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INTELLECTUAL PROPERTY RIGHTS, DEVELOPMENT, AND CATCH-UP

AN INTERNATIONAL COMPARATIVE STUDY

EDITED BY

HIROYUKI ODAGIRI, AKIRA GOTO,
ATSUSHI SUNAMI, AND RICHARD R. NELSON

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Preface

The study reported here is part of a broad program of research on how nations behind the technological and economic frontier in the past have caught up with the leaders, and of the similarities and differences in the opportunities and challenges faced by countries that today are trying to catch up.

The term catch-up is intended to highlight that historically, and today, countries that are lagging behind use as models and performance standards practices employed in countries that are in the lead. The fact that so many countries continue to be poor testifies to the fact that learning to do what others already have done, that is catching up, is not easy. We also want to highlight that, by use of the term catch-up, we do not mean to connote that economic development involves, much less requires, exact copying. While efforts to develop generally do use practices in advanced economic countries as broad models, what is achieved almost always diverges somewhat from the practices serving as targets for emulation. Partly this reflects that in most cases exact copying is impossible even if that were the objective. In part it reflects deliberate and often creative modifications aimed to tailor practice to local needs and circumstances.

Technological learning is an essential part of the catch-up story; however, we have a broad view of what technologies are, defining the term as encompassing the wide range of productive techniques for meeting human needs that have been developed over the years. And many of the capabilities and activities for technological learning involve much more than what engineers mean when they talk about technology. Many of the key capabilities involve modes of organizing, coordinating, and managing activities. In many cases these latter kinds of capabilities are more difficult to develop and master than the necessary engineering knowhow.

Most technologies are operated through organizations, and learning to master the needed organizational structures and modes of management is an essential aspect of the catch-up process. In turn, firms and other organizations are dependent on a nation's education and training systems, labor and capital markets, competition and regulatory policies, programs in support of infrastructure, resources, and environmental management, and the ability of government more generally to provide a context for rapid sustained economic development. Thus, while the catch-up program has the processes of technological learning in the foreground, the background involves many different facets of a nation's institutional structures.

One such structure, and the one that is different today in a number of important respects from what it was before, is the intellectual property rights (IPR) regime. In particular, as will be shown in this book, countries that achieved successful catch-up in an earlier era generally operated with relatively weak IP systems that, at least as viewed in much of today's discussion, facilitated bringing

in and learning to master the frontier technologies of other countries. Today, almost all countries have IPR regimes that adhere to the much tighter standard of TRIPS. Many observers have expressed concern that this will make catching up much more difficult. Others have argued, on the contrary, that general adherence to TRIPS standards actually will help countries to catch up because without sufficient IPR protection firms in developed countries would not invest in developing countries or license technologies.

However, the current debate about this is almost totally oriented by theory. Convincing empirical support for the differing theoretical positions has been virtually absent. In fact up to now there has been hardly any empirical research on the pathways of technological learning, and the influence of IPR regimes on how those pathways work. The project reported in this book was oriented to building a body of empirical knowledge so that the complex and vital set of issues about the role of IPR regimes in the processes of catch-up could be discussed intelligently. This role, as we believe and as we will actually see in this book, varies significantly across countries, reflecting the different eras in which they have been developing and the different social and natural environment. Moreover, even within a single country it varies in important ways across industries. This consideration led us to organize the project as an international comparative one and also ask each contributor to pay sufficient attention to industrial case studies. Indeed the three workshops we held over the span of more than two years gave us great opportunities to learn from other countries' experiences and to gain deep insight on the real, multidimensional impact of IPR on catch-up. The outcome of this process of our own learning is this book.

