China's Path to Innovation

Over the past three decades, China has experienced rapid economic growth and a fascinating transformation of its industry. However, much of this success is the result of industrial imitation and China's continuing success now relies heavily on its ability to strengthen its indigenous innovation capability. In this book, Xiaolan Fu investigates how China can develop a strategy of compressed development to emerge as a leading innovative nation. The book draws on quantitative and qualitative research that includes cross-country, cross-province and cross-firm analysis. Large multi-level panel datasets, unique survey databases, and in-depth industry case studies are explored. Different theoretical approaches are also used to examine the motivations, obstacles and consequences of China's innovation with a wider discussion around what other countries can learn from China's experience. This book will appeal to scholars and policy-makers working in fields such as innovation policy, technology management, development and international economics and China studies.

XIAOLAN FU is Professor of Technology and International Development and Founding Director of the Technology and Management Centre for Development at the University of Oxford. Her research interests include innovation, technology and industrialisation; trade, foreign direct investment and economic development; emerging Asian economies; and innovation and productivity in the UK and US. She also has first-hand experience working in the business and academic sectors in China before coming to the UK.

Professor Fu has integrated a variety of scholarly articles from the firm level to the industry level to the national policy level, to produce the first comprehensive treatment of Chinese innovation activities from an open innovation perspective. Her masterful book points the way towards open innovation with Chinese characteristics.

Henry Chesbrough, Professor at UC Berkeley's Haas School of Business and author of *Open Innovation*

That China is the workshop of the world is now a 'given'. Professor Fu has invested years in the search for clues to how the goods in the China workshop have moved from being 'assembled in China' through 'invented in China' to 'invented and commercialised in a complex open engagement with the world's capital and skilled labour'. This book is the authoritative result and is essential reading.

Barbara Harriss-White, Emeritus Professor of Development Studies, Oxford University and co-editor of *China-India: Pathways of Economic and Social Development*

This fascinating book by a leading Chinese scholar is hugely informative of the challenges China faces in its quest to become a major global innovative economy. It populates a knowledge gap, challenges our conventional wisdom and provides important insights for corporate and government policy makers alike.

Raphael Kaplinsky, Professor of International Development, The Open University

China achieved an average annual growth rate of 9.8% for 35 years, made possible only by continuous technological innovations, after the transition from a planning economy to a market economy in 1979. Such a long period of extraordinary growth was unprecedented in human history. This book carefully studies China's open national innovation system at national, regional and firm levels. It deciphers how China was able to achieve such a remarkable success in the past, examines how China may sustain dynamic growth in the future and suggests what other countries can learn from China's success. The book is a must-read for anyone who wants to understand Chinese economic development.

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

Finally, we have an analytical volume that combines economic theory, international experience, and China's socio-economic conditions to formulate a most credible strategy to greatly strengthen China's capacity to innovate. Xiaolan Fu's 'Open National Innovation System' approach deserves careful study by other developing countries because it is also applicable to them.

Wing Woo, Professor, University of California at Davis and President, Jeffrey Cheah Institute on Southeast Asia, Malaysia

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Preface

This book is an outcome of my research on innovations in China over the past 10 years. I started my research on innovation as a project team member of a Cambridge-MIT joint project on 'International Innovation Benchmarking', which compared innovation activities in Europe, the UK in particular, and the United States. Innovations were a key area of concern for policy makers and business managers, as well as the academic scholars. Although China's economic reforms started in 1978, up to the early 2000s the Chinese economy had been driven by system reforms, investment, exports and foreign direct investment (FDI) at different periods. Innovation was still a concept that had never really come to the centre of China's development strategy, nor had it arrived at the debate on the drivers of its long-term economic growth. Having witnessed the competition among industrialised countries for leadership in innovation and the priority that has clearly been given to skills and innovation in policy making in these countries, I started my pursuit to understand how to build innovation capabilities in a developing country such as China. I strongly believe that this will be a crucial area for China, not only for academic research but also for policy making and business management in the real-world context. In fact, without much waiting, the Chinese government began to change its development strategy in 2006. It placed development of indigenous innovation as the top priority in its official national development plan.

As a researcher who has a strong interest in China's industrial competitiveness and its external trade and investment, I have worked extensively in these areas; hence, I started my research quest from my understanding of the sources of innovative knowledge and technology in China and the processes of innovation diffusion. I gradually moved on to researching the conditions and processes of innovation creation in developing countries. I also examined the relationship between different paths at different stages of development of a country, their advantages and disadvantages and the conditions for effectiveness of each path. My

past work experiences and interest in studying innovations in the developed and other developing countries allowed me to examine China's path from an international comparative perspective. This has formed the basic structure and approach of research that I present in this book.

China's Path to Innovation is a combination of a selected number of my published journal papers and several new studies on some of the most recent topics regarding China's ongoing transformation from imitation to innovation. It is a serious academic book based on 10 years of research and reflection. All published and unpublished new papers are selected and organised to provide a systematic, comprehensive and coherent study of China's path to innovation, although each chapter is fairly self-contained. Journal publication offers a great advantage that one's research comes under close scrutiny through the peer review process and can benefit greatly from it. My aim is to publish the more original parts of the book in this way with updated data and information. The hope is that the whole will add up to more than the sum of its parts and that we can identify and develop a general model of the technology development strategy of the developing countries based on a series of peer-reviewed, in-depth studies of individual factors, mechanisms and cases.

