

BRICS

NATIONAL SYSTEMS OF INNOVATION

**Inequality
and
Development
Challenges**

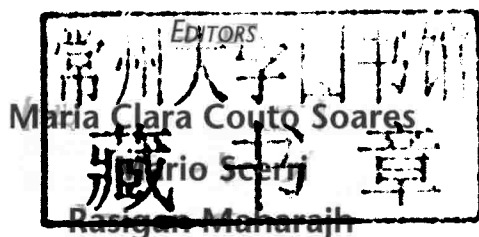
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Series Editors: **José E. Cassiolato**, Federal University of Rio de Janeiro, Brazil.

Maria Clara Couto Soares, Federal University of Rio de Janeiro, Brazil.

This series of books brings together results of an intensive research programme on aspects of the national systems of innovation in the five BRICS countries — Brazil, Russia, India, China and South Africa. It provides a comprehensive and comparative examination of the challenges and opportunities faced by these dynamic and emerging economies. In discussing the impact of innovation with respect to economic, geopolitical, socio-cultural, institutional and technological systems, it reveals the possibilities of new development paradigms for equitable and sustainable growth.

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List of Abbreviations

AI	Africa Institute
AIDS	Acquired Immunodeficiency Syndrome
ARC	Agricultural Research Council
ATM	Automatic Teller Machine
BBBEE	Broad-based Black Economic Empowerment
BC	Backward Classes
BEE	Black Economic Empowerment
BNDES	National Bank for Economic and Social Development
BRICS	Brazil, Russia, India, China and South Africa
BRT	Bus Rapid Transit System
CDOT	Centre for Development of Telematics
CHIPS	Chinese Household Income Project Survey
CNI	National Confederation of Industry-Brazil
CNPq	National Council for Scientific and Technological Development
CSIR	Council for Scientific and Industrial Research
CSLS	Centre for the Study of Living Standards
CULS	China Urban Labour Survey
CUT	Central University of Technology
CV	Coefficient of Variation
DoL	Department of Labour
DPE	Department of Public Enterprise
DSIR	Department of Scientific and Industrial Research
DST	Department of Science and Technology
DTI	Department of Trade and Industry
ECLAC	Economic Commission for Latin America and the Caribbean
FASIE	Foundation for Assistance to Small Innovational Enterprises
FDI	Foreign Direct Investment
FERA	Foreign Exchange Regulation Act
FET	Further Education and Training
FFC	Financial and Fiscal Commission
FINEP	Studies and Projects Finance Organisation

FIRE	Finance, Insurance, Real Estate, and Business Services
GC	Gini Coefficient
GDP	Gross Domestic Product
GER	Gross Enrolment Ratio
GERD	Gross Domestic Expenditure on Research and Development
GGP	Gross Geographic Product
GNI	Gross National Income
GRP	Gross Regional Product
HDI	Human Development Index
HEI	Higher Education Institutions
HEMIS	Higher Education Management Information System
HET	Higher Education Training
HIV	Human Immunodeficiency Virus
HRS	Household Responsibility System
HS	Harmonised System
HSRC	Human Sciences Research Council
IBGE	The Brazilian Institute of Geography and Statistics
ICT	Information and Communication Technologies
INEP	National Institute of Studies and Research on Education
IPEA	Institute of Applied Economic Research
IPEADATA	Economic Applied Research Institute Database
IPO	Initial Public Offering
IPR	Industrial Policy Resolution
IPS	Industrial Policy Statement
IT	Information Technology
LABS	Laboratory for Accelerator Based Services
LLL	Lifelong Learning
MBA	Master of Business Administration
MCT	Ministry of Science and Technology
MDIC	Ministry of Development, Industry and Foreign Trade
MOHRSS	Ministry of Human Resources and Social Security of the People's Republic of China
MPCE	Monthly Per Capita Expenditure
M RTP	Monopolies and Restricted Trade Policies
MSER	Middle School Enrolment Ratio
MSEs	Micro and Small Enterprises

