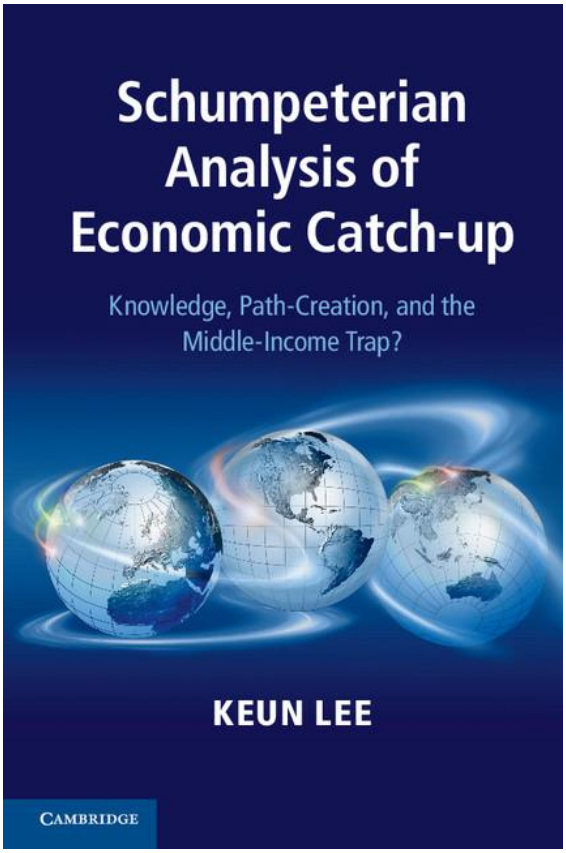
Keun Lee
(Seoul National University)

Schumpeterian analysis of economic catch-up: knowledge, path-creation and the middle income trap

Cambridge Univ. Press, 2013/09



Abstract

One of the puzzles about why some countries have stronger economic growth than others revolves around the so-called 'middle-income trap', the situation in which a country that has grown strongly gets stuck at a certain level. In this book, Keun Lee explores the reasons why examples of successful catching-up are limited and in particular, why the Asian economies, including China, have managed to move, or are moving, beyond middle-income status but economic growth has stalled in some Latin American countries. This is one of the first studies to demonstrate using patent analysis that the secret lies in innovative systems at the firm, sector and country levels which promote investment in what the author calls 'short-cycle' technologies and thereby create a new path different from that of forerunning countries. With its comprehensive policy framework for development as well as useful quantitative methods, this is essential reading for academic researchers and practitioners.

Table of Contents

Part Two: Empirical Analysis at Three Levels

3. Knowledge and Country-level Catch-up
   3.1. Introduction
   3.2. From the NIS to Economic Growth
   3.3. Measuring the NIS and the Specific Hypotheses
   3.4. From the NIS to Economic Growth: Regression Results
   3.5. Summary

4. Knowledge and Sector-level Catch-up
   4.1. Introduction
   4.2. Theoretical Framework and Hypotheses
   4.3. Divergence in Technological Catch-up: First- versus Second-tier Countries
   4.4. Structure of the Regression Models and the Results
   4.5. Summary

5. Knowledge and Firm-level Catch-up: Korean versus US Firms
   5.1. Introduction
   5.2. Theoretical Framework and Hypotheses
   5.3. Measurement and Data
   5.4. Knowledge and Firm-level Performance
   5.5. Summary

Part Three: Toward a Theory and How to Escape the Trap

6. Toward a Knowledge-based Theory of Economic Catch-up
   6.1. Introduction
   6.2. Summary of the Findings in Part Two
   6.3. Specializing in Short-cycle Technologies for Sustained Catch-up
   6.4. Technological Turning Point and High, Middle, and Low Roads for Development
   6.5. From Trade-based Specialization to Technological Specialization
   6.6. Detour, Emulation, and Direct Replication

