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# SCIENCE AND TECHNOLOGY POLICIES, INDUSTRIAL REFORM AND TECHNICAL PROGRESS IN CHINA

## Can socialist property rights be compatible with technological catching up?

*Alberto Gabriele*

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**DISCUSSION PAPERS**

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# Contents

## Abbreviations

| | |
|---|---|
| AMC | asset management company |
| COE | collectively owned enterprise |
| CRS | Enterprise Contract Responsibility System |
| EIU | Economist Intelligence Unit |
| GDP | gross domestic product |
| FDI | foreign direct investment |
| HRS | household responsibility system |
| K/L | capital over labour |
| LME | large and medium-scale enterprises |
| M&A | mergers and acquisitions |
| MOST | Ministry of Science and Technology |
| NIE | newly industrializing economy |
| NSI | national system of innovation |
| OECD | Organisation for Economic Co-operation and Development |
| R&D | research and development |
| S&T | science and technology |
| SETC | State Economic and Trade Commission |
| SME | small and medium enterprise |
| SOE | state-owned enterprise |
| SSB | State Statistical Bureau |
| SSTC | State Science and Technology Commission |
| TNC | transnational corporation |
| TFP | total factor productivity |
| TVE | township and village enterprise |
| UNCTAD | United Nations Conference on Trade and Development |
| UNDP | United Nations Development Programme |
| WTO | World Trade Organization |

# SCIENCE AND TECHNOLOGY POLICIES, INDUSTRIAL REFORM AND TECHNICAL PROGRESS IN CHINA

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### *Abstract*

*This paper analyses the quest for technological progress in China, a large, semi-industrialized, socialist developing country. In the introduction, it is argued that international income convergence is not an automatic product of market forces. Therefore, the path of technological progress in a less advanced country is dependent on its absorptive capacity, which can be enhanced by the development of an effective national innovation system. The specific meaning attached to key terms such as technological progress, market-compatibility and "socialism" are also explained. Section II briefly illustrates the relative position of China in the international division of labour, as well as some basic economic and social indicators. Section III contends that the huge amount of FDI flowing to China is not per se a major source of technical progress, but important gains can be obtained through strategic bargaining with large transnational corporations from industrialized countries. Section IV sketches the main lines of evolution of Chinese technological culture since the inception of the reforms and provides basic data on China's R&D system. Section V analyses the new focus of innovation and research policies and describes the major science and technology programmes. Section VI shifts the analysis to the level of industrial enterprises, arguing that a kind of symbiosis exists among the two groups of public firms. Collective enterprises realize their comparative advantage specializing in simpler industrial activities and benefit from technological spillovers from state-owned enterprises, while the latter are undergoing a process of upgrading and rationalization in order to gain a strong position at the upper end of the technological spectrum. This section also presents and illustrates aggregate data on production and employment trends in China's industry and proposes a tentative estimate of the technical change component of labour productivity growth in state-owned enterprises, showing that it has been substantial and increased in the late 1990s. Section VII concludes that China's experience so far shows that a radical improvement in a socialist economy's ability to achieve technical progress is not inconsistent with the reaffirmation, in a new and diversified form, of a fundamentally public framework of property relations.*

## I. INTRODUCTION

This paper focuses on some aspects of the catching-up effort being carried out in a socialist developing country such as China. In this introduction, besides mentioning some of the topics that will be discussed, I shall specify the function and meaning to be attached to a few basic concepts in order to clarify the theoretical background referred to in parts of the text.

Some policy-related features of China's overall development strategy will be examined from the point of view of the pursuit of a single crucial goal, which is technical progress. The concept of technical progress used in this paper is broad and goes beyond the scientific and technical innovations stemming directly and indirectly from R&D activities aimed at the generation of new knowledge. In fact, technical progress also encompasses the web of imitative and adaptive changes – in the realms of production organization, product design, materials and energy consumption, procurement, sales and distribution, management, finance, administration, and other economically relevant activities – which result in higher

productivity and jointly foster the progressive climbing of the technological ladder and a more favourable position in the international division of labour. As the most widely used, if imperfect, quantitative indicator of technical progress is the evolution of total factor productivity (TFP) the paper will also review the debate on the estimates of TFP growth in different sectors of the Chinese economy, and especially in the reforming sector of industrial state-owned enterprises (SOEs). Other related topics, such as the technical progress-enhancing potential of foreign direct investment (FDI) and of cooperation with large transnational corporations (TNCs) from developed countries, will also be briefly examined in the first part of section II. However, the core of the paper is constituted by an analysis of the evolution of China's research and development (R&D) and industrial systems, with particular attention to the latter's still dominant state and collectively owned enterprises (COEs), seen as the key components of the country's overall national system of innovation (NSI).

