

BRICS

NATIONAL SYSTEMS OF INNOVATION

The
**Role
of the
State**

EDITORS

Mario Scerri | Helena M. M. Lastres



The Role of the State

BRICS ■ NATIONAL SYSTEMS OF INNOVATION

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List of Abbreviations

ANC	African National Congress
APL	Local Productive Arrangements (Arranjos Produtivos Locais)
AsgiSA	Accelerated and Shared Growth Initiative for South Africa
BASIC	Brazil, South Africa, India, and China
BIPP	Biotechnology Industry Partnership Programme
BNDES	National Bank of Economic and Social Development (Banco Nacional de Desenvolvimento Econômico e Social)
Bolsa Familia	Poor Family Support Pension
BPC/LOAS	Social Benefit/Social Security Act
BRIC	Brazil, Russia, India, and China
BRICS	Brazil, Russia, India, China, and South Africa
CadÚnico	Unified Register of Social Programs
CAE	Chinese Academy of Engineering
CAPES	Coordination of Qualification of Graduate Human Resources (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior)
CAS	Chinese Academy of Sciences
CASS	Chinese Academy of Social Sciences
CEPAL	The Economic Commission for Latin America and the Caribbean (ECLAC)
CIDE	Tax on Intervention in the Economic Field (Contribuição de Intervenção do Domínio Econômico)
CII	Confederation of Indian Industry
CLTD-2020	Conception of a Long-Term Development of the Russian Federation until 2020
CNI	National Confederation of Industry (Confederação Nacional da Indústria)
CNPq	National Council of Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico)
COSATU	Congress of South African Trade Unions

COMECON	Council for Mutual Economic Assistance
CPC	Communist Party of China
CSIR	Council for Scientific and Industrial Research
CTA	Aerospace Technical Centre (Centro Técnico Aeroespacial)
DACST	Department of Arts, Culture, Science, and Technology
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DHET	Department of Higher Education and Training
DOD	Department of Ocean Development
DoE	Department of Education
DOEn	Department of Environment
DoL	Department of Labour
DoS	Department of Space
DRDO	Defence Research and Development Organisation
DSIR	Department of Scientific and Industrial Research
DST	Department of Science and Technology
DTI	Department of Trade and Industry
DTI	Scholarship for Industrial and Technological Development (Desenvolvimento Tecnológico e Industrial)
EMBRAPA	Brazilian Agricultural Research Corporation
ESKOM	Electricity Supply Commission
ESTD	Early Stage Technology Development
EU	European Union
FAIR	Facility for Antiproton Reactor and Ion Research
FAST	Fund for Accelerating Start-ups in Technology
FBA	Federal Budget Allocations on R&D
FDI	Foreign Direct Investment
FERA	Foreign Exchange Regulation Act
FICCI	Federation of Indian Chambers of Commerce and Industry
FINEP	Studies and Projects Funding Agency (Financiadora de Estudos e Projetos)
FNDCT	National Fund of Scientific and Technological Development (Fundo Nacional de Desenvolvimento Científico e Tecnológico)
FPP	Family Pension Programme
FTE	Full-time Equivalent

FUNTEC	Technological Fund
GDP	Gross Domestic Product
GEAR	Growth Employment and Redistribution: A Macroeconomic Strategy
GERD	Gross Expenditure on Research and Development
HEI	Higher Education Institution
HSE	State University, Higher School of Economics (Moscow)
HSRC	Human Sciences Research Council
IBGE	Brazilian Institute of Geography and Statistics
IBSA	India, Brazil and South Africa
ICAR	Indian Council of Agriculture Research
ICICI	Industrial Credit and Investment Corporation of India
ICMR	Indian Council of Medical Research
ICT	Information and Communication Technology
IDC	Industrial Development Corporation
IDRC	International Development Research Centre
IITs	Indian Institutes of Technology
INPE	National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais)
INR	Indian Rupee
INSPIRE	Innovation in Science Pursuit for Inspired Research
IPCA	Inflation Rate
IPEADATA	Database on Brazilian economy
IPRs	Intellectual Property Rights
ISCOM	Iron and Steel Corporation of South Africa
IT-BPO	Information Technology and Business Process Outsourcing
ITER	International Thermonuclear Experimental Reactor
ITIs	Industrial Training Institutes
JIPSA	Joint Initiative on Priority Skills Acquisition
LDB	Law of Fundamentals and Guidelines for Education (Lei de diretrizes e Bases da educação)
Lei da Inovação	Law of Innovation
Lei do Bem	Law of the Goods