7. How to Build up Technological Capabilities to Enter Short-cycle Technology Sectors
   7.1. Introduction
   7.2. Overview of the Learning Process and Stages
   7.3. Licensing/Transfer/FDI-based Learning to Build Absorptive Capacity
   7.4. Diverse Modes of Learning Design Capabilities
   7.5. Learning by Leapfrogging: Mobile Phones and Digital TV in Korea
   7.6. How to Move to Short-cycle Technology Sectors: A Summary

8. Catching-up and Leapfrogging in China and India
   8.1. Introduction
   8.2. India's Service Sector Leapfrogging and China's Manufacturing Sector Catching-up
   8.3. India's IT Services Industry as Another Leapfrogging Case in Short-cycle Technology
   8.4. Overcoming the Middle-income Trap: China's Strength in Short-cycle Technologies
   8.5. Technological Turing Point in China and India

Part Four: Technological Turning Point and Conclusion

9. Hypothesizing a Theory of Technological Turning Point
   9.1. Summary
   9.2. A Single Variable Theory?
   9.3. Turning Points in Other Economies
   9.4. Resource-based Development and Other Alternatives
   9.5. Remaining Issues

10. Summary and Concluding Remarks
    10.1. Summary
    10.2. Contribution and Limitations

Endorsements by Other Scholars

"Based on convincing theoretical and empirical analyses, Professor Lee argues that Korea and Taiwan's success hinges on their shift, after reaching middle-income status in the 1980s, to specialize on shorter cycle technology-based sectors, which rely less on existing technologies, allow their economies to leverage the greater opportunities that arise from the emergence of new technologies, and enable them to continue the catching up process. This book is original, makes important contributions to the development literature, and should be read by anyone concerned about how to help a country overcome the middle-income trap."

Justin Yifu Lin, Peking University and Former Chief Economist, the World Bank

"This book lays out a convincing new perspective on the conditions behind the remarkable development of manufacturing in South Korea and Taiwan. The well documented argument is that in several of the industries where firms in these countries were very successful, technology at the frontier was going through a transition, with the technology coming in requiring a different set of skills and capabilities than the technology becoming obsolete. This diminished the advantage of the old industrial leaders and provided a window of opportunity for effective entry in these two economies. The story Keun Lee tells is fascinating and thought provoking."

Richard Nelson, Professor, Columbia University

"The manuscript is original, relevant and impressive because Keun Lee consistently proves his argument with analyses conducted at three connected levels: countries, sectors and firm. Keun Lee inserts findings into a broader discussion of economic catch up, and on the role of public policy. The book encompasses other large emerging countries that were not (yet) as successful as Korea and Taiwan, such as India and Brazil, or that are on the road of sustained catch up such as China.

Franco Malerba, Editor, 'Industrial & Corporate Change'

"This book is essential reading for any scholar interested in the economics of technological catch-up. While the core argument interestingly emphasizes the length of technological life cycles, Keun Lee here provides a fascinating treatment of the role of different types of firms and countries in the capacity for catch-up."

John Cantwell, Editor-in-Chief, 'Journal of International Business Studies'

"Based on a profound theoretical understanding of the process of technological change and using careful and innovative empirical methodologies, the book provides a very sophisticated framework to understand the process of technological innovation and learning at the firm, sectoral, and national levels. It is a path-breaking work that should be read by everyone who is interested in understanding the process of economic development."

Ha-Joon Chang, University of Cambridge and author of *Kicking Away the Ladder*

"The book presents an original analysis of the catch-up processes pursued by Korea and Taiwan (with a discussion extended to China and India) demonstrating (using patent data analysis) that successful catch-up involves strong attention to targeted knowledge capture and build-up of capabilities. The argument is that catch-up is always strategic, in that there must be smart choices made over which technologies to target, and the role of what are called high, middle and low roads. It is sure to become a classic in the field."

John Mathews, author of the *Tiger Technology* and Professor at Macquarie University

Preface

This book originated with a research grant I received from the National Research Foundation of Korea (No B00007). Given only to a selected number of 'star' scholars, this Ministry of Education funded grant requires scholars to write a single-authored monograph over a five year period. Before I received it, I had, like most economists, focused my energies mainly on writing journal articles. Although I had published my doctoral thesis as a book some time ago, I felt that writing an article for a journal was a far more valuable contribution than writing a book. Needless to say, I did not like the idea of writing one, and without the grant, this book would not have existed.

