

# 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 Globelics ([www.globelics.org](http://www.globelics.org), accessed 3 December 2011) and RedeSist (the Research Network on Local Production and Innovation Systems) at the Economic Institute of the Federal University of Rio de Janeiro ([www.redesist.ie.ufrj.br](http://www.redesist.ie.ufrj.br), accessed 3 December 2011). 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*) characterize 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.<sup>1</sup>

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.

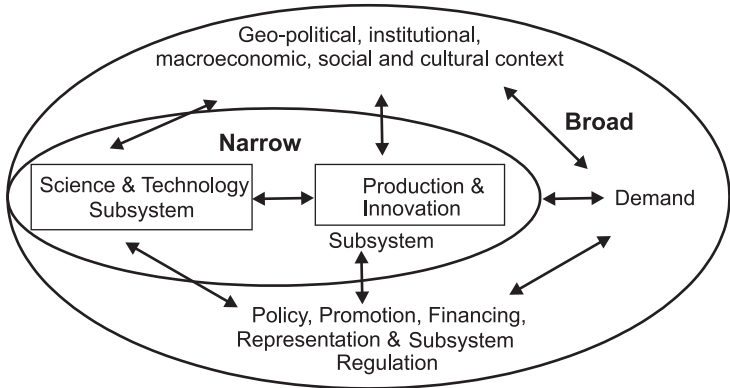
Systems of innovation, defined as a set of different institutions that contribute to the development of the innovation and learning capacity of a country, region, economic sector, or locality, comprise a series of elements and relations that relate production, assimilation, use, and diffusion of knowledge. 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.<sup>2</sup> The other is the idea that space matters, that the analysis of systems of innovation should be done at the national (Freeman 1982; Lundvall 1988) and local levels (Cassiolato et al. 2003).

The national character of SI was introduced by Christopher Freeman (1982, 1987) and Bengt-Åke Lundvall (1988) and has been

widely used as an analytical tool and as a framework for policy analysis in both developed and underdeveloped countries. As a result, research and policy activities explicitly focusing on SI can be found in most countries and a rapidly growing number of studies of specific NSIs have been produced. Although some authors tend to focus on the NSI in a narrow sense, with an emphasis on research and development efforts and science and technology organisations, a broader understanding of NSI (Freeman 1987; Lundvall 1988) is more appropriate. This approach takes into account not only the role of firms, education and research organisations and science and technology institution (STI) policies, but includes government policies as a whole, financing organisations, and other actors and elements that influence the acquisition, use and diffusion of innovations. In this case emphasis is also put on the role of historical processes — which account for differences in socio-economic capabilities and for different development trajectories and institutional evolution — creating SI with very specific local features and dynamics. As a result, a national character of SI is justified.

Figure 1 is an attempt to show both the narrow and the broad perspectives on NSI. The broad perspective includes different, connecting sub-systems that are influenced by various contexts: geopolitical, institutional, macroeconomic, social, cultural, and so on. First, there is a production and innovation sub-system which contemplates the structure of economic activities, their sectoral distribution, degree of informality and spatial and size distribution, the level and quality of employment, the type and quality of innovative effort. Second, there is a sub-system of science and technology which includes education (basic, technical, undergraduate, and postgraduate), research, training, and other elements of the scientific and technological infrastructure such as information, metrology, consulting, and intellectual property. Third, there is a policy, promotion, financing, representation, and regulation sub-system that encompasses the different forms of public and private policies both explicitly geared towards innovation or implicitly, that is, those that although not necessarily geared towards it, affect strategies for innovation. Finally, there is the role of demand, which most of the time is surprisingly absent from most analyses of SI. This dimension includes patterns of income distribution, structure of consumption, social organisation and social demand (basic infrastructure, health, education).

**Figure 1:** *The Narrow and Broad Perspectives on NSI*

Source: Adapted from Cassiolato and Lastres (2008).