An "effort" is needed in a relatively poor country in order to "catch up" with more advanced ones because automatic market mechanisms do not lead to international growth convergence.[1] International convergence appears to be a phenomenon limited to clusters of highly integrated economies at not too distant levels of overall development,[2] and/or to the cases of individual countries, or groups of countries which have implemented strong and proactive accumulation and growth-enhancing economic strategies (UNCTAD, 1997, 1998).[3]

Therefore, even taking into account the relevance of exogenous constraints, the appropriateness of national development strategies carries a decisive weight, at least for those developing countries which, due to a set of historical and structural factors, are in fact endowed with an appreciable degree of autonomy and self-determination. These countries must open up and rely to a large extent on the progressive absorption of foreign technology, mainly from the developed countries of the North, but this goal cannot be achieved simply as a byproduct of economic liberalization.[4] North-South R&D spillovers

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[1] For "growth convergence" we mean a state of affairs in which poorer countries grow faster than rich ones, so that their per capita incomes eventually converge towards the same level. In relation to the concept of "conditional convergence" (see footnote 2), the aforementioned type of convergence might be called "absolute convergence". Barro and Sala-i-Martin (1995a: 420), referring to an ample data set on real per capita growth rates in different countries, show that the absolute convergence hypothesis "fares badly in terms of the cross-country data … for 119 countries, the growth rate from 1965 to 1985 is basically unrelated to the log of per capita GDP in 1965 … . Thus, any hope of reconciling the convergence hypothesis with the data has to rely on the concept of conditional convergence".

[2] Barro and Sala-i-Martin (1995b) developed the concept of "conditional convergence", according to which the coexistence of a complex series of conditions is a necessary condition for convergence to occur. Conditional convergence appears to have occurred among the relatively similar OECD countries.

[3] A number of observers have attempted to explain the lack of convergence focusing on structural factors, among them human capital (Barro and Sala-I-Martin, 1995a, b) and externalities (Lucas, 1990). Others individuate in the very shallow division of labour (*à la* Smith) the origin of the underdevelopment trap, in which both wages and the rate of profit are low, and thus no foreign capital is forthcoming and no movement towards a higher level steady state takes place (Rodriguez-Clare, 1996). A shallow division of labour is tantamount to a lack of diffusion of those roundabout production methods typical of developed economies, which to be implemented need the complementary presence of many specialized physical inputs as well as intermediate goods difficult or costly to acquire in the South, which are only imperfectly tradeable. *A fortiori*, modern production requires a series of producer services (banking, auditing, machine repair, etc.) and infrastructures, which are of course non-tradeable (Porter, 1990). Moreover, local institutions might also be inadequate, and amenable to change only over a relatively long period of time.

[4] Neoclassical theory would, in principle, predict higher-than-average rates of return to capital in poorer countries, according to their lower K/L ratios. Capital should hence flow abundantly towards developing countries, leading to very high growth rates. In practice, this is not necessarily the case, due to the absence in these countries of a host of complementary conditions, which constitutes the essence of underdevelopment. As a matter of fact, in the long run, the classical assumption on the uniformity of the rate of profit tends to hold also at the international level (Rodriguez-Clare, 1996).

do occur through international trade,[5] but it is not trade per se which brings about the transmission of knowledge. The diffusion of R&D results across borders is more partial and slow than simplified neoclassical assumptions might allow (Lichtemberg, 1992), consistently with the common founding of high social returns to R&D at the national level. The diffusion of knowledge through trade depends to some extent on factors belonging to the most advanced trade partners, as some firms are more willing than others to transfer knowledge to their partners from developing countries. However, a set of endogenous factors typical of each country, which jointly constitute its absorptive capacity, carry a far heavier weight.[6]

The concept of absorptive capacity was pioneered by Cohen and Levinthal, who applied it to the analysis of the optimizing strategy of a firm in a competitive national market, but can be readily extended to a developing country's efforts to enhance its efficiency in the task of keeping up with externally generated science and technology (S&T) advances. Cohen and Levinthal (1990) define absorptive capacity as "the ability of a firm to recognize the value of new, external information, assimilate it and apply to commercial ends… [which is] … largely a function of the level of prior knowledge…" and argue that it is "critical to its innovative capabilities" (*idem*: 128). Therefore, prior knowledge has to be seen not only as a stock of information, but also as a "set of learning skills" (*idem*: 130). An organization's absorptive capacity goes beyond the abilities of its individual components, as there are aspects of absorptive capacity which are distinctly organizational and depend not only on the firm's interface with the external environment but also on "transfers of knowledge across and within subunits" internal to the organization itself" (*idem*: 132). In the case of a firm, absorptive capacity, along with other mostly informal activities, depends on its R&D effort, because "R&D not only generates new information, but also enhances the firm's ability … to identify, assimilate and exploit knowledge from the environment" (Cohen and Levinthal, 1989: 569). When the concept is extended to a country, absorptive capacity is to be considered a function of several structural and policy-related domestic factors, among which the availability of human capital (measured, for instance by the rate of literacy, and the number of technicians and engineers), besides, of course, the existence, extent, effectiveness and flexibility of a national R&D and innovation system (Keller, 1996).

The concept of *social*[7] or *national* absorptive capacity is closely related to that of an NSI. The notion of NSI was introduced in contemporary debate by Freeman (1987), who defined NSI as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies" (Archibugi et al., 1999: 1), and developed by Lundvall (1992) and Nelson (1993). According to Chesnais (1995), the notion of NSI encompasses a set of interactions among

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