We thus wish to thank not just the contributors to this book but all those who were present in some or all of these workshops and provided valuable comments from which we learnt, including Leonard Burlamaqui, Giovanni Dosi, Andrzej Jasinski, Rasigan Maharajh, Fabio Montobbio, Hiroshi Nagano, Galina Sagieva, Jun Suzuki, Nick von Tunzelmann, and Nguyen Vo Hung. In its early stages, the idea of looking at catch-up from various angles was catalyzed by the Earth Institute of Columbia University in New York. Recently the United Nations University and MERIT in Maastricht has joined the Columbia Earth Institute as a co-sponsor. For the IPR and catch-up project from which the present book was born, financial support was provided by the twenty-first-century COE/RES project of Hitotsubashi University funded by the Japanese Ministry of Education, Culture, Sports, Science and Technology, and by the National Graduate Institute for Policy Studies. We wish to thank them all.

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Abbreviations

ASEAN	Association of Southeast Asian Nations
CNP	Centro Nacional do Petroleo (Brazil)
CSIR	Council of Scientific and Industrial Research (India)
FDA	Food and Drug Administration (USA)
FDI	foreign direct investment
FTA	free trade agreement
GDP	gross domestic product
GERD	gross domestic expenditure on R&D
GMO	genetically modified organism
GNE	gross national expenditure
GRI	government research institute
GSP	generalized system of preference
HDD	hard disk drive
HEIs	higher education institutions
IC	integrated circuit
ICT	information and communications technology
IP	intellectual property
IPR	intellectual property right(s)
IPO	initial public offering(s)
IT	information technology
ITC	International Trade Commission
ITRI	Industrial Technology Research Institutes (Taiwan)
LE	large enterprises
M&A	mergers and acquisitions
MNCs	multinational corporations
MNE	multinational enterprise
NCRD	National Council for Research and Development (Israel)
NIEs	newly industrializing economies
OCS	Office of the Chief Scientist, Ministry of Industry, and Trade (Israel)
ODM	original design manufacture
OEM	original equipment manufacture
PCT	Patent Cooperation Treaty
PRIs	public research institutes
R&D	research and development

RTO	research and technology organization
S&T	science and technology
SEZ	special economic zone
SME	small and medium-sized enterprises
SOEs	state-owned enterprises
STE	science, technology, and higher education
SU	high-tech start-up company
TFP	total factor productivity
TI	Texas Instruments
TLO	technology licensing office
TNCs	transnational corporations
TRIPS	Trade-Related Aspects of Intellectual Property Rights
VC	venture capital
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

Contents

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Introduction

Hiroyuki Odagiri, Akira Goto,
Atsushi Sunami, and Richard R. Nelson

This book investigates the role intellectual property rights (IPR) regime played and is playing in catch-up. The book contains a collection of eleven country studies, each authored by a specialist (or two or three specialists jointly) of the country's innovation system.

All of us, the authors of country studies and the editors, share a belief that the processes and institutions involved in catch-up ought to be the central question of development economics. Apart from the pioneer country, economic development necessarily involves a process of catching up with leading countries at the time. Catch-up is never achieved by investment in physical assets and labor alone: also needed are the learning of modern technologies and accumulation of one's own technological capabilities. That is, a development process essentially involves learning about and trying to take on board practices that are in use in countries towards the frontier. Despite this fact, most literature on economic development has paid scant attention to the technological aspect of catch-up. Even if it did, the authors usually assumed it was easy for developing countries to take advantages of the backlog of technologies invented and adopted in advanced countries. Such an assumption is far from reality. As we will repeatedly argue in this book, catching up is not about simple copying, first of all because exact copying is almost impossible to do and, second, because various conditions in the adopting country call for modification in the practice. This is why catch-up cannot be achieved without trial and error and without capacity. To be sure, some countries did catch up and some even forged ahead. Some, however, actually fell behind (Abramovitz, 1986). Such variation occurs only because learning to do what others have already done is not at all simple.