I have since realized my folly. For me, writing a monograph became an opportunity to synthesize my work and to compile the ideas I have scattered across journals. In one sense, this book is an outcome of the Korean government's 'industrial policy' in the area of education. While the focus of Korean industrial policy during the catch up period was to promote specific industries, the current priority of the Korean government is to boost the level of academic scholarship.

Given the background of the book, and its focus on economic catch-up, it is somewhat ironic that it devotes so little space to industrial policy itself. The reason for this is that several important works have already been written on

industrial policy in East Asia, such as that by Ha-Joon Chang and Alice Amsden. Adopting a Schumpeterian approach to innovation systems, this book provides a more theoretical and generalizable account of the divergent process of catch-up as it occurs in different countries or parts of the world. In addressing the important question of why some countries have been more successful than others, the book identifies several key innovation systems. The cycle time of technologies is one such variable. It refers to the speed with which technologies change or become obsolete over time, and the speed and frequency at which new technologies emerge. This book demonstrates that successful economies and firms have tended to specialize in, or gradually move into sectors based on short cycle technologies.

The argument that qualified latecomers can advantageously target such sectors and specialize in them is based on the fact that the dominance of the incumbent can be disrupted by the opportunities presented by ever-emerging new technologies. Latecomers do not have to rely too greatly on the existing technologies whose use is dominated by the incumbents. The new opportunities present new growth prospects, and a lower reliance on existing technologies may lead to the faster localization of a knowledge-creation mechanism. This property could also mean lower entry barriers and the possibility of greater profitability since there is less conflict with the technologies of advanced countries, fewer required royalty payments, and even a first-/fast-mover advantage or product differentiation. As an analogy, research by Jones and Weinberg (2012) on the age-achievement relationship in the natural sciences demonstrates that young scientists (who can be seen as being similar to late entrants attempting to play catch up) tend to make more contributions at a younger age when they practice in the fields of abstract /deductive knowledge than when they attempt to make a mark in the more inductive fields that draw on accumulated knowledge, and in which existing knowledge is slow to reach obsolescence.

This book often uses Korean and Taiwanese firms and industries as examples of successful catch-up, leaving us with an intriguing question: did the policy makers in these countries have the criterion of short cycle time firmly in mind as they planned and conducted industrial policy? While the answer to this question is no, they were in fact always asking themselves, "what's next?". They looked keenly at which industries and businesses were likely to emerge in the immediate future and thought carefully about how to enter the emerging ones. Without specifically planning to do so, in effect the policy makers were always pursing the short-cycle industries as these were often the ones that relied less on existing technologies.

The key strategies for economic development identified in the current study differ from the traditional recommendation. We maintain that trade-based specialization is more suitable for low-income countries than middle-income countries. This study then makes its biggest contribution to the literature by taking the first step to explicitly and theoretically address the specialization conditions for middle-income countries. We recommend that they specialize in technological sectors that rely less on existing technologies, and that afford the greater opportunities associated with new technologies. In this way, our findings complement the growth identification and facilitation framework of Justin Lin, in which policy-makers are advised to target an industry that is both new to a latecomer country, and mature in the forerunning country. This allows the latecomer country to begin the process of moving into shorter-cycle sectors. This book argues that after a certain amount of technological capability is built up in the latecomer economy, it can then target another industry that is new to both the latecomer and forerunning economies. This is an effort at leapfrogging, and China is already doing this in various industries. Thus the distinctive policy arguments of this book is that sustained industrial catch-up requires not only an entrance into mature industries, but also an effort to leapfrog into emerging industries that are new to both the advanced and developing countries.

