

**BRICS**

NATIONAL SYSTEMS OF INNOVATION

**Financing  
Innovation**

EDITORS

Michael Kahn | Luiz Martins de Melo |  
Marcelo G. Pessoa de Matos



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# Financing Innovation

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Editors: Michael Kahn, Luiz Martins de Melo and Marcelo G. Pessoa de Matos

# List of Abbreviations

ADTEN	National Technological Development Support Program
APIDC	Andhra Pradesh Industrial Development Corporation
ARMSCOR	Armaments Corporation of South Africa
ASC	Administrative Staff College
ASCI	Administrative Staff College of India
BACEN	Central Bank of Brazil
BBSDP	Black Business Supplier Development Programme
BERD	Business Expenditure on Research and Development
BNDES	National Bank of Economic and Social Development, Banco Nacional de Desenvolvimento Econômico e Social
BNDESPAR	BNDES integral subsidiary for capital markets operations
BNH	National Housing Bank
BOVESPA	São Paulo Stock Exchange
BPO	Business Process Outsourcing
BRICS	Brazil, Russia, India, China, and South Africa
BRICs	Biotechnology Regional Innovation Centres
CAPES	Commission on Qualification of Graduated Human Resources
CDB	China Development Bank
CAS	Chinese Academy of Sciences
CASS	Chinese Academy of Social Sciences
CEF	Federal Savings Bank
CIS	Co-operative Incentive Scheme
CIP	Critical Infrastructure Programme
CMIE	Centre for Monitoring Indian Economy
CNPq	National Council for Scientific and Technological Development
CONTEC	Programme for Capitalisation of Technology-based Enterprises
CPMF	Provisional Contribution on Financial Operation

CRIATEC	Programme for Creation of Technology
CSIR	Council for Scientific and Industrial Research
CVCF	Corporate Venture Capital Fund
CVM	Securities and Exchange Commission of Brazil
DACST	Department of Arts, Culture, Science and Technology
DST	Department of Science and Technology
DTI	Department of Trade and Industry
EI	Engineering Index
EIP	Enterprise Investment Programme
ELETRORBRAS	Brazilian Electric Power Company
EMBRAER	Brazilian Aeronautics Enterprise
EU	European Union
FAP	Foundation to Support Research
FASIE	Russian Foundation for Assistance to Small Innovative Enterprises
FDI	Foreign Direct Investment
FGP	Federal Goal-oriented Programmes
FGTS	Unemployment and Retirement Guarantee Fund
FINEP	Finance Agency of Studies and Projects
FIP	Private Equity Funds
FNDCT	National Fund for Scientific and Technological Development
FUNDAP	Foundation for Administrative Development
FVCF	Foreign Venture Capital Fund
GDP	Gross Domestic Product
GERD	Gross Expenditure on Research and Development
GMM	Generalised Method of Moments
GNP	Gross National Product
GVCF	Government Venture Capital Fund
GVFL	Gujarat Venture Finance Limited
HNI	High Networth Individual
IAN	Indian Angel Network
IBGE	Brazilian Institute of Geography and Statistics
ICT	Information and Communication Technologies
IDB	Inter-American Development Bank
IDC	Industrial Development Corporation
IIT	Indian Institute of Technology
INPI	National Industrial Property Institute
IPO	Initial Public Offering
IPR	Intellectual Property Rights

IRR	Internal Rate of Return
ISCOR	Iron and Steel Corporation
ISTP	Index to Scientific & Technical Proceeding
KAS	Knowledge Application System
KDS	Knowledge Distribution System
KIS	Knowledge Innovation System
MCTI	Ministry of Science and Technology and Innovation
MEIDE	Micro Evidence on Innovation and Development
MFIEE	Mutual Funds for Investment in Emerging Enterprises
MNC	Multinational Corporation
NAL	National Aerospace Laboratories
NASDAQ	National Association of Securities Dealers Automated Quotations
NGO	Non-governmental Organisation
NIS	National Innovation System
NISC	National Innovation System of China
NMTLI	New Millennium India Technology Leadership Initiative
NRF	National Research Foundation
NSI	National System of Innovation
OECD	Organisation for Economic Cooperation and Development
PAPPE	Programme to Support Small Innovative Enterprises
PASEP	Programa de Formação do Patrimônio do Servidor Público
PATME	Programme for Technological Support to Small and Medium Enterprises
PBMR	Pebble Bed Modular Reactor
PDP	Productive Development Policy
PE	Private Equity
PETROBRAS	Brazilian Oil Company
PINTEC	Brazilian Innovation Survey
PIS	Social Integration Programme
PITCE	Technology and Foreign Trade Industrial Policy
PPP	Public-private Partnership
PRI	Public Research Institute
PROER	Programme for Restructuring and Strengthening of the Financial System