NACI	National Advisory Council on Science and Technology
NCEUS	National Commission for Enterprises in the Unorganised Sector
NGO	Non-Governmental Organisation
NIS	National Innovation System
NRD	National Experimental Research and Development Survey
NSDP	Net State Domestic Product
NSI	National System of Innovation
OBC	Other Backward Castes
OECD	Organisation for Economic Co-operation and Development
PASTER	Programme aimed at Technological Self-Reliance
PC	Personal Computer
PEA	Economically Active Population
PINTEC	Survey on Technological Innovation
PL	Poverty Line
PNAD	National Household Sample Survey
POF	Consumer Expenditure Survey
PPP	Purchasing Power Parity
PSER	Primary School Enrolment Ratio
R&D	Research and Development
RFBR	Russian Foundation for Basic Research
RSA	Republic of South Africa
RSFSR	Russian Soviet Federative Socialist Republic
S&T	Science and Technology
SALT	South African Large Telescope
SC	Scheduled Castes
SCE	Secondary Certificate Examination
SEBRAE	The Brazilian Service of Support for Micro and Small Enterprises
SECEX	Department of Foreign Trade
SET	Science, Engineering, and Technology
SET4W	Science, Engineering and Technology: Permanent Sub-Committee of NACI
SETA	Sector Education and Training Authority
SEZ	Special Economic Zone
SIM	Subscriber Identity Module
SIP	Statement on Industrial Policy

SIRO	Scientific and Industrial Research Organisations
SME	Small and Medium Enterprise
SMS	Short Message Service
SPR	Science Policy Resolution
ST	Scheduled Tribes
StatsSA	Statistics South Africa
STI	Science, Technology and Innovation
TDDP	Technology Development and Demonstration Programme
TNCs	Transnational Corporations
TPS	Technology Policy Statement
TVEs	Township and Village Enterprises
ULC	Unit Labour Costs
UNDP	United Nations Development Programme
USD	United States Dollar
USSR	Union of Soviet Socialist Republics
VC	Venture Capital
ZAR	South African Rand

Foreword

Inequality is one of the most deeply rooted characteristics of under-development. It is also present in highly industrialised countries, but its magnitude and consequences in developing countries are overwhelming. Moreover, a marked difference in the level of inequality has been suggested as a main cause of divergences in the process of development (Lindegarde and Tylecote 1998).

There are two characteristics concerning inequality worth recalling. One is that fighting inequality is like fighting a mobile target. Once something important, for instance, an innovation capable of saving children, is available only for some children, inequality rises. To keep inequality at bay is a permanent task. The second characteristic is that inequality is perceived as particularly damaging for social cohesion. As Albert Hirschman put it, tolerance to inequality is '... like a credit that falls due at a certain date. It is extended in the expectation that eventually the disparities will narrow again. If this does not occur, there is bound to be trouble and, perhaps, disaster' (1981: 40). Fighting inequality is one of the means to consolidate democracy.

Inequality has, obviously, many faces. The following quote gives an accurate perspective on the issue:

To speak of a social inequality is to describe some valued attribute which can be distributed across the relevant units of a society in different quantities, where 'inequality' therefore implies that different units possess different amounts of this attribute. The units can be individuals, social groups, communities, nations; the attributes include such things as income, wealth, status, knowledge, and power (Wright 1994: 21).

Throughout this book, the reader will find that several such units are analysed, including those characterised by gender, ethnicity, geography, and class. The attributes are also diverse, and are combined in such a way that the issue of quality of life and life opportunities is highlighted for the different nations that constitute the BRICS group.

Innovation has to do with inequality, and as this book rightly points out, inequality also influences innovation. From a developmental point

of view, a main issue is to orient innovation efforts in a direction that diminishes inequality, and to make inequality a point of departure for innovation efforts. The way inequality is conceptualised is important in this regard. If the concept is restricted to income inequality, the role of innovation appears to be mainly related to economic growth. Innovation is associated in this way to the positive trickle-down effect that economic growth is expected to have on inequality. The problem in this regard is twofold. On the one hand, even with pro-active social redistributive policies, historical experience shows that people left behind form a hard core of important dimension. On the second hand, if inequality is expressed in highly differential qualities of social services, like education or health, inequalities in the quality of life are impossible to diminish only with money, even if differences in income are narrowed. This is due to the fact that the investments needed to narrow the gap of well-being in its multiple aspects, if intended by simply 'individual catching-up', are prohibitive. Here innovation is called into action.

