

## HARNESSING PUBLIC RESEARCH FOR INNOVATION IN THE 21ST CENTURY

### An International Assessment of Knowledge Transfer Policies

Universities and public research institutes play a key role in the innovation ecosystem. Many countries have implemented national strategies to support the commercialization of knowledge produced by public institutions, to help take their innovations and scientific breakthroughs to market and ultimately boost economic growth. Research bodies themselves have also introduced practices to support knowledge transfer activities.

The legal, policy, and institutional approaches to knowledge transfer are diverse, and there is no standardized set of assessment metrics relevant to both high- and middle-income countries. In this context, how can policymakers best help countries and institutions improve the efficiency of their knowledge transfer practices to maximize innovation-driven growth and to seek practical solutions to critical societal challenges?

Comprised of research and insight by esteemed international contributors, *Harnessing Public Research for Innovation in the 21st Century* addresses this policymaking challenge. It assesses the current role of public research institutions in modern innovation systems and considers how to best optimize existing policies, based on inputs from leading academics, practitioners, and policymakers. It analyses what does and does not work in knowledge transfer practices, policy options, and future measurement priorities, and looks in detail at three high-income and three middle-income country examples. The book provides a useful foundation for future empirical work, the development of appropriate metrics, and for crafting new innovation policy approaches.

“This book represents a major step towards reaching a systematic approach to the measurement of knowledge transfer practices and outcomes.”

HU ZHIJIAN, President, Chinese Academy of Science and Technology for Development

“Unlike most existing work in this area, this book emphasizes that firms benefit from academic research not only through formal but also more informal channels and from open science, and that there are tensions, as well as complementarities, between these two.”

BHAVEN SAMPAT, Associate Professor, Columbia University

“Enabling access to cutting-edge research is vital to tackling the challenges countries face, and for policymakers, it is thus ever more important to identify which knowledge transfer practices work and which do not. This research is critical in this regard.”

PIPPA HALL, Director of Innovation and Chief Economist, Intellectual Property Office, United Kingdom

“This book does an excellent job of identifying key metrics that should be measured by knowledge transfer offices.”

RAGAN ROBERTSON, Technology Transfer Officer, University of California, Los Angeles, and Association of University Technology Managers (AUTM) Cabinet Member, Metrics and Surveys, United States of America

“Brazil has established a comprehensive legal framework for innovation. But is that enough? There are barriers that can only be overcome with continuous adjustment of policies. In this context, this book provides good guidance.”

ANTENOR C.S. CORRÊA, Senior Analyst in Science and Technology, and Fernanda V.M. Magalhães, Specialist in Public Policies and Government Management, Federal Government of Brazil

“Going forward, knowledge transfer will play a pivotal role in driving future growth in Africa. We welcome this book and encourage the African measurement community to invest in related metrics.”

PHILIPPE KUHUTAMA MAWOKO, Executive Secretary, African Observatory for Science, Technology and Innovation, African Union Commission

CAMBRIDGE AND THE WORLD INTELLECTUAL PROPERTY  
ORGANIZATION

*Intellectual Property, Innovation and Economic Development*

Intellectual property (IP) is at the heart of modern economic life. In many countries, investment in intangible assets is growing faster than investment in tangible assets. Policy makers – whether in rich or poor economies – seek to promote an IP framework that is conducive to innovation and economic growth.

The series *Intellectual Property, Innovation, and Economic Development* intends to inform such policy initiatives through rigorous scholarship. Each book in the series examines a major aspect of the interface between IP, innovation and economic development. Economic analysis is complemented by contributions from other academic disciplines to present the latest scholarship and consider its real-world implications. The series builds on studies by the World Intellectual Property Organization, reflecting the research interests of the international policy-making community.

**Series Editor**

Carsten Fink, Chief Economist, World Intellectual Property Organization

**Editorial Advisory Board**

Megan Macgarvie, Associate Professor, Markets, Public Policy and Law, Questrom School of Business, Boston University, USA

Beth Webster, Director of the Centre for Transformative Innovation, Professor and Pro Vice-Chancellor for Research Impact and Policy, Swinburne University, Melbourne, Australia

Mark Wu, Henry L. Stimson Professor, Harvard Law School, Faculty Director, Berkman Klein Center for Internet and Society, USA

**Books in the Series:**

*The Informal Economy in Developing Nations – Hidden Engine of Innovation?*

Edited by Erika Kraemer-Mbula and Sacha Wunsch-Vincent

*The International Mobility of Talent and Innovation – New Evidence and Policy Implications*

Edited by Carsten Fink and Ernest Miguez

Cambridge University Press  
978-1-108-84279-2 — Harnessing Public Research for Innovation in the 21st Century  
Edited by Anthony Arundel , Suma Athreye , Sacha Wunsch-Vincent  
Frontmatter  
[More Information](#)

---

HARNESSING PUBLIC  
RESEARCH FOR  
INNOVATION IN THE  
21ST CENTURY

An International Assessment of Knowledge  
Transfer Policies

Edited by

ANTHONY ARUNDEL

*UNU-MERIT, Maastricht University and University of Tasmania*

SUMA ATHREYE

*Essex Business School*

SACHA WUNSCH-VINCENT

*World Intellectual Property Organization*



CAMBRIDGE  
UNIVERSITY PRESS

Cambridge University Press  
978-1-108-84279-2 — Harnessing Public Research for Innovation in the 21st Century  
Edited by Anthony Arundel, Suma Athreya, Sacha Wunsch-Vincent  
Frontmatter  
[More Information](#)

CAMBRIDGE  
UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre,  
New Delhi – 110025, India

79 Anson Road, #06–04/06, Singapore 079906

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

[www.cambridge.org](http://www.cambridge.org)

Information on this title: [www.cambridge.org/9781108842792](http://www.cambridge.org/9781108842792)

DOI: 10.1017/9781108904230

© World Intellectual Property Organization 2021

This work is in copyright. It is subject to statutory exceptions and to the provisions of relevant licensing agreements; with the exception of the Creative Commons version the link for which is provided below, no reproduction of any part of this work may take place without the written permission of Cambridge University Press.

An online version of this work is published at [doi.org/10.1017/9781108904230](https://doi.org/10.1017/9781108904230) under a Creative Commons Open Access license CC-BY-NC-ND 4.0 which permits re-use, distribution and reproduction in any medium for non-commercial purposes providing appropriate credit to the original work is given. You may not distribute derivative works without permission. To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc-nd/4.0>

All versions of this work may contain content reproduced under license from third parties. Permission to reproduce this third-party content must be obtained from these third-parties directly.

