BOOK REVIEWS

Technological Superpower China

Jon Sigurdson, in collaboration with Jiang Jiang, Xinxin Kong, Yongzhong Wang and Yuli Tang
(Cheltenham, Edward Elgar, 2005), xviii+347 pages

China's economic boom and political ambition have fuelled unprecedented investment in science and technology. Since 1999, the country's spending on research and development (R&D) has trebled, and it has now become the world's second largest R&D investor (in purchasing-power-parity terms).[1] At the same time, China has benefited significantly from the internationalization of R&D by transnational corporations (TNCs), as growing numbers of Western companies open research facilities in cities such as Beijing and Shanghai (UNCTAD, 2005).

Is China about to become the next technology superpower? Is it merely a "workshop of the world" based on the efficient use of foreign technology, or will it be able to become a "global R&D centre"? In their book, *Technological Superpower China*, Jon Sigurdson and collaborators provide some insightful answers to these questions that concern policymakers the world over. The book examines China's technological advance since the early 1980s, its approach to using foreign technology combined with its own manpower, and the integration of its national science and technology programmes with the knowledge and innovation systems of national and international corporations, as well as of various localities. The author makes an informative and persuasive case showing that China has emerged as a major R&D player and a technological competitor to countries such as Japan and the United States. The book is very relevant to the current debates in R&D, FDI and related policy issues, and is recommended to all those interested in an updated presentation of China's technological progress.

China's science and technology development: various perspectives

Who are the main actors behind China's rapid technological advancement? What are the main factors explaining this achievement, and what

[1] OECD, "China will become the world's second highest investor in R&D by end of 2006, finds OECD", press release, 4 December 2006.

are the key areas of strength and challenge for China? Jon Sigurdson addresses these questions by undertaking a comprehensive analysis of the dynamic, multifaceted process of China's science and technology development since the start of its "open door" policy in the late 1970s. According to him, China's technological advances have been based on combining public initiatives and corporate efforts, integrating regional ambitions with national policies, and using foreign technology coupled with its own manpower.

In terms of the relationship between the public and private sectors in the innovation process, China has long suffered from the absence of an innovative enterprise sector – a common weakness of the innovation systems of developing and transition economies.[2] In the first chapter of his book, the author suggests that, until the early 1980s, science and technology remained completely within the government domain, but, nowadays, the corporate sector has taken on a major portion of R&D in China.[3] However, he recognizes that the most research-intensive companies are still either State-owned or maintain close links with the public sector.[4] He argues that government programmes and initiatives remain important, but the private sector is growing in importance in the national innovation system. The first chapter addresses this as well as other general issues regarding China' technological progress and lists the main components of China' innovation system, providing the conceptual background and setting the stage for later discussion.

Chapters two and four discuss government science and technology policies and programmes and the corporate sector's R&D efforts, respectively. Chapter two first takes the reader through a historical sketch of China's science and technology policy and then outlines in detail various national science and technology programmes, mainly those involving the Ministry of Science and Technology. In addition, the chapter examines China's technological and scientific

[2] In developing and transition economies, a major part of R&D is undertaken by universities and government research institutes and is often delinked from the productive sector (UNCTAD, 2005).

[3] The business sector has become the dominant R&D actor in China's innovation system, performing over two thirds of R&D in 2005 (OECD, 2007).

[4] Actually, the rapid increase in business sector R&D in China since the mid-1990s has been the result of the conversion of some public research institutes into business entities (OECD, 2007).

manpower, with a particular emphasis on its producers – the country's universities; it mentions the contribution of students returned from overseas as well. Indeed, various types of returnees have played an important role in technological and commercial advances in China and other developing countries, such as India (see, for example, Saxenian, 2006; Wilsdon and Keeley, 2007), and more research is needed to better assess their contributions. Chapter four describes the reform of China's research institutes since 1978 and analyses the R&D efforts of Chinese enterprises by putting together a number of case studies on companies in the information and communications technology (ICT) industry, such as Lenovo, Huawei Technologies and Putian Group.

The subsequent chapters present some industry case studies: the ICT industry in general and the integrated circuit industry in particular in chapter five, the textiles, electronics, semiconductor, supercomputers, aircraft, biotechnology and pharmaceutical industries in chapter six, and the space programme and the defence industry in chapter seven. Although each chapter has its own focus, there is an overlapping coverage of industries among those chapters. The ICT industry has become China's largest manufacturing industry and hosts the country's most innovative companies. Broadly defined, the industry includes a wide spectrum of sub-industries, including, for instance, computer and peripherals, telecom equipment and integrated circuit. The global industrial and technological context, the national institution and policy environment, and the interaction between foreign and domestic firms have determined the development trajectories of these industries (Liang, 2004). Systematic analyses of their productive and innovative progresses are crucial for understanding China's technological development during the past two decades. In this regard, chapters five and six provide in-depth descriptive analysis with a mix of technological and institutional perspectives, which allows the author to take into account the complexity of the issue and contribute to the literature and current debates.