This portrayal of the national innovation system framework is a corollary of an understanding that

- innovation capacity derives from the confluence of economic, social, political, institutional, and culture-specific factors and from the environment in which they operate, implying the need for an analytical framework broader than that offered by traditional economics (Freeman 1982, 1987; Lundvall 1988);
- the number of firms or organisations such as teaching, training and research institutes is far less important than the habits and practices of such actors with respect to learning, linkage formation and investment. These shape the nature and extensiveness of their interactions and their propensity to innovate (Mytelka 2000; Johnson and Lundvall 2003);
- main elements of knowledge are embodied in minds and bodies of agents or embedded in routines of firms and in relationships between firms and organisations. Therefore, they are localised and not easily transferred from one place/context to another, for knowledge is something more than information and includes tacit elements (Lundvall 1988);
- the focus on interactive learning and on the localised nature of the generation, assimilation and diffusion of innovation implies that the acquisition of foreign technology abroad is not a substitute for local efforts (Cassiolato and Lastres 1999);
- national framework matters, as development trajectories contribute to shape specific systems of innovation. The diversity of NSIs is a product of different combinations of

their main features that characterise their micro, meso and macroeconomic levels, as well as the articulations among these levels (Freeman 1987; Lastres 1994).

From the specific point of view of less developed countries (LDCs) the usefulness of the SI approach resides precisely in the facts that (a) its central building blocks allow for their socio-economic and political specificities to be taken into account and (b) it does not ignore the power relations in discussing innovation and knowledge accumulation. As this book argues, these features are particularly relevant in the analysis of the BRICS countries' innovation systems. As the analysis of economic phenomena also takes into consideration their social, political and historical complexity, policy prescriptions are based on the assumption that the process of development is influenced by and reflects the particular environment of each country, rather than on recommendations derived from the reality of advanced countries. A number of development studies followed these ideas, arguing that technical change plays a central role in explaining the evolution of capitalism and in determining the historical process through which hierarchies of regions and countries are formed. Furtado (1961), for instance, established an express relation between economic development and technological change pointing out that the growth of an economy was based on the accumulation of knowledge, and understood development within a systemic, historically determined, view. Although original, these contributions have a close correspondence with Myrdal's (1968) proposition that: (a) contexts and institutions matter; (b) positive and negative feedbacks have cumulative causation; (c) cycles may be virtuous or vicious, and with Hirschman's (1958) point that interdependencies among different activities are important.

The need to address paradigmatic changes and the problems and options deriving from the upsurge of information technologies led to the outbreak in Latin America in the 1980s of a series of interconnected work from the innovation perspective. Building on Furtado's work on changes associated with the industrial revolution, authors like Herrera (1975) and Perez (1983) analysed the opportunities and challenges associated with the introduction of these radical changes in the region. It was only then that the innovation and development literature started to integrate the empirically validated knowledge about learning inside firms with the contributions stemming from the work of Freeman, Perez, Herrera, and others on new technologies,

changes of techno-economic paradigms and systems of innovation. What gave special impetus to this direction was the empirical work focusing on technological capability building as part of a broader national innovation system. The role of government policies in orienting the speed and direction of technological changes was also highlighted (Freeman and Perez 1988).

Development processes are characterised by deep changes in the economic and social structure taking place from (technological and/or productive) discontinuities that cause and are caused by the productive, social, political, and institutional structure of each nation. Development is also seen as a systemic process, given the unequal capitalism development in the world. The recognition of national specificities of these processes is also fundamental. We found the same stress on the national character of development processes in List's work (1841), and on the NSI idea of Freeman (1982) and Lundvall (1988) in Furtado's (1961) discussion about the transformation of national economies where their structural complexity is manifested in a diversity of social and economic forms. For Furtado, it is in this transformation that the essence of development resides: structural changes 'in the internal relations of the economic and social system' (ibid.: 103) that are triggered by capital accumulation and technological innovations. The emphasis on diversity, and the recognition that: (a) both theory and policy recommendations are highly context dependent, (b) the economy is firmly embedded in society, and (c) knowledge and technology are context-specific, conform some general identities.