PROES	Programme of Incentive to the Reduction of State Institutions in Banking Activities
PROFARMA	Programme to Support the Development of the Health Industrial Complex
PROSOFT	Programme to Support the Software Industry Development
R&D	Research and Development
RAS	Russian Academy of Science
RBRF	Russian Basic Research Foundation
RF	Russian Federation
RFH	Russian Foundation for Humanities
RFTD	Russian Foundation for Technological Development
RHAE	Programme to Support Human Resources in Strategic Sectors
ROI	Return on Investment
SAFEX	South African Futures Exchange
SBU	Small Business Unit
SCI	Science Citation Index
SEBRAE	Brazilian Service to Support Micro and Small Enterprise
SELIC	Special System for Settlement and Custody
SEO	Socio-economic Objective
SIE	Small Innovative Enterprises
SIZ	Special Innovation Zone
SMEs	Small- and Medium-scale Enterprises
SMME	Small, Medium and Micro Enterprises
SOE	State-owned Enterprise
SPII	Support Programme for Industrial Innovation
SSAS	Sector Specific Assistance Scheme
TDB	Technology Development Board
TePP	Techno-entrepreneur Promotion Programme
THRIP	Technological Human Resources for Industry Programme
TIS	Technology Innovation System
USPTO	United States Patent and Trademark Office
UVCF	University Venture Capital Fund
VAT	Value Added Tax
VC	Venture Capital
VIF	Venture Innovation Fund



## Foreword

The role of financing to support company strategies to introduce new products and processes in the economy has long been recognised as key. More than a hundred years ago, Joseph Schumpeter pointed out the crucial function of banks in stimulating economic growth and innovation, as well as identifying and financing new investments in production. He also emphasised the differences between countries due to the organisation of their banking and credit systems. Especially for small firms and other organisations that could not benefit from previous profits, credit was singled out as a starting point to introduce an innovation. In the third chapter of his 1911 book, *The Theory of Economic Development*, Schumpeter pointed out that credit works as a command for the economic system to accommodate the entrepreneurs' goals, and so development could flow. Later on, with the 'capitalism of trusts', innovation was fundamentally connected to large-scale firms and their initiatives. The power of these firms to accumulate reserves and to directly access capital markets changed their need for credit. Nevertheless, in his work *Business Cycles* (1939), he once again qualified the relation between credit and innovation, as he pointed out that such a relationship is essential for the capitalist machine to work properly.

In the 1970s and 1980s, among others, Chris Freeman addressed this issue when he analysed the Japanese National System of Innovation (NSI) in the post-war period. There, he stressed the systemic nature of innovation, the strong connections between banks, production systems and large conglomerates (*keiretsus*). These elements, together with the building of financing competence capable of fostering new industrial and technological capacities, were depicted as the main reason Japan was able to significantly advance in technology and innovation activities. Two related dimensions of the NSI approach are of paramount value to explain how production and innovation capabilities are acquired, used and further developed: 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. Another of his

longest-standing arguments refers to the strategic role of government policies, especially in times of ruptures and crises, in mobilising and reorienting national production and innovation systems.

In Latin America, the so-called structuralist literature also dealt with the issue of innovation and technical progress. One of its most influential contributions relates to the argument that the main factor behind 'the passive behavior of local firms towards technological development' was related to the overall geopolitical and macroeconomic context, which in fact obstructed their potentially more active strategies and greatly contributed to limiting the scope for explicit science, technology and innovation (ST&I) policies. Comparing of firms' behaviour and their innovation trajectories in different countries has reinforced the argument that, indeed, the specific characteristics of national macroeconomic systems contain and condition the microeconomic decisions that form the standards of financing, corporate governance, international trade, competition and technical change. Actually, one of the pitfalls of most neo-classical Walrasian economic models is that macroeconomic solutions are reduced to the sum of microeconomic decisions. There is no room in this model for contextualisation or for considering the influence of malign and benign macroeconomic scenarios. For instance, it does not take into account monetary, fiscal and credit policies, nor the action (and autonomy) of central banking institutions, and, therefore, cannot account for specific relationships between the interest rate, the exchange rate, the expected inflation level and the fiscal environment.