The ways in which innovation can help to fight inequality depend on the type of inequality, but some general comments can nevertheless be made. As Everett Rogers remarks, innovation will probably enhance inequality there where inequality is already high. But this will not happen if innovation is designed directly to enhance equality. This is not a usual goal for innovation, but it is a possible goal for it. Innovation for equality can be unusual, but still is innovation, meaning that it must provide a solution for a problem involving something new, be it the solution itself or the way the solution is conceived or built. For innovation purposes problems need to be transformed by some agent in demands for solutions, with all the specifications that such solutions should fulfill. Specific communities, different kinds of associations (like Doctors without Borders) and business firms are examples of such agents in the case of equality-related innovations; public policy is probably the strongest one everywhere, but particularly so in developing countries.

The National Systems of Innovation approach is particularly suited for the idea of innovation directed to fight inequality. Inclusive innovation systems is a concept that suggests the kind of dynamic that links problems stemming from inequality, agents able to put forward a demand for solutions, innovation capabilities that help to solve the problems, and policies fostering the production and use of the solutions found. But inclusive innovation systems can only be built within

existing innovation systems, and will shape differently for different attributes and different units, to use Wright's terminology. The reader will find in this book all the information and the analyses needed to understand how inequality looks like in the BRICS countries, and how the actual systems of innovation of these countries behave. The reader will be able, then, to make his/her own synthesis and, in dialogue with the authors, figure out how innovation can help to fight inequality. The opportunity to do this, so rare, so timely, so welcome, is a contribution of the book to the wedding of innovation and solidarity.

Montevideo
June 2010

Judith Sutz



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Preface

This series 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-Åke 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 which helped 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 series 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 and we are very obliged to them and their staff for their support. We would especially like to thank Richards Isnor, 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.

Supplementary grants were received from various agencies of the Brazilian Ministry of Science and Technology, especially the Studies and Projects Finance Organization (FINEP), the National Council for Scientific and Technological Development (CNPq). In particular, we would like to thank the general secretary of the Ministry of Science and Technology, Dr Luiz Antonio Elias, and the president of FINEP, Luis Fernandes, who have given enthusiastic support to the BRICS project since its inception.

Introduction

BRICS National Systems of Innovation

José E. Cassiolato and Maria Clara Couto Soares

Preamble

The world is experiencing significant transformations in its geopolitical and economic constitution. The processes of transformation have accelerated over the last decades. A significant part of the growth potential of the world economy nowadays and for the coming decades resides in some fast-developing countries. Brazil, Russia, India, China, and South Africa (BRICS) have displayed such potential for dynamic change. In a historic rupture with past patterns of development, the BRICS countries are now playing a major role in alleviating the current global crisis whilst revealing new and alternative progressive paradigms.

Much beyond the emphasis given by international agencies to the identification of investment possibilities in the BRICS production structures or to the prospects presented by their consumer markets, our perspective in analysing the BRICS countries is inspired by their significant development opportunities, as well as their several common characteristics and challenges, and the learning potential they offer for other developing countries. Identifying and analysing these opportunities and challenges will help to uncover alternative pathways towards fulfilling their socio-political-economic development potential within the constraints of sustainability.

The central focus of this book series is the National System of Innovation (NSI) of the five BRICS countries. Each book deals with a key component of the innovation system, providing the reader with

access to analyses on the role played by the state, the financing, direct investment and the small and medium enterprises, besides approaching a particularly relevant — though still not extensively studied — aspect of the BRICS economies: the challenge of inequality and its interrelations with the NSIs of these countries.

The research endeavour that generated the publication of this book series has gathered universities and research centres from all the BRICS countries, as well as policy makers invited to discuss the outcomes. The research development and the comparative analysis of its results are intended to bring to light the challenges and opportunities of the BRICS countries' national innovation systems from the points of view of these same countries. Part of the effort undertaken was addressed to the construction of a shared methodology aimed at advancing the comprehension of the specificities of innovation systems in each country. This was done in view of the need for improvements in the analytical framework used for the analysis of the national innovation systems located in countries outside the restricted sphere of developed countries. Special attention was paid to the political implications. However, instead of searching for generalisable policy recommendations, it was sought to identify and analyse bottlenecks that are common to the BRICS economies, their complementarities and competition areas, as well as other aspects of major importance for supporting decision makers and that are able to incite reflection about the subject of innovation and development in other less developed countries.