MCT	Ministry of Science and Technology (Ministério da Ciência e Tecnologia)
MDIC	Ministry of Development, Industry and Foreign Trade (Ministério do Desenvolvimento, Indústria e Comércio Exterior)
MEC	Ministry of Education (Ministério da Educação)
MIIT	Ministry of Industry and Information Technology
MIT	Ministry of Information Technology
MNES	Ministry of Non-conventional Energy Sources
MOE	Ministry of Education
MS&T	Ministry of Science and Technology
M RTP	Monopolies and Restrictive Trade Practices
MS	Ministry of Health (Ministério da Saúde)
MSE	Micro and Small Enterprise
MTE	Ministries of Labour and Employment (Ministério do Trabalho e Emprego)
NACI	National Advisory Council on Innovation
NASSCOM	National Association of Software and Service Companies
NCR (Delhi)	National Capital Region (Delhi)
NCST	National Council of Science and Technology
NDRC	National Development and Reform Committee
NEPAD	New Partnership for African Development
NGP	New Growth Path
NIS	National Innovation System
NMITLI	New Millennium Indian Technology Leadership Initiative
NNSF	National Natural Science Foundation
NRDC	National Research Development Corporation
NRDS	National Research and Development Strategy
NRF	National Research Foundation
NRGES	National Rural Employment Guarantee Scheme
NRH	National Rural Health Mission
NSERB	National Science and Engineering Research Board
NSI	National System of Innovation
OBMEP	Brazilian Mathematics Olympiad of Public Schools
OECD	Organisation for Economic Cooperation and Development
PAC	Programme for the Acceleration of Growth (Programa de Aceleração do Crescimento)

PACTI	Action Plan for Science, Technology and Innovation
PDE	Plan for Development of Education
PDP	Policy for Production Development
PDTA	Programme for Agricultural Technological Development
PDTI	Programme for Industry Technological Development
Petrobras	Brazilian Energy Company
PINTEC	Brazilian Survey on Technological Innovation
PISA	Programme for International Students Assessment
PITCE	Industrial, Technological and Foreign Trade Policy (Política Industrial, Tecnológica e de Comércio Exterior)
PMO	Prime Minister's Office
PNCTI	National Policy of Science, Technology and Innovation
PPP	Public-private partnership
PRDSF	Pharmaceutical R&D Support Programme
PRO-AERO- NÁUTICA	Programme for Financing to Enterprises from the Brazilian Aeronautical Production Chain
PROFARMA	Programme of Support to the Development of the Health Industrial Complex
PROSET	Stimulus to Retention of Human Resources of Interest to Sectoral Funds
PROSOFT	Development of Software Industry and Services Information Technology
PROTVD	Programme of Support to Implementation of the Brazilian System of Terrestrial Digital TV
PRS	Public Research System
PURSE	Promotion of University Research and Science Excellence
R&D	Research and Development
RDP	Reconstruction and Development Programme
Real Plan	Plan for Economic Stabilisation (Plano Real)
RedeSist	Research Network on Local Innovative Production Arrangements and Systems
RGPS	General Regime of Social Security
RHAE- Inovação	Human Resources for Strategic Activities-Innovation

RISDP	Regional Indicative Strategic Development Plan
RMV	Life Monthly Pension (Renda Mensal Vitalícia)
Rosnano	Russian Corporation for Nanotechnology
Rosstat	Russian State Statistical Service
RSA	Republic of South Africa
RVC	Russian Venture Company
SADC	South African Development Community
S&T	Science and Technology
SAEB	The System for Assessment of Basic Education (Sistema de Avaliação da Educação Básica)
SARChI	South African Research Chairs Initiative
SCI	Science Citation Index
SETEC	Secretariat of Technological Development and Innovation
SMEs	Small- and Medium-scale Enterprises
SPR	Scientific Policy Resolution
SPREAD	Sponsored Research and Development
SPRU	Science Policy Research Unit
SSI	Sectoral System of Innovation
STIs	Scientific and Technological Institutions
STPs	Software Technology Parks
STPIs	Software Technology Parks of India
TDDP	Technology Development Demonstration Programme
TELECE-	
NTROS	Community centres for Internet access
TePP	Techno-Entrepreneur Promotion Programme
TIA	Technology Innovation Agency
TIFAC	Technology Information Forecasting and Assessment Council
TNCs	Transnational Corporations
TV-PROTVD	Brazilian System of Terrestrial Digital
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USSR	Union of Soviet Social Republics
USTP	University Science and Technology Park
VA	Value-added
VAT	Value-added tax
VTC	Vocational Technical Centres (Centros Vocacionais Tecnológicos)
WTO	World Trade Organization

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Foreword

If there are any reservations about the importance of intensified cooperation between Brazil, Russia, India, China, and South Africa, this book will speedily dispel them. The usual reservations are based on doubts about economic complementarities and fears that all developing countries rely mainly on natural resource endowments and are therefore unable to trade with each other. This book shows that there is ample scope for comparative studies and hence cooperation in science and technology, and hence innovation for the mutual benefit of each.

The book also shows beyond any doubt that the state has a crucial role in sponsoring innovation, directly and indirectly, thereby leading a process that is often well-supported by the private sector. An essential foundation for innovation is obviously strong mathematics and science in schools and universities. However, state institutions are also vital for providing leadership, setting the pace, providing incentives, and in many other ways.