When citing this work, please include a reference to the DOI 10.1017/9781108904230

First published 2021

*A catalogue record for this publication is available from the British Library.*

ISBN 978-1-108-84279-2 Hardback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

## CONTENTS

<i>List of Figures</i>	<i>page</i> x
<i>List of Tables</i>	xiii
<i>List of Contributors</i>	xvi
<i>Foreword</i>	xxix
HU ZHIJIAN	
<i>Foreword</i>	xxxii
PIPPA HALL	
<i>Foreword</i>	xxxiii
BART VERSPAGEN	
<i>Preface</i>	xxxv
<b>PART I Setting the Context</b>	<b>1</b>
1 The Evolving Role of Public R&D and Public Research Organizations in Innovation	3
SUMA ATHREYA AND SACHA WUNSCH-VINCENT	
Comment 1.1	25
FABIO MONTOBBIO	
Comment 1.2	30
LIEN VERBAUWHEDE KOGLIN	
2 Evaluating Knowledge Transfer Policies and Practices: Conceptual Framework and Metrics	35
ANTHONY ARUNDEL AND SACHA WUNSCH-VINCENT	
Comment 2.1	68
BHAVEN SAMPAT	
Comment 2.2	73
RAGAN ROBERTSON	
Comment 2.3	76
ROSEMARY WOLSON	

3	Measuring Global Patenting of Universities and Public Research Institutes	80
	JUAN YANG, INTAN HAMDAN-LIVRAMENTO, BRUNO LE FEUVRE, SACHA WUNSCH-VINCENT, AND HAO ZHOU	
<b>PART II Selected Comparative Country Studies</b>		<b>139</b>
4	United Kingdom	141
	FEDERICA ROSSI AND SUMA ATHREYE	
5	Germany	182
	DIRK CZARNITZKI AND GEORG LICHT	
6	Republic of Korea	226
	KEUN LEE AND HOCHUL SHIN	
7	Brazil	263
	FERNANDA DE NEGRI AND CRISTIANE VIANNA RAUEN	
8	China	299
	BAOMING CHEN, CAN HUANG, CHUNYAN PENG, MINGLEI DING, NING HUANG, XIA LIU, AND JUAN YANG	
9	South Africa	328
	MICHAEL KAHN	
<b>PART III The Way Forward</b>		<b>359</b>
10	Policies and Practices for Supporting Successful Knowledge Transfer from Public Research to Firms	361
	ANTHONY ARUNDEL	
	Comment 10.1	386
	HENRI J.M. THEUNISSEN	
	Comment 10.2	389
	KERRY FAUL	



## CONTENTS

ix

11	Policy Recommendations: Aiming for Effective Knowledge Transfer Policies in High- and Middle-Income Countries	393
	SUMA ATHREYA AND FEDERICA ROSSI	
	Comment 11.1	418
	ANTENOR CESAR VANDERLEI CORRÊA AND FERNANDA MAGALHÃES	
	Comment 11.2	422
	SI KYONG SUNG	
12	Toward a Comprehensive Set of Metrics for Knowledge Transfer	425
	ANTHONY ARUNDEL AND NORDINE ES-SADKI	
	Comment 12.1	452
	PHILIPPE KUHUTAMA MAWOKO	
	Comment 12.2	457
	GIANCARLO CARATTI	
	Comment 12.3	460
	AMIT SHOYON RAY	
	<i>Technical Annex: Survey on Policies and Practices for IP-Mediated Knowledge Transfer</i>	464
	<i>Index</i>	475

## FIGURES

1.1	Share of R&D (measured by GERD) in GDP by income group of countries, 2000–16	12
1.2	Share of public sector in total R&D, high- and middle-income economies	14
1.3	Share of basic research conducted by the public sector for 2017 or latest available year, as a percentage of all national expenditures for basic research	15
1.4	R&D intensity (GERD as a percentage of GDP), case study countries	19
1.5	Share of GERD financed by the government, case study countries	20
2.1	Knowledge transfer channels between the public research sector and businesses	37
3.1	Public research institute and university PCT applications, absolute numbers (left) and as a percentage of total PCT applications (right), 1995–2016	91
3.2	Trend and share in university and public research institute patent families worldwide, 1995–2014	91
3.3	Trend in university and public research institute foreign-oriented patent families worldwide and share of total, 1995–2013	92
3.4	Share of university and public research institute PCT filings for top ten origins in 2007 and 2016	94
3.5	University and public research institute PCT filings originating from middle-income countries as a share of total university and public research institute PCT filings	95
3.6	Increase in university and public research institute filings by high- and middle-income groups	96
3.7	University and public research institute patenting by leading origin countries	98
3.8	The trend over the past decade in PCT filings for selected origins	99
3.9	University and public research institute PCT filings in middle-income countries	101
3.10	University and public research institute patent filings using PATSTAT data	103
3.11	University and public research institute patent filings for middle-income countries	105

## LIST OF FIGURES

xi

3.12	University and public research institute patent applications as a share of total applications for selected countries (%), 1980–2013	107
3.13	Distribution of PCT applications by technology sector, 2007–16	108
3.14	Share of PCT applications for the top three fields of technology, 2016	109
3.15	Shares of leading technology sectors in PCT applications filed by the top five universities	112
3.16	Top three technology fields for selected universities and public research institutes, 2010–13	113
3.17	The share of the business sector in total PCT applications from selected origins	121
3.18	Nonresident university and public research institute patent applications for selected patent offices, 2006–15	131
3.19	Share of nonresident university and public research institute patent applications for selected offices, 2006–15	132
3.20	Patent applications filed abroad by universities and public research institutes for selected origins, 2006–15	133
3.21	Share of patent applications filed abroad by type of applicant, selected origins, 2006–15	133
4.1	Cumulative number of degree-awarding institutions active since 1900	143
4.2	Universities' sources of income	145
4.3	Cumulative number of public sector research establishments active since 1950	147
4.4	Shares of university and PSRE staff involved in different types of knowledge transfer activity	158
4.5	Patenting and spinout activities of universities	162
4.6	Patenting and spinout activities of PSREs	162
5.1	Number of students at different types of HE college in Germany	184
5.2	Distribution of R&D expenditure in 2010	184
5.3	KTТ missions and activities of different institutions in German public science	187
5.4	Patenting in Germany before and after the abolition of professor's privilege	201
5.5	Trends in German patenting for university and public research institute researchers ("within" transformed), 1995–2008	202
5.6	Average trends of spinoff activity (within demeaned)	207
5.7	The firms' perspective on KTT channels	208
8.1	Share of total R&D expenditures by enterprises, public research institutes, and universities in China, 2000–16	302
8.2	Share of 2016 R&D expenditures in China by application	303
8.3	Domestic invention patent applications by different types of organization, 1995–2016	305

8.4	Number of patent transfers and licenses by universities, 2010–16	315
8.5	Value of patent ownership transfers and licenses by universities, 2010–16 (million CNY)	315
8.6	Total annual knowledge transfer agreements by universities, 2008–14	316
8.7	Total annual value of knowledge transfer agreements by universities, 2008–14 (million CNY)	316
9.1	Major STI policy documents or acts	334
10.1	Factors that influence knowledge transfer	369
11.1	The knowledge ecosystem in high-income economies	403
11.2	The public research ecosystem in middle-income economies	406
11.3	Five questions to guide policy toward knowledge exchange from universities	414