Moreover, the speed of catch-up depends not just on the technological gap from leaders but also on the country's social capability, including educational attainment and entrepreneurship, and domestic and international legal, economic, and scientific institutions. One such institution is the IPR regime, patents in particular. Patents, as commonly argued, may promote innovation and catch-up. They may also foster formal technology transfer. Yet they may prove to be barriers for developing countries in acquiring technologies through imitation and reverse-engineering. Therefore, the current move to harmonize the IPR system

internationally, such as the TRIPS agreement, may have unexpected but grave consequences on developing countries.

The chapters in this book will show that the influences of IPR can be pervasive and complex in reality. Moreover, the way IPR regime exerts such influences is subject to historical, social, economic, legal, and other conditions that vary significantly across countries and across development stages. It also varies significantly across industries or technology fields. This belief prompted us to make an international comparative study. Only by exploring what really took place and is taking place in different countries and in different industries can we understand the true relationship between IPR and catch-up. This volume makes such an exploration and shares and compares the results that we have gathered three times over a span of three years.

The purpose of this introductory chapter is to clarify the issues to be discussed and list the questions to be raised, with the last section giving a brief introduction to subsequent chapters. We begin by discussing what is meant by "catch-up." A brief history of the patent system will also be discussed.

WHAT IS CATCH-UP AND WHAT IS NEEDED FOR CATCH-UP?

Catch-up may be defined as the process in which a late-developing country narrows its gap in income (as one may specify by the word "economic catch-up") and in technological capability (equally "technological catch-up") vis-à-vis a leading country.[1] These two meanings of catch-up are hard to separate because, without exception, economic catch-up requires technological catch-up. This fact has been evident since, say, the Industrial Revolution of the eighteenth century and is now even more so as many industries became technology-intensive. The process of "creative destruction" led by innovation (or "new combination") is the core moving force of economic development as emphasized by Schumpeter (1934, 1942), and this is no different in countries trying to catch up, even if the means of innovation differ across developed countries and developing countries. All countries, therefore, endeavor to catch up technologically through improving indigenous technologies and acquiring from abroad more efficient modern practices.

Catch-up has been assumed to be easier than the growth efforts of leading countries. Gerschenkron (1962: 8) argued the following in his famous book *Economic Backwardness in Historical Perspective*: "Industrialization always seemed the more promising the greater the backlog of technological innovations which the backward country could take over from the more advanced country." Subsequently, a number of empirical studies were made to show that the rate of

[1] A related concept is "convergence": "'catch-up' relates to the ability of a single country to narrow the gap in productivity and income vis-á-vis a leader country, while 'convergence' refers to a trend towards a reduction of the overall differences in productivity and income in the world as a whole" (Fagerberg and Godinho, 2005: 514).

economic growth of a country is inversely related to its initial level of industrialization as measured most typically by per capita GDP. Even if these results indicate that late-comers caught up faster on average, there remains a lot of variance around the average as some low-income countries failed to catch up and remained severely underdeveloped. The empirical results do not explain the cause of this variation: nor do they explain the mechanism behind the average relationship. As Fagerberg concluded after his survey of these empirical studies, "it seems difficult to use the results from these studies to discriminate among different theories in this field. Probably, the estimation of a single-equation model—with GDP per capita and other variables included—is an activity to which there are now sharply diminishing returns" (1994: 1171).

Instead, we need to realize that catch-up is a complex process. Moreover, the mechanisms of catch-up and the means used for this purpose have changed significantly over the years and depending on the endowments of the country as well as government policies and the state of technological development. In short, catch-up is a multi-dimensional phenomenon. To understand why, we need to take a broad view of what technologies are. However true it may be that late-developing countries have a larger opportunity to learn, imitate, or import more advanced *physical technologies*, the presence of such opportunity alone does not guarantee that these countries can take advantages of it. They also need *social technologies* (Nelson, 2008) or *social capability* (Ohkawa and Rosovsky, 1973; Abramovitz, 1986).