I would also like to contrast this book's emphasis on innovative system with that on inclusive systems in the book "Why Nations Fail" by Acemoglu and Robinson. First of all, their book does not explain how a country can move toward more inclusive institutions, which is also pointed out in a book review by Bill Gates. Furthermore, I observe that the inclusive or extractive dimension may be relevant more for low income countries or pre-modern economies existing before the world became inter-dependent and globalized, and that contemporary middle income nations fail not because of extractive institutions but more because of weak innovation systems, since they also affect their international competitiveness. This contrasts with differences in the degree of inclusiveness among them, which are not that substantial.

This study also provides a yardstick with which one can assess whether a middle income country is stuck in the middle-income trap, or if it is in fact moving beyond the middle income stage to achieve high-income status. We label this phenomenon the technological turning point, or the point at which cycle time, as measured by the patent portfolio of a country, reaches a peak and turns to technologies with shorter cycle times. Korea and Taiwan passed this turning point in the mid-1980s, and China seems to have reached this point in the mid-1990s. The Indian graph also shows a peak in its cycle time in the late 1990s, but a downward trend is not yet clear enough to declare that it has passed its technological turning point.

While this book defines economic catch-up as a narrowing of a firm or country's gap vis-à-vis a leading country or firm, the concept has a long history, going back to the famous work of Gerschenkron and Abramowitz's (1986) influential article ("*Catching Up, Forging Ahead, and Falling Behind*"), which popularized the concept of catch-up and made it part of the standard vocabulary of development economists. While his article examines the relative performance of European economies after the World War II, this book is about non-Western latecomer countries. It conducts a multi-national, quantitative analysis of economic catch-up across three dimensions (i.e., firms, sectors, and

countries) based on a single consistent framework focused on the innovation system. This multi-level analysis identifies a consistent set of catch-up determinants and operationalizes them using patent data, with technological cycle-time (short cycles) serving as the transition variable, and the localization of knowledge creation and technological diversification serving as end-point variables.

This book offers both new and refined methodologies for quantifying the conceptual elements of innovation systems and Schumpeterian economics, which can be used to conduct econometric analyses across the country, sector and firm levels. While these methods are useful for researchers, the book also contains important insights for practitioners and policy makers. In particular, Chapter 7 offers suggestions on building up the technological capability required for the journey toward economic catch-up. It focuses on the role of the government, of public research institutes, and of public–private partnerships. We consider capability building to be one of the most binding elements in catching-up growth.

This book owes a lot to an intellectual tradition that can be called Neo-Schumpeterian or evolutionary economics, and in particular to the works of Richard Nelson, beginning with the book he co-authored with Sidney Winter (1982) called *An Evolutionary Theory of Economic Change*. I am a latecomer in this school and I came to study the book only in the early 1990s - a full decade after it was first published. My intellectual journey started in that period, and I evolved from being a student of the economics of transitioning former socialist economies, to being a student of the economics of innovation in latecomer economies, Interestingly, both areas can be subsumed under the heading *economics of catch-up.* While the former is about the catch-up of economic systems, both focus on reducing the performance gap between latecomers and the forerunning economies. This book argues that you cannot catch up by trying to directly emulate or replicate the economic practices of the forerunning economies. Catch up comes only if you take a different path from them.

My personal encounter with Nelson came another 10 years after my encounter with his book, namely at the 2004 Globelics Conference held in Beijing. After the conference, I became a key participant of the research group on catch-up that he initiated, as well as of the Globelics conferences led by another mentor of mine, Bengt-Ake Lundvall. The catch-up group held its first meeting at the campus of the Columbia University in May 2005. The meeting resulted in several books on multiple subjects, specifically sectoral innovation systems and catch-up (Malerba and Nelson 2012), IPR and catch-up (Odagiri et al 2011), and innovative firms and catch-up (Amann and Cantwell 2012). It also spawned another forthcoming book on university-industry linkages and catch-up. I have contributed a chapter in each of the four books and have learnt tremendously from the community which meets annually at the Globelics meeting. Earlier sections of the book have been presented at these meetings, and they have provided me with a great opportunity to pursue my own intellectual catch-up through an exposure to the leading ideas of eminent scholars in the field, such as John Cantwell, Giovanni Dosi, and Franco Malerba. It was my good fortune to receive both direct and indirect feedback on my research from these scholars.