In any attempt to understand recent and future technological advancement in China, it becomes unavoidable to think about the relationship between regional efforts and national policies, and certainly the regional dimension should not be overlooked. Indeed, over the past two decades, regional initiatives have played an important role in shaping China's new science and technology landscape (OCED, 2007). Taking China's "extraordinary size and diversity" (p. 215) and significant regional diversity into account, chapter eight examines

the country's regional innovation systems. This is followed by a case study on Shanghai in chapter nine. In these two chapters, the role of development zones (especially high technology parks), industrial clusters and universities in the operation of regional innovation systems is highlighted.

From the workshop of the world to a global hub for research and development: the role of foreign direct investment

For the readers of *Transnational Corporations*, an interesting question related to China's technological rise is the role of FDI in this process. In the past two decades or so, TNCs have helped transform China's industrial landscape, making it a "workshop of the world", which has contributed to the performance of the world economy in recent years. TNCs' contribution to China's industrial development cannot be delinked from their technological contribution. As more and more TNCs establish R&D centres in the country, they have helped accelerate the process of China's integration into global innovation networks and its moving up along the value chain (UNCTAD, 2005).

In his book, Jon Sigurdson devotes one chapter to this issue by examining China's technology access through FDI, both inward and outward. In chapter three, the author argues that FDI brings capital, management skills and technologies in a wide spectrum of industries, and attracting FDI by offering access to the Chinese market has lured a large number of TNCs to establish bases for high-technology production. However, he recognizes that the real challenge is to create a local environment that will facilitate a rapid diffusion of technologies and enhance the spillover effects of FDI. Although TNCs' high-technology manufacturing in China is still dominated by final assembly production, the country has seen substantial inflows of FDI in R&D since the early 2000s. Based on case studies on companies such as Motorola, chapter three discusses the impact of foreign R&D on China's innovation system[5] and associated policy challenges. Quoting the *European Competitiveness Report 2004*, the author suggests in the concluding chapter (chapter ten) that China has been successful in selectively attracting FDI in technology-intensive industries in order to benefit from embedded technology and organizational skills. Technological impact of outward FDI is also briefly discussed in the chapter.

[5] R&D spending by foreign affiliates accounted for 24% of total business R&D in China in 2003 (UNCTAD, 2005).

Implications of China's rapid rise as a "technological superpower"

During the past decade, China has dramatically increased the number of students in tertiary education and the funding for R&D, although some indicators such as the number of patent applications still suggest that it is far from reaching its goal of becoming a knowledge-based economy. To shift away from industrial development based on the intensive use of low-skilled labour and natural resources and a low level of innovative capabilities, China has embarked on the implementation of a strategy centred on "independent innovation" (*Zizhu chuangxin*). The country will further increase its level of investment in R&D, and, accordingly, its R&D spending is predicted to rise to 2% of GDP by 2010 and 2.5% by 2020.[6] What are the implications of China's rise as a major R&D player for the rest of world?

In chapter ten, based on a review of recent reactions from the Triad to China's technological rise, Jon Sigurdson argues that the European Union and Japan view the emerging technological power in China from a commercial perspective, which naturally has strong "nationalistic overtones" (p. 300), while the United States considers it as a double-edged sword in the sense that it has not only commercial implications but equally strong strategic consequences. As highlighted in an OECD report, if managed properly, the development of China's innovative capability can give rise to a positive sum game, benefiting not only China but the world at large; however, mismanagement carries the risk of costly tensions (OECD, 2007).

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[6] See "China bets big on big science", *Science*, 311, 17 March 2006.

* This review represents the personal opinion of the reviewer and does not necessarily reflect the view of the United Nations.

References

Liang, Guoyong (2004). *New Competition: Foreign Direct Investment and Industrial Development in China*, ERIM Ph.D. Series, 47 (Rotterdam: RSM, Erasmus University).

OECD (2007). *OECD Review of Innovation Policy, China, Synthesis Report* (Paris: OECD).

Saxenian, Annalee (2006). *The New Argonauts: Regional Advantage in a Global Economy* (Cambridge, MA: Harvard University Press).

UNCTAD (2005). *World Investment Reports 2005: Transtional Corporations and the Internationalization of R&D* (New York and Geneva: United Nations).

Wilsdon, James and James Keeley (2007). *China: the Next Science Superpower?* (London: Demos).

China is already an economic superpower. At purchasing power parity, which adjusts the value of a dollar for what it can buy in a given country, China now has a larger economy than the U.S. The gap is only likely to grow, given that China has far more people making and buying things, and theyâ€™re likely to get richer than they are today. Just looking at the scale of an economy in terms of what it can buy domestically may be misleading, however. Superpowers buy military bases, influence and goods abroad.