Learning to do what others have already done is seldom easy. Even though the term "catching up" may connote more or less exact copying of the practices of more technologically advanced countries, what needs to be achieved often diverges in one way or another from those in model countries. It may be that exact copying is physically impossible due to climatic, geological, and other conditions. Even if this is not the case, exact copying can be undesirable and deliberate modifications, possibly creative ones, have to be implemented to tailor the practice to local circumstances. It is here that social capability is most in need because the organizational, managerial, and institutional aspects of productive practice are often most difficult to replicate, and the most in need of adaptation to indigenous conditions, norms, and values.

As one of us has suggested (Nelson, 2008: 3), the term "institutions" is commonly used "to denote structures and forces that mold and hold in place prevalent social technologies." The success and speed of catch-up depends on not just technological gap from the leaders but also the country's social capability, including educational attainment and entrepreneurship, and the structures for it, such as domestic and international legal, economic, and scientific institutions. This fact leads to two important messages. One is that, even if two countries import the same set of technologies, they will not necessarily achieve the same speed of catch-up, which is why we stress the need for discussing catch-up in country-specific and period-specific manners. The other is that, even for "technological" catch-up, a country needs to learn a lot more than what engineers generally mean when they talk about technology, such as blueprints and machines. It also needs to learn social technologies to acquire capabilities for

organizing, coordinating, and managing related activities under possibly a very different set of institutions from those of originating country. And these capabilities can be much more difficult to develop than the needed engineering know how. Only by realizing this fact can it be explained why some countries catch up rapidly while others fail to do so, even among countries at similar development stages technologically.

To acknowledge this fact is imperative because the countries in our study experienced catch-up at different times under different environment. Continental European countries including the Nordic countries and the USA achieved major catch-up in the nineteenth century and the early (i.e. pre-World War I) twentieth century, when global economic and political integration was still limited, with many countries protecting their markets, networks of railroads and telecommunications were only gradually being built, science was still relatively primitive and was not yet tightly linked to industrial technology, and legal disputes on infringement of intellectual property rights were less complicated. This makes a marked contrast to the environment surrounding the countries that started their catch-up efforts after World War II. Moreover, even among these countries, there is a significant difference between earlier ones, such as Japan, whose first catch-up efforts started in the latter half of the nineteenth century and second catch-up efforts right after World War II, and Korea, Taiwan, and Israel, who started similar efforts a decade or two later. The experiences of these nations can be contrasted in turn to those nations whose major catch-up efforts began after the 1980s, such as China, India, South East Asian countries like Thailand, and Latin American countries including Argentina and Brazil (even though some of these countries were actually front-runners in the early periods).

Changes took place on many fronts. In addition to the progress of globalization, information and communication networks, and science-based innovation as mentioned above, worldwide institutional changes yielded important consequences. In particular, the start of the WTO in 1995 restricted the countries' option to use trade policies and foreign direct investment (FDI) policies strategically as, for instance, Japan did at the time of her catch-up (see Chapter 4). Similarly, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) required WTO member countries to conform to standard rules.

In consequence, the process, mechanism, and mode of catch-up can and have to differ in many ways among different countries. It is exactly for this reason that we believe a systematic international comparative study is needed on catch-up experiences at different times and different environment.

LEARNING ADVANCED TECHNOLOGIES

Technology never flows automatically from a high-technology country to a low-technology country. To receive and absorb this flow, a country has to have so-called "absorptive capacity," and the zeal for importing, absorbing,

and applying these technologies. Historically, countries used diverse means and channels to acquire advanced technologies as the studies in subsequent chapters will show.