The history of state leadership is particularly striking in post-independence India when Nehru insisted on a modernisation programme which has been built on by succeeding leaders, not least of whom the current Prime Minister. Indeed, the chapter on India is an inspiring story of the deliberate actions by a government in an underdeveloped country striking out to develop science and technology to break through the legacy of backwardness. Would that other countries were equally determined and decisive!

The contrast, the chapter on China, is surprising. China's industrialisation path was initially based on natural resource endowments and has only recently pressed forward with innovation seriously. This may be because the Asian Tigers initially adopted the policy of last-stage assembly in factories introduced from developed countries. This meant that the relevant research and development was denied them for a long time. It seems that China and others first concentrated on the introduction of technology and equipment with short-term efficiency objectives. However, it is obvious that they have caught up and are now capable of designing their own

innovation systems which are clearly essential to sustain their high growth rates.

The case of Brazil is of great interest. In recent decades the state has resorted to a variety of institutions to boost science and technological development. Each step reflected a realisation that Brazil ought not to depend on the importation of US capabilities. The establishment of the National Bank for Social and Economic Development (BNDES) is an outstanding example of a country seeking an original approach to the harnessing of capital for industrial investment. The results are astounding and the impact on GDP growth very significant.

The story from Russia is less inspiring, though there too big advances are underway. The South African case is perhaps the least encouraging, though there has been a significant advance in spending on R&D recently. The problems here are very fundamental, starting in the schooling system, and the lack of drive at the universities to promote mathematical sciences. The efforts of the innovative African Institute of Mathematical Sciences are embryonic but influential because its teaching is based on problem solving, and thereby shows what can be done.

The challenge in South Africa is all the greater for the recent revelation by Citigroup Global Markets that it has over US\$ 2.5 trillion of non-energy monetary reserves making it the richest nation when assessed by the in situ value of its natural resources. South Africa is in the top 15 countries with gold, iron ore, nickel, and platinum group metal reserves. This poses an enormous challenge for innovative work to ensure that beneficiation follows on exploration, leading to fabrication.

Fundamental to all this is the financial contribution of the state. As we have now learnt with respect to the international financial crisis, the market alone cannot fix a country's inadequacies. According to Ha-Joon Chang, 40 to 60 per cent of R&D in the United States is provided by the state. It is well-known that their university research benefits enormously from their military budget even if the grants are often disguised. However, it is not only the state that has a responsibility. We are informed that in India gross expenditure on research and development is 68 per cent from government sources and 30 per cent from the business enterprise sector. Surely others can learn from this example.

This book raises the platform of discourse on development to a higher level. It escapes from the narrow confines of trade and investment policy, and reaches out to the more remote spaces of scientific innovation. It is an exciting journey.

Ben Turok

Member of Parliament
African National Congress
South Africa
May 2010

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Preface

This book is the result of a collaborative effort of several people and institutions. The contributions presented here consolidate the findings of the project ‘Comparative Study of the National Innovation Systems of BRICS’ sponsored by the International Development Research Centre (IDRC). The project is rooted in a larger research effort on BRICS national innovation systems being developed in the sphere of the Global Research Network for Learning, Innovation and Competence Building Systems — Globelics. The Globelics initiative on BRICS economies brings together universities and other research institutions from Brazil, Russia, India, China, and South Africa. The aim is to strengthen an original and less dependent thought, more appropriate to understanding development processes in less developed countries.

First and foremost, we would like to thank Professor Bengt-Ake Lundvall, the coordinator of Globelics, who supported and promoted the BRICS project from the outset in 2003 and organised the First International Workshop of the BRICS Project in Aalborg, Denmark, in 2006. Without his leadership and enthusiasm the project could not have taken off.

We owe special thanks to project researchers and coordinators for their engagement in project activities and accessibility to overcome difficulties that naturally emerge from the geographical and cultural diversity of BRICS. We are also very grateful to those who provided the necessary administrative and secretarial support that resulted in the good performance of this project, especially Luiza Martins, Fabiane da Costa Morais, Tatiane da Costa Morais, and Eliane Alves who helped in editing activities and whose support was crucial for formatting the manuscript and organising the tables and figures. Max dos Santos provided the technical IT support for the research network.

The core ideas analysed in this book were discussed at international seminars organised in Brazil (2007), South Africa (2008), India (2009), and again in Brazil (2009) under the auspices of the BRICS Project, gathering scholars, academics, policy makers, businessmen,

and civil society representatives. Our understanding of this complex theme has evolved considerably thanks to the seminar participants' constructive criticism. We are grateful to them as well as to all the other people not named here who also helped in the implementation of the project.

None of this work would have been possible without financial support. The support given by the IDRC was essential for the completion of this project. We are very obliged to IDRC and their staff for their support. We would especially like to thank Richards Isnar, Federico Buroni, Gustavo Crespi, Veena Ravichandran, Isabel Bortagaray, and Clara Saavedra. We are also grateful to Bill Carman and Michelle Hibber, then IDRC Publishers, for the technical assistance provided in the preparatory work that led to this publication.

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