SCIENCE AND TECHNOLOGY POLICY IN CHINA

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Contents

Summary

This chapter examines the case of China in science and technology policy. It analyzes the role of science and technology in the economic development of China, in relation to the formulation and implementation of the policy that assisted the establishment and thereafter adjustment of the science and technology system, and served to co-ordinate scientific and technological activities.

The time span covers fifty years from the 1950s to the 1990s. This is the time when China achieved record development performance in her modern history. The article emphasizes the importance of institutional settings on the development of science and technology. Incentive structure and co-ordination mode are therefore analyzed as

critical factors responsible for the functioning of science and technology, to link it with technological change and hence productivity growth.

Learning and capability-building are also given analytical emphasis, as indicators of the dynamic process in which, as an industrial latecomer, China improved her capacity in innovation and in policy-making. The chapter examines the latest developed schools of thought on technological innovation and development economics in the context of China.

It provides in-depth, but succinct, explanations for the development of China in the centrally-planned (1950s to 1970s) and market reform (1980s and 1990s) periods and achievements, from the point of view of learning and capability building, and their institutional bearing. The chapter ends by pointing out the new challenges China will have to address in her science, technology and innovation policy for the twenty-first century, if she is to sustain and accelerate her modernization.

1. Introduction

This article analyzes the science and technology policy in China. Before entering into the detail of the subject, however, let us emphasize that the article assumes that the science and technology policy is aimed at social and, mainly, economic development. Although this focus might appear as a partial point of view, since other values such as the health of the scientific community itself might be pertinent, it nevertheless relies on the fact that, in the long run, development performance is the result of the effectiveness of innovation, one of the major goals of the science and technology policy.

The capacity to innovate embraces the capacity of the economy to create new products and services, new markets and institutions. In this sense, innovation policy, technology policy, and science and technology policy are used as synonyms in this chapter. The analysis is organized around institutional aspects—the organizational structure, the incentives and the co-ordination mode of the innovation system— in order to explore why innovation performance was what it was in different periods of development in China.

The strength and pattern in generation and application of scientific and technological knowledge of an economy are largely supported by its institutional setting. The innovation system is always "country-specific". In the case of China, the specificities of the innovation system are not only the result of historical, political and cultural factors, but also, or perhaps more so, of economic regimes.

The modern history of China is a history of a traditional society struggling to respond to the challenges from the frontier of science and human civilizations. During the hundred years since the Opium War of 1840—an event that divides the history of China between ancient and contemporary— little action was taken in a consistent and effective way in order to answer them.

The conservatives were powerful; they beat down the reform initiatives at the end of the nineteenth century, and then the court of the final imperial Qing Dynasty terminated altogether in the 1911 revolution. In the following several decades, China lived in social turmoil and wars; old institutions were discredited and destroyed but new ones had not been tested out.

It was only in the middle of the twentieth century, by the establishment of the People's Republic in 1949, that China got onto the track where it was able to impose internal order, accelerate economic development and restore national dignity.

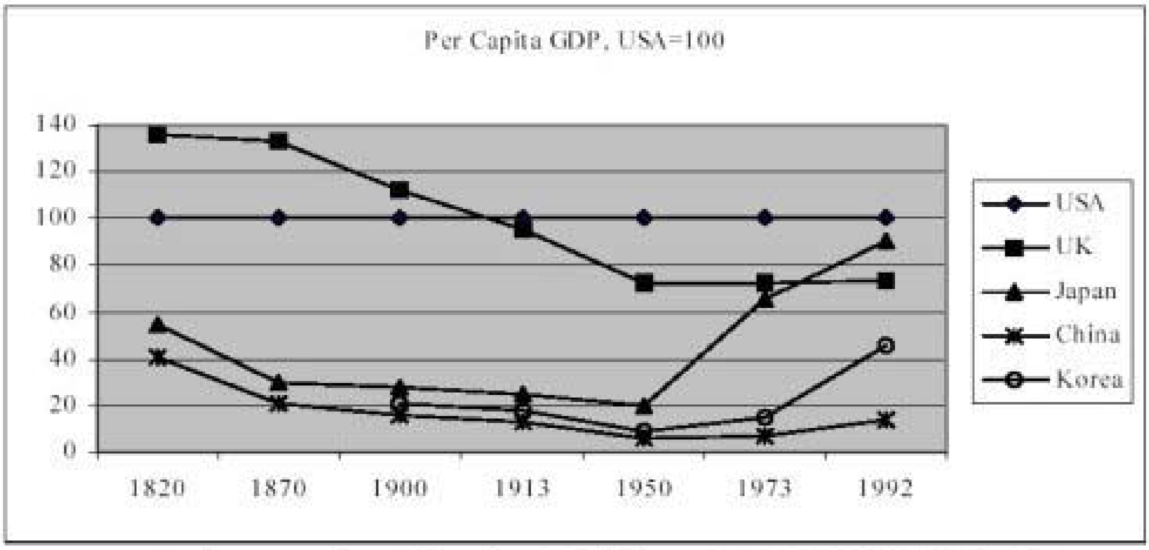
The establishment of the People's Republic was, as Maddison terms it, "the Chinese equivalent to the 1868 Meiji revolution in Japan". Figures 1 and 2 give an overview of how China passed through the years from the nineteenth to the twentieth century in international comparative terms.