## TABLES

2.1	Impacts of IP-based knowledge transfer policies on universities/public research institutes and firms	42
2.2	Socioeconomic effects of IP-based knowledge transfer policies	44
2.3	Impacts on low- and middle-income countries	46
2.4	Knowledge transfer channels and data sources	51
2.5	Basic metrics from KTO surveys	53
2.6	Supplementary metrics from KTO surveys	57
2.7	Variables for standardizing knowledge transfer office (KTO) metrics	59
3.1	Comparison of PATSTAT national patent data coverage for featured countries	86
3.2	Share of patent applications filed in selected technology fields by applicant type, 2013–15	110
3.3	Top PCT applicants for the university sector in 2016	115
3.4	Top PCT applicants among governments and public research institutes in 2016	118
3.5	Top fifty-five patent applicants worldwide, based on total number of patent families, 2010–13	122
3.6	Top five university and public research institute patent applicants worldwide by selected origins, 2010–13	129
4.1	Public funding of universities and PSREs	148
4.2	Indicators of research commercialization activities in UK universities	159
4.3	Summary indicators of research commercialization activities in UK PSREs	165
4.4	Collaboration with universities and governments	169
4.5	Cooperation on innovation activities with universities and government at different geographical levels	170
5.1	Selected key features of German public research institutes	186
5.2	Top-ranking universities for patent applications, 1990–2009, and research	188
5.3	Public research institute heads' assessment of their institutes' key tasks (%)	192
5.4	KT by leading German public research institutes at a glance	194
5.5	Leading collaboration partners by sector, 2008–10	197

5.6	Main users of public research institute research, as identified by public research institute heads	198
5.7	University researchers' patent activity by applicant type, 1995–2008	203
5.8	Academic entrepreneurship before and after the 2002 policy reform (annual mean values), 1995–2008	206
5.9	Importance of main knowledge transfer channels, by universities and public research institutes, 1997–9	210
5.10	External funding and channels of commercialization as reported by researchers in 2008	213
5.11	Key characteristics of the three case study universities	221
6.1	Public R&D expenditure and number of Korean public research institutes and universities, 2000–14	232
6.2	Number of domestic patent applications by public research institutes and universities 2000–15	234
6.3	Output of R&D activities by Korean public research institutes and universities – new technologies and knowledge transfer, 2007–14	235
6.4	Output of R&D activities by Korean public research institutes and universities – license income, 2007–14	237
6.5	University knowledge transfer contracts by industry, 2011–13	239
6.6	Firms reporting universities or research institutes as sources of innovation information, 2011–13	240
6.7	Primary types of cooperation with public research organizations among surveyed firms	241
6.8	Knowledge transfer contracts and share of different types of knowledge transfer, 2007–14	243
6.9	Laboratory companies – sales and employment, 2009–15	244
7.1	Main policies and instruments for S&T funding in Brazil in 2012	274
7.2	Number of research infrastructures in Brazil by launch period	275
7.3	Number of universities, research universities, and federal technological institutions in Brazil in 2015	276
7.4	R&D investment by the main public universities in Brazil in 2012	278
7.5	Budget or revenues of the main public research institutes in Brazil in 2014	279
7.6	Number of patents filed by Brazilian universities and research institutions at the National Institute of Industrial Property, 2000–12	281
7.7	Firms that innovated using a cooperation agreement with a university or public research institute in 2014	283
7.8	Knowledge transfer contracts undertaken by Brazilian public research institutes and public universities by type of contract in 2014	288
8.1	Number of SCI-indexed papers by different organizations in China, 2003–17	304

## LIST OF TABLES

XV

8.2	Share of transaction value of knowledge transfer contracts by seller types, 2009–16 (%)	312
8.3	Patent applications, grants, and transfers by 1,497 universities in 2015	317
8.4	R&D and licensing modes of universities and public research institutes (%)	318
8.5	Patent exploitation rates in 2014 (%)	319
8.6	Patent sales (assignments) rates in 2014 (%)	319
8.7	Patent licensing rates in 2014 (%)	320
9.1	R&D expenditure of leading universities, public research institutes, and state-owned enterprises, 2013–14	332
9.2	Innovation outputs in 2015	345
9.3	Share of innovative firms rating sources of information for innovation as “highly important”	346
9.4	R&D expenditure and knowledge transfer metrics for four leading universities in 2014	348
9.5	Metrics of the knowledge transfer activities of South African universities and public research institutes, fiscal year 2013–14	351
10.1	Policies to support knowledge transfer for differing capabilities of public research organizations and firms	370
11.1	Convergence of knowledge transfer policies	399
11.2	Differences between the national systems of innovation of six high- and middle-income countries	401
11.3	Differences in range of supporting policies	409
12.1	Data collected for IP-mediated knowledge transfer plus research agreements at the institutional level (results for six countries)	426
12.2	Data collected for IP policies at the national (✓) or institutional (✓✓) level (results for six countries)	433
12.3	Metrics at the institutional level for policies and practices to support knowledge transfer	434
12.4	Data collected in previous surveys of academic engagement	437
12.5	Knowledge transfer metrics from surveys of academics and firms	438

## CONTRIBUTORS

ANTHONY ARUNDEL obtained a bachelor's degree from Simon Fraser University in Canada and a master's in the economics of innovation from Maastricht University in Maastricht, the Netherlands. He is concurrently a Professorial Fellow at UNU-MERIT and an adjunct professor at the University of Tasmania in Australia. He has published extensively on business and public sector innovation. His research interests cover innovation measurement, knowledge transfer, innovation methods and strategies, and environmental innovation.

SUMA ATHREYE is Professor of Technology Strategy at Essex Business School. She has worked on several areas of technology management, including research on the technology-related activities of multinational enterprises, as well as the technology licensing behavior of firms. Her recent work has been on patent use by firms and she has studied the incentive effect of patents on firm profits and R&D, the role of technology leadership in encouraging patenting in open innovation contexts, and, more recently, on the barriers to the use of formal protection methods among UK firms.

GIANCARLO CARATTI is Head of Intellectual Property and Technology Transfer at the European Commission (EC), managing its intellectual property and promoting knowledge transfer. In 2015, he was deputy commissioner general for the EU participation in the World Expo Milano. He worked in the universities of Florence and Pisa as teaching and research assistant in mechanical engineering. He spent one year as visiting scholar at the Georgia Institute of Technology and worked in a private engineering firm before entering the EC in 1986.

BAOMING CHEN, Director, Comprehensive Development Institute (CDI), Chinese Academy of Science and Technology for Development (CASTED), Ministry of Science and Technology (MOST), Beijing, China. Baoming Chen obtained a PhD in economics from Renmin University in



Beijing, China. His research interests lie in S&T development strategy and policies. He is a core member of revising the law on promoting the transformation of S&T achievements. He leads many research projects on knowledge transfer, S&T development planning, international S&T cooperation, and other S&T policies.

DIRK CZARNITZKI is a full professor at the Department of Management, Strategy and Innovation at KU Leuven in Belgium. He holds a doctoral degree in economics from the University of Duisburg-Essen, and he has been a research fellow at the Centre for European Economic Research (ZEW), Mannheim, Germany, as well as post-doc at UC Berkeley before he joined KU Leuven in 2005. His research interests are mainly in the fields of the economics of innovation and applied micro-econometrics. The lines of research address topics such as the evaluation of public innovation policies, the economics of science, intellectual property rights, corporate governance and innovation, as well as knowledge and technology transfer including academic entrepreneurship. Dirk has published more than sixty articles in international, refereed journals including the *Journal of Economics and Business Statistics*, the *Review of Economics and Statistics*, *Management Science*, the *European Economic Review*, *Journal of Applied Econometrics*, *Research Policy*, and many others.