Innovative activities are dependent upon investment strategies as a whole by firms. Innovation portfolios are positively influenced by macroeconomic stability that favour long-run investments and are negatively influenced by policies that increase uncertainty and instability, and that favour financial speculation. Therefore, it is essential to recognise that key macro variables and other macroeconomic conditions enclose and shape the space both for microeconomic decisions and for implementing policies that foster production and innovation development.

The recognition of the importance of innovation activities has led governments in different parts of the world to establish policies to guide and stimulate the productive sector. Among them, those that target funding and financing have received special attention. Main efforts have been directed at stimulating organisations to (i) incorporate and use new knowledge, aiming at increasing the quality and

the value added to goods and services, as well as to (ii) endogenise and enroot these processes.

Within this context, the Brazil, Russia, India, China, and South Africa (BRICS) countries' policies are growing even more relevant as it becomes clear that they constitute a large share of the most dynamic parts of the world economy. In the beginning of this century, around two-thirds of the world gross domestic product (GDP) was concentrated in advanced economies, and in 10 years their share decreased to around 50 per cent. Indeed, the global crisis and the recession in developed economies reinforced a mismatch in the pace of growth in the least developed countries. Growth in the world economy over the last decade has relied heavily on the prominence of emerging countries. As a result, recent decades have witnessed a shrinking distance between developed and developing nations. Investment, production and consumption are gradually moving to the developing world. Within such a scenario, a dispute has also arisen for larger portions of international trade, heating up foreign competition. Preserving national autonomy and the possibility of continued growth requires a new look at the interface between macroeconomic, industrial, commercial and innovation policies. It is, therefore, important to assess the real stamina, characteristics and sustainability of this process. To examine the capacity to orient and support industrial and technological strengths is at the core of such a task.

This is precisely the central objective of this book, which provides a map of institutions and instruments and an analysis of experiences in fostering and financing innovation in BRICS. It singles out significant differences between these countries that are inherent to their historic evolution, and the specificities of their financial systems along with other parts of their NSI. In all cases, however, one will find that governments are strongly inducing innovation in the productive sector through sophisticated financial mechanisms. The chapters of the book also point out that the efficacy in using these instruments varies substantially, as BRICS countries have not only undergone major political, institutional and economic transformations, but are also inserted in specific geopolitical contexts. Moreover, they have a singular macroeconomic environment, as well as a pattern of industrial structure and specialisation, while pursuing different policy targets.

The BRICS countries' experiences in financing innovation have other points in common. First, departing from the understanding that innovation is a systemic process — involving firms along the

production chain and the diverse organisations that affect it — successful policies have targeted the whole set of organisations instead of concentrating on a single individual firm or project. Given the territorial dimension of the BRICS countries, this has also meant fostering articulation and mobilisation of national, regional and local systems for production and innovation. Second, policies for financing innovation have been influenced by complementary policies, in particular those that constitute ‘implicit’ innovation policies, such as the macroeconomic policies, trade policies, etc. The chapters discuss the degree of integration of innovation policy and other policies. Also particularly vital in the analysis is the assessment of the level of autonomy and endogeneity of the innovation policy and its relationship with the development policy, their convergence or dissonance, and the degree of differentiation between the two.

Official government banks have played a crucial role in all five countries. It is important to note the efforts of these banks in providing compensative and decisive stimulus to the national economies during the international crisis, helping to soften its effects in most countries. Regarding the financing of innovation, in the case of China, the analysis covers the performance of the Industrial and Commercial Bank of China, the Bank of China, the China Eximbank, and especially the China Development Bank (CDB). To a lesser extent, this is also the case for India and Brazil. In the long run, governmental action and public financing have been decisive in promoting essential changes in their social and economic systems. In India, the post-independence period was marked by a perspective of planned development and the building up of a wide range of financial institutions to mobilise savings and channel investment to meet the priorities of the development plans. Ranging from the Industrial Finance Corporation of India (IFCI), the Industrial Development Bank of India (IDBI), a subsidiary of the Reserve Bank of India, to the Industrial Credit and Investment Corporation of India (ICICI), a complex set-up was erected to meet the long-term financing requirements. Transformations in the post-liberalisation period include the mobilisation of a broad array of institutions and support programmes under the leadership of the Department of Science and Technology and the National Innovation Foundation.

In Brazil, two federal government organisations are at the core of innovation promotion policies. The Studies and Projects Finance Organisation (FINEP) is specifically dedicated to fostering innovation.