In 1820, China had a GDP per capita which accounted for around 40 percent of the United States' GDP per capita. Since then, this figure declined to its lowest point in 1950, which was around 5 percent of the USA standard.

Labor productivity must have taken a similar declining curve but the data is not available. China had been falling severely behind in terms of productivity as well as in terms of GDP throughout the nineteenth century and the first half of the twentieth century.

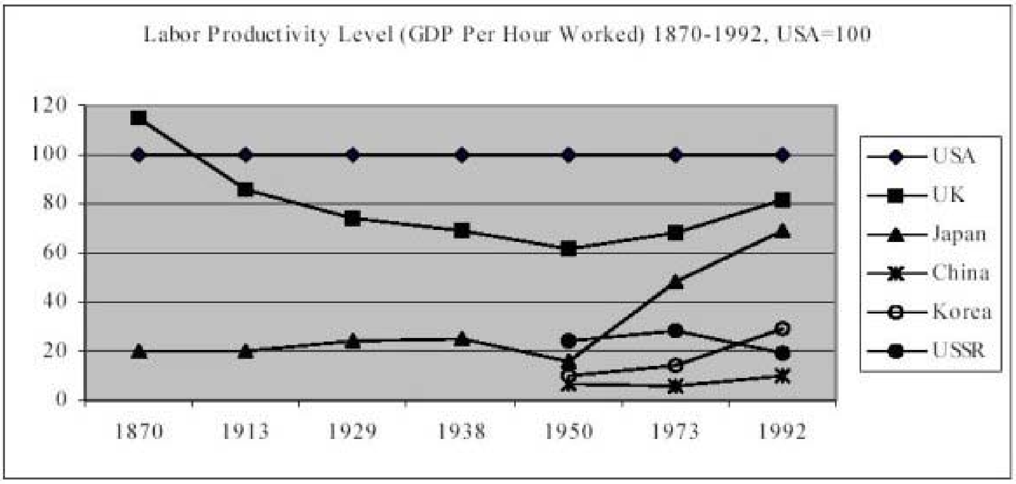
From 1950 onwards, the indicators stopped declining, with slow improvement or relative stagnation for the first period between 1950 and the 1970s, and rapid improvement since the end of the 1970s, corresponding to the respective centrally-planned and market reform periods.

Economists call this process "catching-up" in which the gap with the economic forerunner is narrowed. China has been in the track of catching-up since 1950.



Source: Author reproduced based on Maddison A. 1995: 23-24, Table 1-3.

Figure 1: GDP per Capita: selected countries, 1820-1992



Source: Author reproduced based on Maddison A. 1995: 47 Tables 2-7 (a) and (b)

Figure 2: Labor productivity level: selected countries, 1870-1992

The data concerning education in the same period demonstrate that China had been experiencing a sweeping destruction of social life and a difficult transformation of its educational system over the past centuries. In 1820, Chinese people were not much less educated than American people were, in terms of years of education of ages 15 to 64. Up to 80 percent of Chinese men used to be able to read and write in traditional China. However, in 1950 China was the poorest among those that are listed in the table; about 80 percent of Chinese adults were illiterate. The data on education show the importance of education in the successful catching-up economies in Asia--Japan, South Korea and Taiwan (China). These countries experienced faster educational developments and a quick upsurge of economic developments. In comparison, although China has invested importantly in education since 1950, progress in education is yet to be facilitated further.

	1820	*1870*	*1913*	*1950*	*1973*	*1992*
USA	1.75	3.92	7.86	11.27	14.58	18.04
UK	2.00	4.44	8.82	10.60	11.66	14.09
Germany	-	-	8.37	10.40	11.55	12.17
Brazil	-	-	-	2.05	3.77	6.41
Japan	1.50	1.50	5.36	9.11	12.09	14.87
China	1.50	1.50	1.50	1.20	3.40	7.60
South Korea	-	-	-	3.36	6.82	13.35
Taiwan	-	-	-	3.62	7.35	13.83

Source: Maddison A. 1995: 37, 77 for all countries except China. The author's calculation, based on data in Statistical Yearbook of China 1993: Tables 3-4, 3-5, 18-4, the figures for China in 1973 and 1992; and estimated for 1820, 1870. As a reference, Maddison provides the data for China which are 1.70, 5.33, and 8.93 for 1952, 1978 and 1995 (Madisson A. 1998: 61).