MINGLEI DING, Senior Research Fellow, CDI, CASTED, MOST, Beijing, China. Minglei Ding obtained a PhD in management science and engineering from Hebei University of Technology and holds postdoctoral certificates on applied economics in NanKai University. His research interests include S&T innovation policies and strategy, regional and industrial economics, innovation, and entrepreneurial management. He engages in a number of research projects on national and regional S&T, innovation policy, strategy, and planning. In recent years, he has been a core member of research projects for the Chinese thirteenth five-year STI planning and the law on promoting the transformation of S&T achievements.

NORDINE ES-SADKI joined UNU-MERIT as a researcher in January 2011. He obtained his bachelor's degree in economics from Maastricht University in 2009. In 2010, he obtained his master's degree in economics from the Erasmus University in Rotterdam with distinction. He is pursuing a PhD on the topic of knowledge flows from public research to firms. His research interests include knowledge transfer, intellectual

property rights, the measurement of science, technology and innovation, questionnaire design, surveys and their methodology, and the economics of regional innovation. He also works part-time as an economics teacher at a lyceum in Maastricht.

**KERRY FAUL**, Head, National Intellectual Property Management Office (NIPMO), Ministry of Science and Technology, Pretoria, South Africa. Kerry Faul completed a bachelor of science degree at the University of KwaZulu-Natal (formerly University of Natal (Pietermaritzburg)) in 1994, majoring in chemistry and biochemistry before going on to do a honors degree and thereafter a master of science degree in biochemistry. After a two-year stint of working in London and traveling extensively, she returned to complete a doctor of philosophy in biotechnology through the Institute of Wine Biotechnology at Stellenbosch University. From 2007 to 2011, Kerry was employed by Spoor & Fisher during which time she completed her *legum* baccalaureus and patent examination boards and was subsequently registered as a South African patent attorney, and admitted as an attorney of the High Court of South Africa. In December 2013, Kerry Faul was appointed as the Head of NIPMO responsible for ensuring implementation of the Intellectual Property Rights from Publicly Financed Research and Development Act (No. 51 of 2008).

**BRUNO LE FEUVRE** is senior statistical analyst at Department for Economics and Data Analytics of the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations based in Geneva, Switzerland. He holds a master of advanced studies in public administration and in information system management from the University of Lyon II, France. In 2001, he was hired by WIPO as an examiner at the International Bureau of the Patent Cooperation Treaty (PCT), and joined the statistics section in 2005 where he specialized in patent and PCT statistics.

**PIPPA HALL**, Director of Innovation and Chief Economist, UK Intellectual Property Office. Pippa Hall obtained a bachelor of science degree in economics at the University of Sheffield, United Kingdom. She also holds a masters in financial and industrial economics from Royal Holloway, University of London, United Kingdom. Her role is to ensure that the UK IPO's policy development activity focuses on key issues and is based on a robust evidence base. She is also responsible for developing strategies and policies to engage business and raise awareness of the importance of intellectual property rights.

## LIST OF CONTRIBUTORS

xix

INTAN HAMDAN-LIVRAMENTO, economist, Department for Economics and Data Analytics, World Intellectual Property Organization (WIPO), Geneva, Switzerland. Intan Hamdan-Livramento is an economist with experience in international trade law. She obtained her doctoral degree in economics from the École Polytechnique Fédérale de Lausanne (EPFL), France, and holds a master's in international law and economics from the World Trade Institute in Bern, Switzerland. She currently works in WIPO's chief economist division, working on issues at the intersection of the industrial organization and intellectual property rights. She was one of the four co-authors of the *World Intellectual Property Report*, one of WIPO's main economic publications since its inception in 2011. Intan previously worked at the World Trade Organization and the International Monetary Fund.

CAN HUANG, professor, head of Department of Innovation, Entrepreneurship and Strategy, and co-director of Institute for Intellectual Property Management at School of Management, Zhejiang University, Hangzhou, China. Can Huang holds a PhD in industrial management from the University of Aveiro, Portugal, an MSc in engineering and a BA in economics from Renmin University of China, Beijing, China. He is a senior editor of *Management and Organization Review* and a member of the editorial boards of the *Journal of International Business Policy*, *Science and Public Policy*, *NTUT Journal of Intellectual Property Law and Management*, *African Journal of Science, Technology, Innovation and Development*, *International Journal of Innovation Studies*, *Science and Management (Ke Xue Yu Guan Li)*, and the UNESCO Science Report (2015 ed.). His research interests include innovation and intellectual property management and science and technology policy analysis.

NING HUANG, research fellow, CDI, CASTED, MOST, Beijing, China. Ning Huang obtained a bachelor of science degree from Shandong University and a doctor of economics degree from the University of International Business and Economics in China. He also holds postdoctoral certificates of applied economics from CASTED and Nankai University in China. He used to be a visiting scholar at the G20 Research Centre of the University of Toronto in Canada. His research focuses mainly on S&T strategy, innovation policies, and international economic and trade rules.

MICHAEL KAHN, advisor, and extraordinary professor, CREST and DST/NRF Centre of Excellence in Scientometrics and Science Policy, Stellenbosch University, Stellenbosch, South Africa. Michael Kahn obtained a PhD in theoretical physics from Imperial College, London, and a master's degree in education policy, planning and management from the University of London. His undergraduate degree is a BSc (hons) from the University of Cape Town. He works internationally as an advisor on R&D and innovation policy, strategy, planning, measurement and evaluation, and is principal investigator for the project on the Mobility of the Highly Skilled. He has authored 100 peer-reviewed journal articles, chapters in books, and books. He has served on the boards of a number of statutory bodies and NGO trusts.

KEUN LEE is a professor of economics at Seoul National University, and founding director of the Center for Economic Catch-up. He is an editor of *Research Policy*, an associate editor of *Industrial and Corporate Change*, and, since 2016, a council member of the World Economic Forum. He served as the president of the International Schumpeter Society (2016–2018), and as a member of the Committee for Development Policy of the UN (2014–2018), and was the winner of the 2014 Schumpeter Prize for his monograph on *Schumpeterian Analysis of Economic Catch-Up* (2013, Cambridge University Press). He obtained his PhD in economics from the University of California, Berkeley. One of his most cited articles is a paper on Korea's technological catch-up published in *Research Policy*, with 1,081 citations (Google Scholar). His H-index is now thirty-seven, with ninety-five papers with more than ten citations. His latest book, *The Art of Economic Catch-Up: Barriers, Detours and Leapfrogging in Innovation Systems*, was published by Cambridge University Press in 2019.

GEORG LICHT is Head of the research department of Economics of Innovation and Industrial Dynamics at the Centre for European Economic Research (ZEW), in Mannheim, Germany. He has held this position since June 1994. He gained his doctoral degree at the University of Augsburg and holds a degree in economics from the University of Heidelberg. Research interests include the economics of innovation and technical change as well as the economics of small firms and entrepreneurship. He was engaged for some years in the development of the Community Innovation Survey (CIS) and innovation surveys in Germany in manufacturing and service industries. He is consultant to the OECD, the EU Commission and the German Federal Ministry of

Education and Research in the area of innovation and technology policy. He has been a member of several expert panels in science and innovation policy.