First, cross-border flow of people was frequent, as people in developing countries went to advanced countries to learn and people from advanced countries went to developing countries to teach and supervise. Many of these visits were short-term but some visitors remained as immigrants. Examples include the British technicians who brought British textile manufacturing methods to the USA in the nineteenth century and settled there and German chemical scientists who did similarly. In Japan at the start of its modern industrialization in the late nineteenth century, both the government and private enterprises sent students and engineers to the West (i.e. the USA and Europe) to study advanced technologies, who, upon returning to Japan, became leading scientists, engineers, educators, business leaders, and policy-makers (like K. Takahashi who established the country's patent system as will be discussed in the Japanese chapter). Japan also invited a number of engineers and educators from the West despite the high salaries they demanded. Such cross-border flow of people became even more prevalent in later years as overseas travel became easier. More recently, as Saxenian (2006) documented, many from Taiwan, China, and India studied in the US (and gained practical experience in Silicon Valley) and then played critical roles in establishing and fostering electronics and software industries in their home countries.

Secondly, developing countries can acquire new knowledge from open sources, such as exhibitions, conferences, books, papers, and patent documents. As will be discussed later in the country chapters, exhibitions were an important source of information about new products and new technologies particularly during the nineteenth century. So were imported books or their pirates. With the spread of telecommunications and then the internet, more knowledge has become available through these and other open sources. Countries, however, need to have sufficient capacity to understand and apply them in order to take advantages of them fully.

Thirdly, they may import products and learn by imitation, or import machines and equipment and learn by using them. These activities, possibly the most common means of technology acquisition for developing countries, require sufficient capacity to understand what is written in the manuals or to copy the products. Imitation is by no means a simple process. In the case of assembled products such as machines and electrical equipment, one needs to reverse-engineer, that is, disassemble the product, reproduce the components, and assemble them again. In the case of chemicals and materials, one has to find out the ingredients and come up with process technologies. These activities require a substantial level of capacity. Also, they tend to involve costly (particularly for still poor countries), risky, and time-consuming investment even if, once successful, the returns can be large. Ample entrepreneurship has to be present therefore.

Fourthly, developing countries can in-license patented technologies and/or know-how from inventors and companies in advanced countries. Absorptive capacity is again needed to grasp licensed technologies, modify them if necessary, and make them commercially useful, or to learn from the licensors' technicians when, as is often the case, guidance and consultancy are a part of the licensing contract. Capacity is also needed to find out the technologies to be licensed, evaluate them, and negotiate with the technology holders.

Fifthly, developing countries may benefit by spillovers from local affiliates of multinationals. Local people may be trained and gain experience while working with these affiliates, and then use the capability thus earned to start their own enterprises, or by working with local firms. In reality, however, the contribution of such spillover is less than clear: despite several prominent cases (for instance, in the Japanese chapter), empirical evidences are inconclusive. For instance, two studies using the sample of developed countries came up with inconsistent results: van Pottelsberghe and Lichtenberg (2001) found that foreign R&D stock embodied in inward FDI (foreign direct investment) does not raise the host country's TFP (total factor productivity), whereas Lee (2006) found that it does raise TFP.[2]

All of these methods were actively employed in countries that successfully caught up, as the chapters in this book indicate. These chapters also indicate that the relative importance among the means varied across countries and across periods, depending on the prevailing state of social capability and the institutions. One such institution is the IPR system and related international arrangements. To this topic, we now turn.

HISTORY OF THE PATENT SYSTEM

"Intellectual property refers to creations of the mind: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce."[3] As this definition by the World Intellectual Property Organization (WIPO) indicates, intellectual property rights (IPR) includes not just the right to industrial property, such as patents for inventions, trademarks, industrial designs, and trade secrets, but also the right to literary and artistic works that is basically covered by copyright. Certainly, these various types of IPR other than patents influence the process of catch-up as, for instance, the lack of trademark protection may discourage multinationals from making direct investment and the lack of copyright protection may be detrimental to innovation in software and other

[2] Interestingly, these studies found opposite effects as regards outward FDI. Van Pottelsberghe and Lichtenberg (2001) found that R&D stock embodied in outward FDI raises the home country's TFP suggesting, according to these authors, the sourcing of knowledge through overseas subsidiaries. By contrast, Lee (2006) found no such effect.

[3] The WIPO site (http://www.wipo.int/about-ip/en/) accessed in Feb. 2009.