The Brazilian Development Bank (BNDES), in its turn, led the way in promoting science and technology institution (STI) activities in the 1960s and 1970s and is taking up this task again. The BNDES has also been a major financier of national industry and infrastructure throughout the Brazilian industrialisation processes and plays a key role in industrial and STI policy. A new pattern of systemic and cooperative initiatives between the two institutions has characterised its activities since 2005.

Likewise, in Russia the government is the main funding source for innovative activities, establishing programmes earmarked for specific strategic goals. On a broader perspective, the challenge is to diversify the Russian economy and transform the country's high scientific capacities into technological and industrial development. The Bank for Development and Foreign Economic Affairs (Vnesheconombank, VEB) plays an important function in directing resources towards these long-term goals.

South Africa conciliates public institutions with the private banking system to finance industry, in general, and innovation, in particular. When it comes to high-risk and long-term initiatives, public institutions such as the Innovation Fund and the state-owned Industrial Development Corporation are depicted as the main players. The Development Bank of Southern Africa (DBSA) takes a stance that explicitly goes beyond the scope of a specific country, recognising the importance of integrated social and economic development in the Southern African regions.

This plurinational perspective based on the specific challenges and opportunities in developing countries is at the basis of the proposition of the BRICS Development Bank. This could provide an alternative that is capable of financing basic and future infrastructure, as well as other development needs in the BRICS economies and their neighbouring countries. Furthermore, it will soften the impact of fluctuations in the international financial system. As a matter of fact, the BRICS Summits have contributed to strengthening relations among the development banks in the five countries. During the BRICS 5th Summit, held in Durban, South Africa, in March 2013, two agreements were drawn up. Besides the BNDES, the signatory institutions included the Vnesheconombank, the Export-Import Bank of India, the CDB and the DBSA. The BRICS Multilateral Cooperation and Co-financing Agreement for Sustainable Development seeks to establish the basis for coordination and an exchange of information

between the development institutions in the five countries, aimed at building partnerships, and improving mechanisms for sustainable development. According to the interests and the rules within each development institution, agreements may be signed to finance projects connected to sustainability. Examples include projects that foster the sustainable use of biodiversity, ecosystems and the regeneration of natural resources; as well as those aimed at developing, disseminating and transferring inclusive and sustainable technology; mitigating and adapting climate change; fostering renewable energy and energy efficiency; and other sustainable development infrastructure projects. The BRICS Multilateral Agreement on Co-financing for Infrastructure in Africa is mostly aimed at facilitating bilateral pacts between development banks in the bloc in order to provide support to develop infrastructure in the African continent.

A development bank anchored in developing countries can become a catalyst for change and provide opportunities for new development partnerships, giving emphasis to the innovations and other opportunities entailed in pursuing more adequate paths towards inclusive and sustainable development. It could provide essential assistance to developing countries and emerging countries as they undertake new and more sustainable infrastructure investment for growth and poverty reduction. It also represents an important opportunity to put into practice modern financial instruments and new sources of funding, such as sovereign wealth funds and public pension funds, as well as adequate forms of risk management, and innovative and cost-effective approaches. The new bank can make a major contribution to the health of the global economy by facilitating the transition to new poles of growth and demand, helping to rebalance global savings and investments, and channelling excess liquidity to productive use. It may become not only a driver for sustainable development in the developing countries, but also the engine for change from which all in the developed and developing world alike will benefit. It is worth noting that, within the scope of growing South–South cooperation, this constitutes an additional initiative, which reaffirms the importance in envisaging and financing new inclusive, sustainable and appropriate development trajectories and models. Fostering and articulating knowledge basis, efforts and capabilities can be instrumental for this purpose.

This book offers pioneering and fundamental contributions for this process and related discussion by focusing on one of its central issues: accumulated know-how on financing scientific, technological and innovation activities in the BRICS.

Enjoy reading these rich and promising experiences.

**Luciano Coutinho**

President

Banco Nacional de Desenvolvimento Econômico e Social



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## Preface

This volume 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 (NISs) being developed in the sphere of the Global Research Network for Learning, Innovation and Competence Building Systems — Globelics. The Globelics initiative on BRICS brings together universities and other research institutions from Brazil, Russia, India, China, and South Africa. It seeks 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.

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The core ideas analysed in this book were discussed at international seminars organised in Brazil (2007), South Africa (2008), India (2009), and 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 constructive criticism from the seminar participants. We are grateful to them as well as to all other people not named here who also helped in the implementation of the project.

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