FERNANDA MAGALHÃES, specialist in public policies and government management, Brazilian Federal Government. She has worked on several areas of public policy, including technological innovation, sustainable development, and international trade. Her previous work was on fostering knowledge transfer from academia and research institutes to the private sector, and she is currently working on environmental issues, biotechnology and nontariff barriers to trade.

PHILIPPE KUHUTAMA MAWOKO, a Congolese national (Democratic Republic of Congo (DRC)), Philippe Kuhutama Mawoko is the interim director of the African Union Observatory for Science, Technology, and Innovation (AOSTI) based in Malabo, the Republic of Equatorial Guinea. He joined the Commission of the African Union in 2011 to help set up AOSTI. He is presently teaching mathematics and statistics at the newly created University of Kwango in DRC. Dr. Mawoko currently serves on the advisory board of the United Nations University Maastricht Economic and Social Research Institute on Innovation and Technology (UNU-MERIT). He is also a member of the advisory board of the Global Innovation Index. Prior to joining AOSTI, he coordinated the African Science, Technology & Innovation Indicators Initiative (ASTII) and the African Mathematical Institutes Network for the Office of Science and Technology (OST) of the NEPAD Planning & Coordinating Agency. Before that, he worked as the program manager for the NEPAD e-Africa Commission. Former minister of post and telecommunications in the DRC, Dr. Mawoko led the initial policy reform in the sector. He also served as senior consultant, forecasting new telecommunication products and services in the marketing division of Telkom South Africa. He worked as a senior consultant at NedCoBank in South Africa. In the 1990s, he took a lectureship at the University of Zimbabwe in Harare and at the National University of Lesotho in Roma. He holds a PhD in mathematics from the University of Salzburg in Austria (1988).

FABIO MONTORBIO is Associate Professor of economics at the Department of Economic Policy, Università Cattolica del Sacro Cuore in Milan, Italy, contract professor at Bocconi University and visiting fellow at iCRIOS (Bocconi University) and BRICK at the Collegio

Carlo Alberto, Turin, Italy. Fabio Montobbio's research interests include the economics of innovation, the economics of patents, university knowledge transfer, the new economics of science and technology, and development. His teaching activities include industrial economics, economics of innovation, and intellectual property rights. He has several publications in international journals, including the *Scandinavian Journal of Economics, Industrial and Corporate Change, World Development, Research Policy*, and the *Journal of Economic Behavior and Organization*.

FERNANDA DE NEGRI is a research leader at the Institute for Applied Economic Research (Ipea). She holds a PhD in economics from the University of Campinas (UNICAMP) and was visiting researcher at the Massachusetts Institute of Technology in 2015 and 2017 and at Harvard University in 2017. She has always been interested in the effects of science and new technologies on the economy, business competitiveness, and productivity. In the public sector, she held positions related to public policies for productivity and science and technology: she was economic advisor to the Minister of Development, Industry and Foreign Trade (2008) and head of the Monitoring and Evaluation Office of the Ministry of Science and Technology (2010–2012). She was also director (2012–2017) and deputy director (2009–2010) of Ipea. She is the author of several articles and books and received the BNDES economics award for her dissertation on the commercial performance of foreign companies in Brazil. In 2014, the book she organized on *Productivity in Brazil* was a finalist in one of the most prestigious literature prizes in the country: the Jabuti Prize.

CHUNYAN PENG, senior research fellow, CDI, CASTED, MOST, Beijing, China. Chunyan Peng obtained a bachelor of economics from Shandong University of Finance and Economics in Jinan and a master's and a doctorate of economics from Renmin University of China. She has contributed to several working papers on Chinese innovation strategy, the law on promoting the transformation of S&T achievements, and Chinese technology transfer policies. She has authored and co-authored several papers and books on innovation.

AMIT SHOYON RAY is Professor of economics at the Centre for International Trade and Development of the School of International Studies in Jawaharlal Nehru University, New Delhi. He was educated at Presidency College, Calcutta, and at the University of Oxford from where

he received his DPhil in economics in 1988. Professor Ray is a development economist and his primary research areas include the economics of technology and intellectual property rights, the economics of health, the pharmaceutical industry, WTO-TRIPS, foreign direct investment, and a wide range of policy issues pertaining to India's development experience. He has over seventy-five research publications including six books and short monographs plus several articles in reputed international journals and edited volumes. Professor Ray has held teaching and research positions at premier universities and institutions in India and abroad, including Oxford University Institute of Economics and Statistics, International Food Policy Research Institute, Washington, DC, Jawaharlal Nehru University, New Delhi, University of Calcutta (Kolkata), Indian Institute of Technology, New Delhi. He has also served as director of the Centre for Development Studies in Trivandrum. He has been a consultant to various national and international bodies, including the Planning Commission (Government of India), the World Bank, and UNCTAD.

RAGAN ROBERTSON, technology transfer officer, University of California, Los Angeles and AUTM cabinet member, Metrics and Surveys, United States of America (U.S.). Ragan Robertson obtained a PhD in biological sciences from Columbia University in New York City. He has been actively involved in knowledge transfer for over ten years, focusing on patent protection, technology development, marketing, startups, and licensing within the life science space. He is the lead editor of the AUTM US Licensing Activity Survey, an analytical report of the patenting, licensing, and startup activities performed by US university and research institution technology transfer offices. He has also authored five peer-reviewed scientific publications.

FEDERICA ROSSI, senior lecturer, Department of Management, Birkbeck, University of London, United Kingdom. Dr. Federica Rossi holds a PhD and MSc in economics (University of Turin, Italy) and a BSc in political economy (University of Modena and Reggio Emilia, Italy). She is an expert in the economics of innovation, including innovation and higher education policy. She has published extensively in peer-reviewed journals on innovation policy evaluation, university–industry collaboration networks, universities' knowledge transfer management, and performance evaluation.

BHAVEN SAMPAT is an associate professor in the Department of Health Policy and Management at Columbia University and a research associate



at the National Bureau of Economic Research. Most of his research focuses on issues at the intersection of health policy and innovation policy. His current work includes (1) various empirical studies of drug and life science patent policy in the U.S. and developing countries; (2) evaluating the validity of different approaches to measure science, innovation and science–technology linkages; (3) examining whether and when science is self-correcting; and (4) assessing the impact of federal indirect cost recovery policy on the biomedical research enterprise. His previous work includes research on the political economy of the national institutes of health, patent examination and patent quality, and the roles of academic patenting in university–industry knowledge transfer. He has written numerous articles and a book on the effects of the US Bayh-Dole Act on academic patenting and knowledge transfer.

HOCHUL SHIN, researcher, Center for Distributive Justice, Seoul National University, Republic of Korea. Hochul Shin obtained a PhD in economics from Seoul National University in Republic of Korea. His research area includes innovation, trade, institution, growth, and inequality. He has published several papers about trade, industrial policy, finance, and inequality in peer-reviewed journals.

