i. Apparently, if $C_{ij}>0$, then FDI firms are dominant in a particular region on certain innovation measurement, and C_{ij} has the value between –1 and +1.

Meanwhile, the study also applies a Principle Factor Analysis (PFA) method to summarize the total 17 measurements, or to decrease numbers of the original measurements but at the same time, keep original information to certain extent, by this way, a clear rank and related map can be revealed according to original measures.

Figure 4 shows the major results that all overseas heavily invested regions (primarily in coast lines, indicated by "cst") are dominated by foreign invested firms in terms of innovation powers, including input and output.

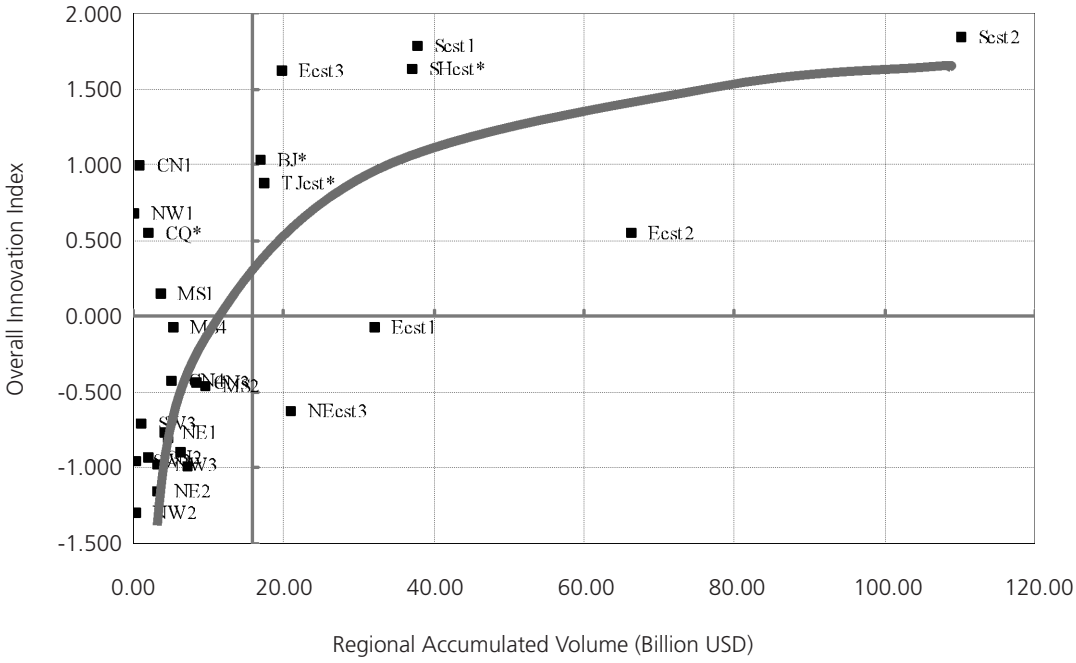

Figure 4. Regional distribution of FDI innovation power against local Chinese firms

Notice1: red line in vertical is indicating average size of the accumulated realized foreign capital, while red line in horizontal indicates bench mark of dominating power on innovation.

Notice2: Chinese regions are coded by directions between north and south and between east and west, numbers are indicating direction toward north and south in general, and cst is indicating coastal province, e.g., NEcst3, meaning the third province from the north in northeast China, with coastline. A code reference table will be provided in the final slides.

In general, the paper can conclude that although China implemented actively various kinds of innovation policy and conducted important projects to raise innovation capability in the country, in terms of industrial innovation aspects, FDI firms appear more dominant in not only the regions where overseas investment is heavier, but also regions with less investment. Therefore, a yellow curve can be predicted that at least, manufacturing based technological innovation is primarily dominated by foreign capitals.

III. Pattern for China's innovation ecosystem.

Thorough previous analysis and research, one picture can be obtained (please refer to Figure 5). In this picture, China's innovation system as an ecosystem has to be open for knowledge and technology inflow, and at same time for generating and inspiring local innovation. However, since there might not be easy for Chinese local firms to access overseas design type technology, sustainable innovation system can be problematic, unless networking and interface facilities among universities, government agencies, and industries in vertical dimension, and supplier – user communication in horizontal dimension can be fully implemented.

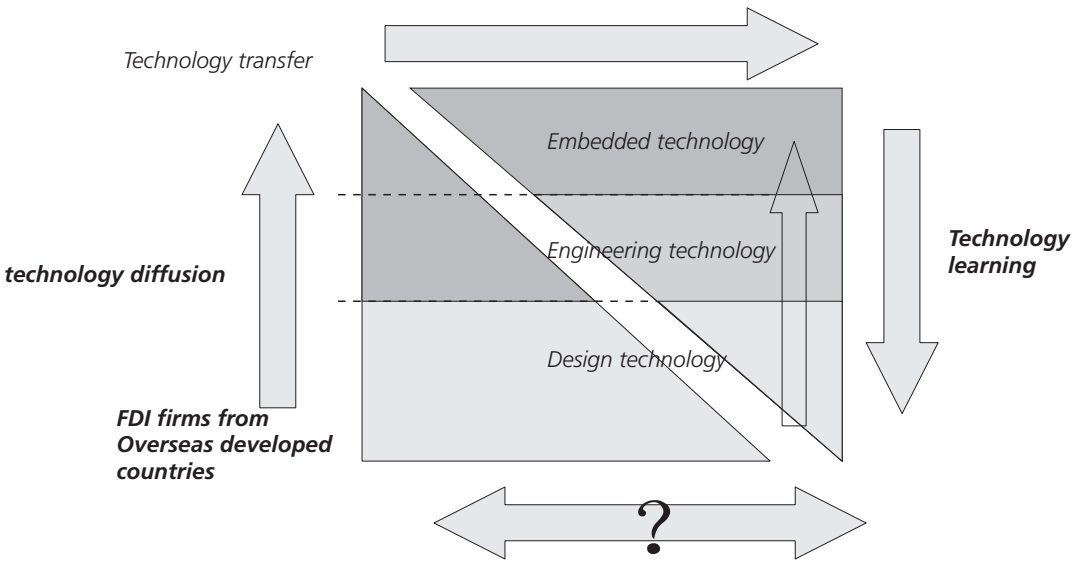

Figure 5. Perspective on Ecosystem of Chinese Innovation System