Furtado (1961) established a direct relation between economic development and technological innovation pointing out that the growth of an advanced economy was based on the accumulation of new scientific knowledge and on the application of such knowledge to solve practical problems. The Industrial Revolution set into motion a process of radical changes based on technical progress that has lasted till now and that is at the root of how the world economy is conformed. In essence, those changes: (a) rendered endogenous the causal factors related to growth into the economic system; (b) made possible a closer articulation between capital formation and experimental science. Such articulation has become one of the most fundamental characteristics of modern civilisation. As pointed out by Furtado (ibid.), the beginning of such a process took place in the countries that were able to industrialise and create technical



progress first, and the quick accumulation made possible in the development of this process became the basic engine of the capitalist system. For this reason, there is a close interdependency between the evolution of the technology in the industrialised countries and the historical conditions on the basis of which such development was made possible. As the behaviour of the economic variables relies on parameters that are defined and evolve into a specific historical context, it is quite difficult to isolate the study of economic phenomena from its historical frame of reference (Furtado 2002). This assertion is more significant when analysing economic, social and technological systems that are different from each other, as in the underdeveloped economies. In this context, underdevelopment may not, and should not, be considered as an anomaly or simply a backward state. Underdevelopment may be identified as a functioning pattern and specific evolution of some economies. Social and economical peripheral structure determines a specific manner under which structural change occurs (industrialisation during the 1950s and 1960s) and technical progress is introduced. Hence different outcomes from those in developed countries are to be expected (Furtado 1961; Rodriguez 2001).

The neo-Schumpeterian perspective also argues that economic development is considered a systemic phenomenon, generated and sustained not only by inter-firm relations, but most significantly by a complex inter-institutional network of relations. Innovation is eminently a social process. Therefore, development — resulting from the introduction and diffusion of new technologies — may be considered as the outcome of cumulative trajectories historically built up according to institutional specificities and specialisation patterns inherent to a determined country, region or sector. Each country follows its own development trajectory according to its specificities and possibilities, depending fundamentally on their hierarchical and power position in the world capitalist system. The more distant underdeveloped countries are from the technological frontier, the larger will be the barriers to an innovative insertion in the new technological paradigm. More serious than technological asymmetries are knowledge and learning asymmetries, with the implication that access, understanding, absorption, domination, use and diffusion of knowledge become impossible. However, even when the access to new technologies becomes possible, most of the time they are not adequate for the reality of underdeveloped

countries and/or these countries do not have a pool of sufficient knowledge to make an adequate use of them. This occurs because the learning process depends on the existence of innovative and productive capabilities that are not always available. On this aspect, Arocena and Sutz (2003) argue that there are clearly learning divides between North and South that are perhaps the main problem of underdevelopment nowadays.

## The Increasing Relevance of the BRICS Countries

The BRICS denomination was originally used to connect the dynamic emerging economies of Brazil, Russia, India, China, and South Africa as continental countries bearing a strategic position in the continents of the Americas, Europe, Asia, and Africa. The BRICS are also joined by their large geographical and demographic dimensions. Collectively, they were home to 42.2 per cent of the world population as of 2010 representing nothing less than 2.9 billion people. In addition, the five countries account for approximately 30 per cent of the earth's surface, holding significant reserves of natural resources such as energy and mineral resources, water and fertile lands. As well, BRICS countries have 24.3 per cent of world biodiversity; Brazil alone embracing 9.3 per cent of the total (GEF 2008).

Moreover, it is the recent performance of these economies and their macroeconomic indicators that make them more and more the focus of surveillance and analysis. In fact, the BRICS countries display a growing economic importance. In 2000, the five countries accounted for 17.1 per cent of the world GDP in public-private partnership (PPP). Their share increased to 25.7 per cent in 2010, with China and India accounting for 13.6 per cent and 5.5 per cent respectively, followed by Russia (3 per cent), Brazil (2.9 per cent) and South Africa (0.7 per cent) (IMF 2011).