SI KYONG SUNG, deputy director, Intellectual Property Utilization Division, Korean Intellectual Property Office (KIPO), Daejeon, Republic of Korea. Si Kyong Sung obtained a bachelor of mechanical engineering and a master of mechanical engineering from Korea Advanced Institute of Science and Technology (KAIST) in Daejeon, Republic of Korea. He was a senior research engineer in LG Electronics and co-invented several system air-conditioners.

H. J. M. (HENRI) THEUNISSEN, chief valorization officer of Maastricht University and the Brightlands Maastricht Health Campus and CEO of Knowledge Transfer Funds BV. Henri graduated in biology (Radboud University Nijmegen), holds a PhD in molecular biology (NKI, University of Amsterdam), and was a post-doc in immunohematology (Central Lab of Blood Transfusion, Amsterdam). He worked at Organon International (later Schering-Plough and Merck) in the cardiovascular and reproductive medicine programs and as head of the genomics & bioinformatics group. As an expat in Cambridge, Massachusetts, U.S., he focused on biotechnology, immunology, and oncology as a senior director, Global Strategy, Portfolio Management and Research



Alliances, and as vice president and officer of Diosynth RTP, North Carolina, U.S. He was also an MT member of Nobilon BV (Boxmeer) for business development and strategic marketing of human vaccines.

ANTENOR CESAR VANDERLEI CORRÊA, science and technology senior analyst, Ministry of Science, Technology, Innovations and Communications, Brazilian Federal Government. Antenor Cesar Vanderlei Corrêa has worked for the Ministry of Science, Technology, Innovations, and Communications (MCTIC) since 1985, where he has held various positions in sectors related to industrial, scientific, and technological policy, especially in the area of information and communication technology. He holds a bachelor's degree in engineering from the University of Brasilia, Brazil, and a master's degree in manufacturing systems engineering from the University of Warwick, United Kingdom.

LIEN VERBAUWHEDE KOGLIN, counsellor, IP Policies for Universities, Small and Medium-sized Enterprises and Entrepreneurship Support Division, World Intellectual Property Organization (WIPO). Lien Verbauwhede Koglin obtained a bachelor of law from the Catholic University of Leuven (KUL), Belgium, and the University of Granada, Spain. She also holds a master of law from the Wilhelms-University of Münster, Germany. She has co-authored a series of WIPO publications on IP for businesses and is the main author of the *WIPO IP Policy Template for Academic and Research Institutions*. She currently spearheads WIPO's activities to assist universities and research institutions in designing and implementing IP policies, and facilitating academic knowledge transfer and commercialization. Before joining WIPO, she was an IP lawyer at Linklaters, Brussels, and Lalive & Partners, Geneva.

BART VERSPAGEN is the director of UNU-MERIT and the chair of international economics, Economics Department of Maastricht University, the Netherlands. Bart is an economist specialized in the economics of innovation, growth, and development. He did his undergraduate studies at the University of Limburg (now called Maastricht University) in Maastricht from 1984 to 1988. He obtained a PhD from the same university in 1992. During the subsequent five years, he held a scholarship from the Royal Netherlands Academy of Arts and Sciences (KNAW). In 1998, he became a professor at Eindhoven University of Technology. In 2008, he moved back to Maastricht University, where he became a professor of international economics. In

2012, he became director of UNU-MERIT. Verspagen's research interests are centered on the process of economic growth and development, especially its relation to innovation and technological change. His research field also covers areas such as international trade, development economics, industrial dynamics, economic history, and applied econometrics, statistics, and mathematical modeling. With regard to the last, he has mainly been applying evolutionary models to economic issues.

CRISTIANE VIANNA RAUEN is general coordinator of professional education at the Brazilian Ministry of Education. She holds a PhD in economics from the University of Campinas (UNICAMP) and was visiting doctoral researcher at Columbia University in 2011. Throughout her career, Cristiane has specialized in topics associated with science, technology and innovation, performing research, teaching, consulting, and public policy formulation activities. She has been a Brazilian civil servant since 2011, holding positions in different organizations, such as the National Institute of Metrology, Quality, and Technology (Inmetro, 2011–2013), where she served as leader of the technology project incubator; Ministry of Science, Technology, and Innovation (MCTI, 2013–2019), where she held the position of advisor to the executive-secretary; Brazilian Institute of Information in Science and Technology (IBICT, 2015–2017), where she worked as a researcher; Institute for Applied Economic Research (Ipea, 2015–2018), where she served as visiting researcher; and, currently, is with the Ministry of Education.

ROSEMARY WOLSON has a bachelor of sciences (hons) in microbiology, a bachelor of law (LLB) and a master of philosophy (MPhil), all from the University of Cape Town. She chairs a committee of the Association of University Technology Managers (AUTM) which awards scholarships to new entrants to the profession from developing economies and is a member of the Public Interest Intellectual Property Advisors Advisory Board. She has previously served on the National Intellectual Property Management Office Advisory Board; the Southern African Research & Innovation Management Association Committee; the NEPAD-Southern Africa Network for Biosciences Working Group on Intellectual Property, Indigenous Knowledge and Benefit-Sharing Guidelines; the steering committee for Tilburg University, the Netherlands, Intellectual Property Rights and Development Project and as a lead analyst for the Global Energy Assessment Knowledge Module on Policies for Capacity

Development. She is passionate about innovation and its potential to change lives for the better.

SACHA WUNSCH-VINCENT is Head of section in the Department for Economics and Data Analytics at the World Intellectual Property Organization (WIPO) and co-editor of the Global Innovation Index. He joined WIPO in 2010 to help set up WIPO's economics work under the chief economist, including the *World Intellectual Property Report*. Before joining WIPO, he was an economist at the OECD Directorate for Science, Technology, and Industry for seven years. Before that, he was Swiss national science fellow at the Berkeley Center for Law and Technology (University of California, Berkeley, U.S.) and the Peterson Institute for International Economics (Washington, DC). Sacha holds a master in international economics from the University of Maastricht with a master's thesis at MERIT and a PhD in economics from the University of St. Gallen, Switzerland. He teaches international economics at Sciences Po Paris, and the World Trade Institute in Bern.

LIU XIA graduated from Shanghai University of Finance and Economics, after which she gained her doctorate in quantitative economics in the European Center for Advanced Research in Economics and Statistics (ECARES) from Université de Bruxelles. She has worked as an academic visitor in the Center for Law and Economics at ETH Zurich and as a post-doctorate researcher in the School of Management, Zhejiang University, China. Her research fields include innovation policy, IP management, and applied micro-econometrics. She currently belongs to the Shanghai International College of Intellectual Property, Tongji University, China.

JUAN YANG, research fellow, CDI, CASTED, MOST, Beijing, China. Juan Yang obtained a bachelor of economics from Central China Normal University and got her master of economics from Zhongnan University of Economics and Law, Wuhan, China. She also holds a doctorate degree in economics from the Renmin University of China. She used to be a visiting scholar in Boston University and a clinical researcher for the Shriners Hospitals for Children based in Boston, and also a fellow of WIPO in Geneva, Switzerland. She contributes to some joint research projects on China's foreign direct investment and IP performance evaluation. She is a core member of research projects on China's S&T open innovation strategy and policies.

