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The transition from imitation to innovation: An enquiry into China's evolving institutions and firm capabilities☆

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ABSTRACT

How is the Chinese economy making the transition from imitation to innovation as the source of sustained long-term growth? We address this question using the evolutionary approach to growth in which institutions support technical advance and enterprises develop capabilities to learn and innovate. Growth is seen as a series of disequilibria in which obstacles to innovation such as outdated institutions and weak incentive systems can cause growth to slow. We review existing literatures on institutions and firm behavior in China and compare these findings with those of our survey of Chinese firms in 2006. Industry and firm studies in the literature show how productivity is rising because of firm entry and exit rather than the adoption of new technologies. A striking feature both of the studies in the literature and our survey is the increasing competitive pressures on firms that encourage learning. Our survey of privately owned small and medium enterprises in five high-tech industries in Zhejiang province found a market-based innovation system and evidence of much process and some product innovations. These enterprises respond to growing product competition and demanding customers with intensive internal learning, investment in R&D and a variety of international and research linkages.

1. Introduction

China's rapid growth and integration into the world economy is spectacular because of its speed and the potential size of its economy. But growth based on a strategy of imitation is unsustainable. The price of success as a major exporter of labor intensive manufactured goods is beginning to rise in terms of potential protectionist actions abroad and rising pollution from industrial production at home. The Chinese authorities recognize this. One of the main goals of the 11th Five-Year Program (2006–2010) adopted in 2006 is "scientific development" and a determined emphasis to encourage "an innovation-oriented nation":

> In the 11th Five-Year Program period, we will implement the strategy of rejuvenating our nation through science and education and take science and technology advancement and innovation as a major driving force of economic and social development. We will give more strategic importance to developing education and fostering high-quality talented people who are endowed with capability and integrity, deepen system reforms, increase input, accelerate the

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development of science, technology and education, and make great efforts to build an innovation-oriented nation and strong nation with abundant human resources (Government of the People's Republic of China, 2006a).

In this paper we examine China's transition from an economy in which growth is based on labor intensive production and imported ideas and technology to one in which growth is driven by domestic innovation. The developmental challenge is to move to the technological frontier from a position that is well behind it. For a time, a developing economy can grow rapidly by reallocating rural labor into low-cost manufacturing and exploiting economies of scale. Eventually, however, this source is exhausted and growth slows down unless, as much historical experience demonstrates, it is sustained by technological advance and innovation.

If China is making this transition, we should expect to see institutions that promote technological advance and firms that develop new capabilities, technologies and products. This view is based on Nelson and Winter's (1982) evolutionary approach to growth. Unlike Solow's (1957) growth model and Romer's (1990) endogenous growth model which are based on macroeconomic theory, Nelson and Winters and others focus on decision-making in the firm.[1] Like Schumpeter (1943) they see capitalism by its very nature as evolutionary and constantly changing. Growth therefore may be a series of disequilibria along a path strewn with obstacles such as outdated institutions, inappropriate incentives or obsolete technologies. Because these obstacles build over time, they may also be difficult to modify, causing growth to slow. The evolutionists call this the "disequilibrium trap". South Korea's experience is instructive here. Important drivers of South Korea's takeoff to sustained growth included high literacy rates and universal education, high rates of savings and capital accumulation, export oriented policies and rapid technological learning. It had a strong central government that intervened extensively in the economy and a strong entrepreneurial spirit, both in the large *chaebols* and in smaller businesses. Eventually some of these characteristics became obstacles to sustained growth and reforms were necessary to free up market forces (Kim, 1997).

Nelson (1993) advances a general view of how technological advance occurs in the modern world. First, most technologies are science-based, although technologies can also give rise to new science. Second, most innovations involve trial and error; there is no silver bullet to devising a product or process with desirable attributes and many approaches involve problem solving or design changes. Third, he stresses the significance of institutions involved in industrial innovation. These are not only enterprises but also supporting institutions (more recently referred to as the "national innovation system") such as universities, government agencies and public policies; the nation's schools and skills training and retraining programs; labor market institutions; financial institutions and governance at all levels. They include a society's culture, its economic constitution and organizations, and public services—what Abramovitz and David (1996) refer to as "social capabilities" that influence the responses of people to economic opportunities.

We use this approach in this paper. In Section 2, we develop three variables and describe the data we use in the study. The first two variables are inputs that influence technological advance and innovation and the third measures the outputs of innovation. The first input variable is a country's institutions and their features that support or obstruct innovation, R&D and design and marketing. The second input is firms' performance and activities: how they capture knowledge, how they produce innovations and how they use their knowledge to capture profits and market share. The outputs of innovation are such variables as patents and copyrights. In Section 3, we examine China's institutions, particularly the national innovation system (NIS) and the policies and incentives that support or inhibit the development and diffusion of innovation. In Section 4, we study firm capabilities and the factors that encourage or inhibit learning, innovating and capturing the fruits of innovation. If China is making the transition, we should expect to find the NIS supporting technological development and diffusion and firms acquiring new equipment, reorganizing productions and marketing, raising productivity and creating new products and processes in order to grow. Section 5 contains our conclusions.

2. Variables and data used in the study

2.1. Institutions as input variables

Institutions as inputs include Nelson's and others specific to China including science and technology (S&T) targets within a S&T development plan, enterprise ownership, and policies encouraging openness and infrastructure such as the Internet. A common aggregate measure is R&D spending as a ratio of GDP (R&D intensity), which varies by industry and is, of course, only one driver of innovation. China's R&D intensity reached 1.6% in 2006 compared to 2.5% and 3.2% in the United States and Japan, respectively (OECD, 2006).[2] R&D spending was mainly allocated to industry in 2004 (67%), with 10% going to higher education institutions. While these allocations are broadly in line with OECD averages the share allocated to government research institutes was twice the OECD average. United Nations (2006) reports China's heavy investments in human resources in science and technology. By 2003 China had 926 thousand researchers, second only to the United States in number. It has also pushed ahead rapidly in cellular telephone use with 215 per thousand people compared to 664 per thousand as the OECD average.

[1] Other works on firm level decision making can be found in Dosi, Freeman, Nelson, Silverberg, and Soete, Eds.,1988 and Verspagen (1993).

[2] China's level of annual spending also has overtaken that of Japan (OECD, 2006). Of course, firms and economies can grow rapidly even if they are not among the first to innovate. What matters is being among the first successful imitators so that they capture some of the rents available from innovation.