The participation of the BRICS countries in world GDP is expected to rise sharply in the years to come. The impact of the financial crisis and global recession on developed world economy over the last three years has only lent support to this expectation, beyond attracting attention to the BRICS economies' capacity to remain immune or quickly recover from the crisis. Large domestic markets, pro-active investment policies, monetary and tax policies with anti-cyclic

capacity, presence of major public banks, and high level of reserves are elements increasingly recognised as having helped at least some BRICS economies to be less affected by the crisis.

While growth slowed in all major regions, China and India continued to grow rapidly in 2009 and 2010 (Table 1). In other BRICS countries the crisis rebounded fast. In Brazil, the GDP fell 0.2 per cent in 2009, but the economy surpassed pre-crisis growth rates in 2010 (7.5 per cent). South Africa showed a GDP decrease by 1.8 per cent in 2009 and had a 2.8 per cent increase in 2010. In Russia, heavily dependent on commodities like oil and gas, the economy has been hit more severely by the global crisis. It experienced shrinking of almost 8 per cent in 2009 but the GDP growth recovered to 3.7 per cent in 2010, beating the developed economies' growth rates. Prospects for 2015 show the five economies representing 29.5 per cent of the world economy.

The economic performance of the BRICS countries has, however, varied widely during the last decades as shown in Table 1. China has maintained its position as the fastest growing economy worldwide. India has also grown significantly and regularly. Brazil has had an irregular performance, well below its potential, but showed an enhancement in the second half of the 2000s. Russia, after the severe 1990s crisis that resulted in a decline of 40 per cent in its real GDP, has recovered and South Africa has had a small improvement in its economic performance that remains below its potential.

These different performances were accompanied by significant changes in the productive structure of the five countries, which reflect dissimilar development strategies.

The competitiveness of China's industrial sector is the main source of the country's impressive economic growth. The share of industry in the composition of China's GDP is unusual and growing: it was around 40 per cent in 1990 and reached 48 per cent in 2009. In contrast, in 2008, 56.1 per cent of the Chinese labour force still remained in rural areas. The relative share of the agricultural sector, which accounted for 30.2 per cent in 1980, is constantly falling, to 11 per cent of GDP in 2009. The share of services grew from 21.6 per cent in 1980 to 41 per cent in 2009.

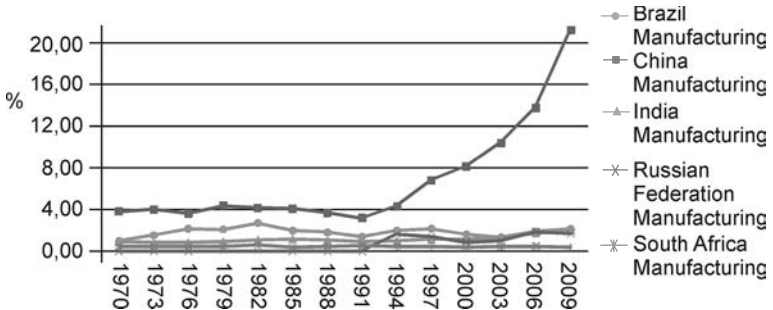
Really impressive is the mounting share of China's manufacturing sector in world manufacturing GDP (Figure 2). In 1990, it represented 3.1 per cent of global manufacturing GDP, achieving 21.2 per cent in 2009.