HU ZHIJIAN is president of the Chinese Academy of Science and Technology for Development (CASTED). He joined CASTED as a general secretary in 2009 to build CASTED into a national S&T strategic think tank. Before joining CASTED, he served as deputy director general, in the Department of Policy, Regulations and Reform of the China's Ministry of Science and Technology. His book *National Innovation System: Theoretical Analysis and International Comparison* was published by China's Social Sciences Academic Press. He holds a PhD in innovation and management from the Chinese Academy of Sciences. He also functions as secretary general of the China Federation of Scientific and Technological Institutes, vice chairman of the China Law Association on Science and Technology, and governing board member of the World Economic Forum.

HAO ZHOU, Director of Statistics, Statistics and Data Analytics, Department for Economics and Data Analytics, WIPO. Hao Zhou obtained a bachelor of science in physics from Peking University. He worked in the Chinese Patent Office as patent examiner and IPC coordinator, then for WIPO as PCT examination coordinator, IT business analyst and senior statistical analyst. He is in charge of statistical data for WIPO publications.

## FOREWORD

HU ZHIJIAN

*President, Chinese Academy of Science and Technology for Development*

Promoting public–private partnership knowledge transfer is one of common notice among countries at different economic development levels. A vital question for policymakers today is how to improve the efficiency of these knowledge transfer practices, maximizing innovation-driven growth.

No unique knowledge transfer blueprint is recognized as time-tested and universally optimal. The Chinese government has been continuously highlighting and facilitating the transformation of scientific and technological achievements into real productive forces. The Chinese knowledge transfer law, Promoting the Transformation of Scientific and Technological Achievements, entered into force on October 1, 1996. An amendment to the law was adopted at the meeting of Standing Committee of the Twelfth National People’s Congress on August 29, 2015, and came into force on October 1, 2015. The modification mainly includes: refining the science and technology performance assessment system, improving the scientific and technological achievements disposal and distribution right systems, perfecting the market pricing mechanism of scientific and technological achievements, strengthening the awards for main scientific and technological contributors, and so on. Meanwhile, lots of high- and middle-income countries have been developing their national law and policies for spurring on the commercialization of publicly funded inventions. Unfortunately, it is not straightforward for policymakers to access information on what works and what does not. Initial evidence indeed suggests that different approaches are needed for different stages of economic development and even for specific sectors. Nevertheless, these experiences and lessons need refining to be used by political makers.

With this in mind, in 2015, under the auspices of the World Intellectual Property Organization (WIPO) and *most* of China, a joint research project on knowledge transfer policies and practices was

initiated with the support of some countries. Two such academic and policy workshops were held with authors and experts in July 2016 and March 2017 to validate the research focus and unify methodologies. We have compiled the main research results into this book.

The main contribution of this book is twofold: To start with, the book develops a conceptual framework to evaluate knowledge transfer practice and outcomes. It provides a six-country study in the same conceptual framework, three middle- and three high-income countries, and also puts forward a standardized set of metrics for assessing national or institutional performance relevant to both high- and middle-income countries' development. With all these efforts, it is possible to do an international comparison at different income levels. The country cases will reveal a wide range of approaches and a variety of tools for policymakers, professional associations, IP offices, and scholars.

I would like to take this opportunity to express my sincere gratitude to the editors and authors for their great contribution to this book. The research represents a major step toward reaching a systematic approach to the measurement of knowledge transfer practice and outcomes. It lays important groundwork for future empirical work, for the development of appropriate metrics, and for crafting new innovation policy approaches. I look forward to the WIPO contributing further valuable works on innovation, intellectual property, and economic development to better benefit its member states at large.

## FOREWORD

PIPPA HALL

*Director of Innovation and Chief Economist, Intellectual Property Office, United Kingdom*

Knowledge transfer has received considerable attention over the past few decades, and is recognized as playing a key role in a competitive knowledge-based economy. Enabling access to excellent, cutting-edge research is vital to tackling the economic, social, and environmental challenges countries face. Through knowledge transfer, public research organizations can maximize the impact of their research, delivering tangible real-world benefits. For individual businesses, it can enable them to improve performance, increase productivity and gain access to new resources and world-leading expertise. And at a national level, knowledge transfer drives economic growth and delivers social benefits. Internationally, there have been achievements in building partnerships and relationships between businesses, research organizations, and government bodies, to deliver real value. However, challenges remain, not least that of assessing the impacts of knowledge transfer initiatives in order to understand how to improve policies and practices.

This is easier said than done. How do you go about trying to evaluate these impacts? Most data collection, if any, occurs at a national level and there is no standardization of what data are collected. There also needs to be a clear understanding of how the different approaches and different channels of knowledge transfer work, such as the interplay between more open science-type approaches with the formal licensing and collaborative agreements.

This book aims to address these gaps. Its contributors are experts in their fields and provide an international perspective on the different approaches to knowledge transfer. It develops a conceptual framework to enable the evaluation of different knowledge transfer policies and practices, with a standardized set of metrics for assessing national or institutional performance. It also makes a valuable contribution in developing a new methodology for how to measure and assess the global volume and distribution of patenting activities carried out by public

research organizations. The development of a common evaluation framework on the possible costs, benefits, and impacts of knowledge transfer activities is an important step forward, providing a better evidence base on which policy decisions can be taken. By assessing the interaction of existing policies and the underlying innovation system structures, the book identifies what works best under different conditions and makes policy recommendations relevant for both high- and medium-income countries. For policymakers, it is vitally important to identify both what works and what does not work, and in what situations, in order to understand how to improve the efficiency of knowledge transfer activities in order to achieve maximum impact.

I welcome the contribution this book makes to the evaluation of knowledge transfer policies and practices, laying important groundwork for future study and the development of innovative policy approaches.



## FOREWORD

BART VERSPAGEN

*Director, UNU-MERIT*

Knowledge produced or built on by public research organizations such as universities and public research institutes is a vital source of new technologies and organizational methods that can contribute to many of the United Nations' sustainable development goals, from improvements in food security and health and a reduction in carbon emissions to economic growth. To achieve social and economic benefits of value to these development goals, relevant knowledge needs to be successfully transferred from public research organizations to firms and government organizations that can use the knowledge to improve or create new services, goods or processes.

Knowledge transfer is a complex process that involves multiple actors and channels for transmitting knowledge. The six case studies in this book for three middle-income and three high-income countries illustrate how the design of policies to support knowledge transfer needs to take into consideration the absorptive capabilities of domestic firms, the research capabilities of universities and public research institutes, and the skills of knowledge transfer professionals. For middle-income countries, in particular, these capabilities and skills are in flux. The case studies show how policies and practices to support knowledge transfer need to both promote capabilities and skills and adapt to changing conditions.

The value of this book lies in its implications for policies and practices to support knowledge transfer and in its practical recommendations to collect a comprehensive set of metrics to ensure that all forms of knowledge transfer, both formal and informal, are placed in perspective. The problems associated with a narrow set of metrics focused on patent licensing have been known for some time. This book provides evidence for why a broader set of metrics, covering contractual, consulting, and informal channels, is important to prevent undue emphasis on some forms of knowledge transfer over others.