A number of other scholars have kindly provided me with comments on the manuscript version of this book. Specifically, Nelson led me to explore more literature on the Schumpeterian theory of the firm, and to further revise a chapter on firm-level analysis. He introduced me also to Tushman's works, which offered the insight that competence-destroying discontinuity may lead to the rise of new entrants. As one of the pioneers in the subject of technological catch-up, John Mathews read several versions of the manuscript and suggested a number of important changes to the overall structure of the book. He led me to reevaluate the priority given to key concepts of the book, and I benefited from his encouragement and feedback at various stages of writing this manuscript.

Among his feedback, Adams Szimai's remarks on the generalizability of the technological turning points led me to think more deeply about this issue and I added a separate chapter on the subject (Chapter 9). I recently found out that post-war Japan also specialized in much shorter cycle technologies than European countries, although by this time, it was too late to add this into the book. Kangkook Lee and Kyooho Park have also commented on early versions of this book. I have to thank Park in particular because we first identified the importance of technology cycle time during our collaboration.

The econometric analysis conducted in this book would not have been possible without a dataset of US Patents. This was compiled by the NBER research group, in particular Bronwyn Hall, who also provided comments on Chapter 4 after I presented my findings in a conference in Hitosubashi University. Some variables used in the book were directly retrieved from the dataset, with my research team re-classifying them at the firm, sector and country levels. I would like thank my students for managing the dataset and conducting the statistical analysis, particularly Junki Park, Buru Im, Raeyoon Kang, and Hochul Shin.

Earlier versions of sections of this book have been presented at various academic meetings and the final versions have benefitted greatly from participant feedback. I would like thank John Foster, Bart Verspagen, Maureen McKelvey, Justin Lin, Joseph Stiglitz, Eduardo Albuquerque, Gabriel Yoguel, KJ Joseph, Xiaobo Wu, Brian Wright, Daniel Schiller, Mammo Muchi, Rajah Rasiah, Sadao Nagaoka, Barry Naughton, Hiro Odagiri, Shulin Gu, Guisheng Wu, Mehdi Majidpour, Xudong Gao, Bhaven Samphat, Mei-Chih Hu, Xielin Liu, Jiang Yu, Xibao Li, Yi Wang, Yao Yang, Walter Park, Lakhwinder Singh, Elias Sanidas, Susan Cozzens, Hyunbai Chun, Jung C. Shin, Chulhee Lee, Byung-Yeon Kim, and Taehyun Jung. Notable occasions in which feedback was received include the 2012 International Schumpeter Society held in Brisbane, several Globelics Conferences (Beijing, Kuala Lumpur, Mexico

City, Buenos Aires, Dakar), IEA-World Bank Conference on New Thinking in Industrial Policy, the EPIP conference in Tokyo, Atlanta Conference on Science, Technology, and Innovation Policy, the Cicalics Workshops (Hangzhou and Beijing), the Africalics Academy (Nairobi, Kenya), the Asia-Pacific Innovation Conferences (Singapore and Seoul), the Gordon Research Conference (New Hampshire), and the EBES Conference (Istanbul). The book benefited also from presentation at many seminars held at Tsinghua University, China Academy of Sciences, University of Gothenburg, UNU-MERIT, American University, Amirkabir University of Technology (Teheran), Punjabi University, Kyoto University, CCER and School of Economics of Peking University, UFMG (Belo Horizonte), Korea University, Lund University, Hannover University, and Seoul National University.

I would also like to thank the people at Cambridge University Press, whose valuable work has made this book available to the World, including Chris Harrison, Claire Poole and Tom O'Reilly. A couple of editors have helped me by lending professional English-editing services to this work. In particular, I thank Amrit Kaur for this service. The last acknowledgement (but certainly not the least) goes to my lovely wife, So-yeon, who always stands by me with her prayer.