It is worth mentioning that the research consolidated in this publication is rooted in a larger research effort on BRICS national innovation systems being developed in the spheres of Globelics¹ and RedeSist (the Research Network on Local Productive and Innovative Systems) at the Economic Institute of the Federal University of Rio de Janeiro.² Globelics is an international academic network which uses the concept of innovation systems (IS) as an analytical tool aimed at the comprehension of the driving forces that push economic development. It aims to advance the use of the IS perspective on a world basis. Established in 2002 and inspired by renowned scholars from the field of economics of innovation such as Christopher Freeman (1987) and Bengt-Åke Lundvall (1992), the Globelics network has, among others, the purpose of encouraging knowledge exchange between less developed countries, thus fostering mutual learning across innovation

research groups in Latin America, Africa and Asia. With this, it is sought to strengthen an original and more autonomous approach to understanding the development processes in developing countries. On the other hand, the focus put by the Globelics network on the study of innovation systems of BRICS results from the recognition that understanding the particular dynamics which connects the knowledge base with innovation and economic performance in each of the five BRICS countries is, today, a precondition for better appreciating the direction that the world economy will be following (Lundvall 2009). It is within such analytical field that the contribution offered by this book series is inserted.

In the following sections we (a) present the broad conceptual approach of NSI used as the guiding analytical framework for the research gathered under this book series; (b) characterise the increasing importance of the BRICS countries in the global scenario; and (c) introduce the five-book collection on NSIs in the BRICS countries.

NSI and Development — A Broad Perspective

One of the most fruitful ways of thinking developed in advanced countries in the last 30 years came from a resurrection and updating of earlier thinking that emphasised the role of innovation as an engine of economic growth and the long-run cyclical character of technical change. A seminal paper by Christopher Freeman (1982) pointed out the importance that Smith, Marx and Schumpeter attached to innovation (*ibid.*: 1) and accentuated its systemic and national character (*ibid.*: 18). Freeman also stressed the crucial role of government policies to cope with the uncertainties associated with the upsurge of a new techno-economic paradigm and the very limited circumstances under which free trade could promote economic development. Since it was formulated in the 1980s, the system of innovation (SI) approach has been increasingly used in different parts of the world to analyse processes of acquisition, use and diffusion of innovations, and to guide policy recommendations.³

Particularly relevant in the SI perspective is that since the beginning of the 1970s, the innovation concept has been widened to be

understood as a systemic, non-linear process rather than an isolated fact. Emphasis was given to its interactive character and to the importance of (and complementarities between) incremental and radical, technical and organisational innovations and their different and simultaneous sources. A corollary of this argument is the context-specific and localised character of innovation and knowledge. This understanding of innovation as a socially determined process is in opposition to the idea of a supposed techno-globalism and implies, for instance, that acquisition of technology abroad is not a substitute for local efforts. On the contrary, one needs a lot of knowledge to be able to interpret information, select, buy (or copy), transform, and internalise technology.

Systems of innovation, defined as a set of different institutions that contribute to the development of the innovation and learning capacity of a country, region, economic sector, or locality, comprise a series of elements and relations that relate production, assimilation, use, and diffusion of knowledge. In other words, innovative performance depends not only on firms and R&D organisations' performance but also on how they interact, among themselves and with other agents, as well as all the other forms by which they acquire, use and diffuse knowledge. Innovation capacity derives, therefore, from the confluence of social, political, institutional, and culture-specific factors and from the environment in which economic agents operate. Different development trajectories contribute to shape systems of innovation with quite diverse characteristics requiring specific policy support.

It is this understanding of the systemic nature of innovation that allows for two crucial dimensions of the SI approach to be explicitly discussed: the emphasis on historical and national trajectories and the importance of taking into account the productive, financial, social, institutional, and political contexts, as well as micro, meso and macro spheres (Freeman 2003; Lastres et al. 2003). Although all of these contexts are relevant for a discussion about development, two in particular should be singled out that are pertinent to this study. One is the financial context, recognised by Schumpeter (1982 [1912]) in his *The Theory of Economic Development*. For him, entrepreneurs, to become the driving force in a process of innovation, must be able to convince banks to provide the credit to finance innovation. In this sense, any discussion about innovation systems has to include the financial dimension.⁴ The other is the idea that space matters,