UNU-MERIT has been pleased to support some of the work behind this book, both through the contributions of Anthony Arundel and by hosting a workshop in Maastricht in March 2017 to discuss the conceptual framework provided in Chapter 2 and the six case studies in Chapters 4 to 9. The results should be of value both to future research on knowledge transfer and to the design of policies and practices that are adapted to specific conditions within countries and within individual universities or research institutes.

## PREFACE

Universities and public research institutes play a key role in enabling the application of scientific breakthroughs and innovations in the marketplace or by government organizations. Their present and potential future contribution to the production and application of knowledge to innovation is undeniable.

To further leverage this role, many countries – developed and developing alike – have implemented national strategies to support the application or commercialization of knowledge produced by public research organizations. In addition, individual universities and public research institutes have introduced practices to support these activities, for instance, by including knowledge transfer to promote innovation as a core part of their mission.

As a result, a vital question for policymakers – and the enquiry of this book – is how to improve the efficiency of these knowledge transfer practices to help maximize innovation-driven growth and/or to seek practical solutions to critical societal challenges.

Unfortunately, it is not straightforward for policymakers or knowledge transfer practitioners to access information on what works and what does not. Countries and institutions have garnered substantial experience with diverse approaches. Yet this information has not been distilled in a way that can provide policy guidance for specific sectors or for countries at varying levels of economic development.

With this in mind, the book pursued the following three objectives:

- to develop a conceptual framework to evaluate knowledge transfer practices and outcomes
- to improve knowledge transfer metrics, surveys, and evaluation frameworks, resulting in a standardized method to assess national or institutional strategies in an internationally comparable way
- to generate findings on what works and what does not, and to propose related policy lessons.

In pursuit of these objectives, we, as the editors of this book, laid particular emphasis on three important realities.

Number one: Public–private knowledge transfer occurs through a large number of formal channels, such as licensing intellectual property (IP), contract research, and contracting, as well as through informal channels, such as the sharing of research results via personal contacts or by “open science” methods, including conferences and publications. It is important to avoid casting these channels in a mutually exclusive way. Indeed, the many forms and facets of these two channels are often not in contradiction; they have fuzzy boundaries in many cases, and they can be complementary and mutually reinforcing.

Number two: Mirroring the above point, policy options are also more numerous and less binary than implied by commentaries that either focus single-mindedly on knowledge transfer policies based on IP as the only way forward or caution that the formalization of knowledge transfer – and, to some extent, the privatization of the application of knowledge – are serious threats to the functioning of a science system based on the free flow of knowledge. In reality, institutions and countries do not have to choose between these two opposites or two radically distinct policy options. Many nuanced policy approaches are possible.

Number three: No country or institution has yet to uncover the ultimate law or tool that provides a silver bullet for achieving effective knowledge transfer to potential users. Economies and institutions worldwide still have untapped potential to better harness the role of public research for innovation. Knowledge of possible relevance to critical topics such as food security, climate change, or health remains tied to books, journals, and the scientific realm without making sufficient impact on innovation and the realities around us. Much of this knowledge may not be being used for other reasons, for example, because the right regulatory systems are not in place or because multiple other complementary activities are needed before it can be put to use. But the potential is clearly there. This is a source of frustration but, first and foremost, also of important hope for the years to come as we get better at making public research more useful to economies and societies worldwide.

These three points are recurrent themes that underlie this book. They also make the topic of this book timely and particularly important.

Many institutions and individuals deserve thanks for their contributions. The main trigger for this book was a discussion and agreement in 2016 among the then minister of the Ministry of Science and Technology

of the People's Republic of China (MOST), Wan Gang, and WIPO's director general, Francis Gurry, that more international work is needed in the field of knowledge transfer practices.

Under the minister of MOST, Wang Zhigang, this book's work with respect to China and a workshop were subsequently financially supported and coordinated by Lin Xin, DG, Zhang Jiejun, (Deputy Director General, DDG), Sun Yongjian (former DDG), and Zhang Bingqing (DDG), all from the Department of Policy, Regulation, and Innovation System within MOST.

For their steady support to this the project, we are also indebted to the Chinese Academy of Science and Technology for Development (CASTED) and its President Hu Zhijian. In particular, we thank Chen Baoming, DDG, and Juan Yang, who was supported by CASTED to work as a WIPO fellow for more than a year on this project, and the staff of the CASTED Institute of Comprehensive Development.

In addition, there are many individuals and other organizations to thank for their help with this book – too many to list. First and foremost, special thanks go to the outstanding authors of the country studies that accompanied this project for close to four years. It is rare to be able to work with such an outstanding cast of academics from Asia, Europe, and Latin America. This rollcall was complemented by notable experts from IP offices, by knowledge transfer practitioners, and by leading policy-makers. Particular thanks to the South African National IP Management Office, the IP Office of the United Kingdom, and the Korean IP Office, as well as the Brazilian Ministry of Science, Technology, Innovations, and Communications. Rosa Fernandez at the Department for Business, Energy, & Industrial Strategy, Adrian Day, Lorena Rivera León, and Antanina Garanasvili provided data and analysis for Chapter 1.

We would also like to thank all participants for their contributions to two associated workshops on the International Comparison of Knowledge Transfer Policies and Practices. The first was held with MOST and CASTED in Beijing, July 2016, and the second at the United Nations University, Maastricht Economic and Social Research Institute, on Innovation and Technology (UNU-MERIT) in March 2017.

This collaboration also showed that knowledge can flow in all directions. While high-income economies and their institutions have extensive experience with knowledge transfer policies and practices, many new experiences are emerging in middle-income economies such as Brazil, China, India, and others. These innovative experiences are a possible source of learning for all other countries.

Thanks for substantive comments go to the editorial advisory board of this book series, Mark Wu, Megan Macgarvie, and Beth Webster, as well as the academic reviewers of this project, Fabio Montobbio and Bhaven Sampat, and also to Carsten Fink, WIPO's chief economist.

Excellent editing was provided by Tobias Boyd, then at WIPO. The project management support and oversight by Charlotte Beauchamp, Head of Publications and Design at WIPO is acknowledged with thanks.

We hope that this book will open a window to future work assessing the diversity of knowledge transfer policies and practices. Its purpose is to lay the groundwork for future empirical work, for the development of appropriate metrics, and for crafting new innovation policy approaches. Ideally, the survey and evaluation framework can also be deployed by WIPO or by other organizations to yield comparable data from multiple countries over time.

*Anthony Arundel, Suma Athreya, and Sacha Wunsch-Vincent  
Maastricht, Southend-on-Sea, and Geneva*

DISCLAIMER

The views expressed herein are those of the authors and do not necessarily reflect the views of the World Intellectual Property Organization (WIPO) or its member states.

Cambridge University Press

978-1-108-84279-2 — Harnessing Public Research for Innovation in the 21st Century

Edited by Anthony Arundel , Suma Athreye , Sacha Wunsch-Vincent

Frontmatter

[More Information](#)

---