Many acknowledgements and thanks are due. Since 2005, my research on innovation and on China has been supported by substantial grants from the Economic and Social Sciences Research Council (ESRC), the Engineering and Physics Sciences Research Council (EPSRC), the British Academy, the Cairncross Foundation and the State Administration of Foreign Experts Affairs (SAFEA) of China. I thank these bodies for their financial support and for the confidence that they have shown in my research.

I am grateful to the copyright holders of the following journals for permitting me, with acknowledgement, to present full or part of the papers that have appeared in their journals in suitably revised form: Xiaolan Fu, Carlo Pietrobelli and Luc Soete, 'The role of foreign technology and indigenous innovation in emerging economies: technological change and catch-up', *World Development, 39* (2011) (part of the Introduction); Xiaolan Fu, 'Foreign direct investment, absorptive capacity and regional innovation capabilities in China', *Oxford Development Studies*, 36 (2008) (Chapter 3); Xiaolan Fu, 'Processing-trade, FDI and exports of indigenous firms: firm-level evidence from high-technology industries in China', *Oxford Bulletin of Economics and Statistics*, 73 (2011) (Chapter 4); Xiaolan Fu and Yundan Gong,

'Indigenous and foreign innovation efforts and drivers of technological upgrading', *World Development*, 39 (2011) (Chapter 5); Xiaolan Fu and Hongru Xiong, 'Open innovation in China: policies and practices', *Journal of Science & Technology Policy in China*, 2 (2011) (Chapter 6); Xiaolan Fu, Hongru Xiong and Jizhen Li, 'Open innovation as a response to constraints and risks and the moderating role of governance', *Asian Economic Papers*, 13 (2014) (Chapter 7); Xiaolan Fu, Jizhen Li and Martin Johnson, 'Internal and external sources of tacit knowledge: evidence from the optical fibre and cable industry in China', *Journal of Chinese Economic and Business Studies*, 9 (2011) (Chapter 9); Xiaolan Fu and Jing Zhang, 'Technology transfer, indigenous innovation and leapfrogging in green technology: solar-PV panel industries in China and India', *Journal of Chinese Economic and Business Studies*, 9 (2011) (Chapter 10); Xiaolan Fu and Qing Gong Yang, 'Exploring the cross-country gap in patenting: a stochastic frontier approach', *Research Policy*, 38 (2009) (part of Chapter 13); Xiaolan Fu and Rongping Mu, 'Enhancing China's innovation performance: the policy choice', *China & World Economy*, 22 (2014) (part of Chapter 14).

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Finally, I can hardly express the debt of gratitude I owe to my family, especially my husband, Shaohui, and my son, Yujie, for their great love and support. Without their support, the book would not have come to fruition.

Xiaolan Fu

Abbreviations

ABC	Absorptive capacity
CDB	China Development Bank
CDMA	Code division multiple access
CILG	Central innovation leading group
CIS	Community Innovation Survey
COEs	Collective-owned enterprises
CPO	Chinese State Intellectual Property Office
DEA	Data envelopment analysis
EIS	European Innovation Scoreboard
EP	Export processing
EPZs	Export processing zones
EU	European Union
FDI	Foreign direct investment
FIEs	Foreign invested enterprises
GDP	Gross domestic products
GLLAMMs	Generalized linear latent and mixed models
GMM	Generalised method of moments
GVC	Global value chains
HKTM firms	Hong Kong, Taiwan and Macao firms
HMT	Hong Kong, Macau and Taiwan
ICT	Information and communication technology
IMD	Institute for Management Development
IPR	Intellectual property rights
ITU	International Telecommunication Union
JV	Joint venture
MLEs	Medium- and large-sized enterprises
MNEs	Multinational enterprises
MOST	Ministry of Science and Technology of China
MSTI	Main science and technology indicators
NIEs	Newly industrialised economics

NIP	National innovation performance
NIS	National innovation system
OBM	Original brand manufacturers
ODM	Original design manufacturers
OECD	Organisation for Economic Co-operation and Development
OEM	Original equipment manufacturers
OFDI	Outward foreign direct investment
OI	Open innovation
OLS	Ordinary least squares
ONIS	Open national innovation system
OT	Ordinary trade
POEs	Privately owned enterprises
PRIs	Public research institutions
PT-FDI	Processing trade–FDI
R&D	Research and development
REF	Research excellence framework
S&T	Science and technology
SEZs	Special economic zones
SFA	Stochastic frontier analysis
SHCs	Shareholding companies
SMEs	Small and medium enterprises
SOEs	State-owned enterprises
SSB	State Statistical Bureau
STP	Strategic technology partnering
TFP	Total factor productivity
UNCTAD	United Nations Conference on Trade and Development
USPTO	United States Patent and Trademark Office
WBDI	World Bank development indicators
WCY	World Competitiveness Yearbook
WFO	Wholly foreign owned
WTO	World Trade Organization
ZTE	Zhongxing Telecommunications Equipment Corporation