Table 1: Years of education: selected countries, 1820-1992 (Per Person Aged 15-64)

The two periods of post-war development in China are divided according to the political-economic regimes that China has undergone, which laid down an overall environment in which the science and technology policy was formulated and implemented. In the first period, from 1950 to the end of the 1970s, China underwent a centrally-planned regime; the second period, since the end of the 1970s, is a period of market reform.

The two periods differ considerably in development performance, although both periods achieved positive catching-up. In labor productivity growth and per capita GDP increase, the second period shows an accelerating pace compared with the first period. Thus, the average annual growth rate of per capita GDP was 6.0 percent for 1978 to 1995, versus 2.3 percent for 1952 to 1978 (Figure 1). This means that the living standard of Chinese people improved rather rapidly in the second period, whereas living conditions had changed only modestly between 1950 and 1978. This indicator did not improve at all in the previous period between 1890 and 1952. Likewise, labor productivity (Figure 2) increased faster in the second period, but it is still very low compared to the productivity leader. To offer a reference point for comparing the two periods, investment levels were similar, both at around 30 percent of GDP. Hence, there must be reasons other than investment levels which are responsible for the difference. We shall explore it from the perspective of innovation and innovation policy.

2. Science and Technology Policy from the 1950s to the 1970s

There were two lines of development strategy in the post-war time: a strategy based on comparative advantages, which advises developing countries to start with labor-intensive and low capital industries, and a strategy which insists on developing capital goods industry as a priority. China followed the second strategy, also called "self-sufficient", in this period. With the capacity of capital goods technology, it was believed the economy would be able to reproduce itself by the domestic provision of means of production or intermediate inputs for the development of various productive sectors. The implementation of the strategy in China was carried out in a centrally planned political and economic regime.

In retrospect, both of the two strategies were partial. Both were "static" in conceiving the essence of economic development. The first strategy emphasizes the comparative advantages derived from the allocation of factor endowments of a developing country; it pays little attention to the creation of new comparative advantages, and does not give any importance to science, technology and innovation. The second strategy, although aware of the importance of technology that is embodied in capital goods and often accompanied with high investment in science and technology, views the acquisition of the technology as a matter of gaining it once and for all. However, the development process is essentially a highly dynamic one. Learning is the most important feature for successful and sustainable development, where capital investment, technological capability-building and institutional restructuring are crucial.

Apart from the political alliances that China had in the 1950s, the centrally planned approach to science, technology and economic production is related to its historical experience. Nationalization of important industries and the large institutional setting needed for centrally-planned economies has a long tradition in China; it can be traced back as far as two thousand years ago, when important industries such as salt and iron began to be nationalized. China was a great contributor to pre-modern science and technology. Inventions that originated in China, such as the compass, gunpowder and printing techniques, were transmitted directly or indirectly and became important inputs for the rise of modern Europe. In ancient China, science and technology were largely government-organized too, especially astronomy, hydraulic engineering, and agricultural and medical science.

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Biographical Sketch

Shulin Gu was trained as a natural scientist in Chemical Physics. From the late 1960s to the 1970s, she worked in several distinguished Chinese institutes. In the Institute of Mechanics of the Chinese Academy of Sciences, she was Assistant to the Director and worked in the field of chemical dynamics; and in the Central Research Institute of the Beijing Petrochemical Corporation she took a leading role in several areas of petro-chemical catalyst processes. Since the 1980s Shulin Gu has been engaged in science, technology and innovation policy studies. She worked in the Institute of Policy and Management of the Chinese Academy of Sciences in the 1980s, and took the leadership of the Science and Technology Policy Department. From 1992 to 2000 she was Senior Research Fellow at UNU/INTECH, Maastricht, where she completed several INTECH projects in science and technology policy and transformation of the innovation system in China, and contributed to the research on national innovation systems in developing countries. Her work is now based on China, and she is Visiting Professor of TsingHua University and Adjunct Senior Research Fellow of UNU/INTECH. Shulin Gu is a member of the Advisory Board of several academic journals. She is also involved in activities organized by UNDP and UNU. Of her wide publications in both Chinese and English, the book *China's Industrial Technology, Market Reform and Organizational Change* (Routledge 1999) is highly appraised in book reviews (*China Quarterly*, 1999 December, *Research Policy* 2001 August) as an important work on S&T policy and the reform of the S&T system in China. Her research interest is in technological innovation and innovation policy in developing countries, and clustering and regional development strategies.