**Table 1: BRICS: Average Rates of Growth of Real GDP, 1980–2015 (percentage)**

	1980–1990	1990–2000	2001–2005	2006	2007	2008	2009	2010	2015*
Brazil	2.8	2.9	2.8	3.7	5.7	5.1	-0.2	7.5	4.1
Russia	-	-4.7	6.2	7.4	8.1	5.6	-7.9	3.7	5.0
India	5.8	6.0	6.9	9.8	9.3	7.3	6.5	9.7	8.1
China	10.3	10.4	9.6	11.6	13.0	9.0	8.7	10.3	9.5
South Africa	1.6	2.1	4.0	5.4	5.1	3.1	-1.8	2.8	2.8
Developed Countries	3.1	2.8	1.9	2.8	2.5	0.8	-3.2	3.0	2.3

Source: UNCTAD (2010) for the period 1980–2008 and IMF (2011) for 2009–2015 data. See <http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx> (accessed 15 March 2011).

Note: \* Estimate.

**Figure 2:** *Manufacturing Sector: BRICS' Share in World GDP, 1970–2009*

Source: UNCTAD (2009). See <http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx> (accessed 15 March 2011).

China has diversified its industrial system to a significant degree during the last 25 years and the share of technologically intensive sectors in industrial output in 2009 reached 42 per cent of the total value added by the manufacturing sector. In the other four countries this share is around 15 per cent.<sup>3</sup> In addition, some major differences in the characteristics of the BRICS countries' manufacturing sectors should be noticed.

Brazil has gone through a structural transformation since the late 1980s, with a significant reduction of the share of industry in total GDP (declining from 41.7 per cent in 1980 to 25.4 per cent in 2009) and a high growth of services (from 50 per cent to 68.5 per cent in the same period). It is worth emphasising that agricultural goods that have had an important role in the country's trade surplus were responsible for only 6.1 per cent of GDP in 2009, showing a fall from 9.0 per cent in 1980. In Brazil, as in Russia and South Africa, the products based on natural resources and commodities have a relatively greater share of national GDP than in China and India.

Russia's economic development is heavily dependent on energy and raw material resources. As in Brazil, the contribution of manufacturing sector to GDP in Russia has declined since the 1980s, decreasing from 44.6 per cent in 1983 to 32.9 per cent in 2009. The share of defence-related industrial complex in manufacturing is significant, together with the strong production base in non-electric machines and equipment. The oil and gas industry alone accounts for more than 10 per cent of the gross value added. The share of services in total GDP has grown in the last two decades achieving

62.4 per cent in 2009 while agriculture has decreased its participation accounting for only 4.7 per cent in 2009.

The Indian economy is essentially service-led. Skills in the manufacturing sector are relatively modest and concentrated in non-durable consumer goods and in the chemical-pharmaceutical complex. However, some manufacturing segments in the automobile complex and in certain basic industries have been developing rapidly in recent years. Since the mid-1980s, the contribution of industry to India's GDP has been almost constant and around 26 per cent, but from 2004 to 2009 it increased to 28.3 per cent. India's capacity in the area of services is significant, particularly those linked to information and communication technology (ICT). The share of services in GDP has grown from 39 per cent in 1980 to 54.6 per cent in 2009. Although the agricultural sector is declining in India's GDP, it still represented 17.1 per cent in 2009 (compared to 36.8 per cent in 1980) and constitutes an important determinant of the overall economic growth.

The services sector has also been playing a more important role in the South African economy. The share of this sector in GDP was 45.4 per cent in 1980 and increased to 65.8 per cent in 2009. The development of the financial sector and the growth of tourism have contributed to this growth. Finance, real estate and business services are expanding their share with regard to government services. South Africa's industrial sector is heavily based on natural resources, mainly steel and non-ferrous metals, with some increases in capacity occurring in non-durable consumer goods and the automobile sector. The share of industry-added value in total GDP value decreased from 48.4 per cent in 1980 to 31.4 per cent in 2009. The metal and engineering sectors dominate the manufacturing sector. Although agriculture is responsible for a small share of South Africa's GDP (3 per cent in 2009), it still represents an important source of employment. The minerals and mining sector remains important also with respect to both employment and foreign trade.

The changes observed in the participation of BRICS countries in international trade were even more significant (Table 2). Their share in merchandise trade value more than doubled in the short period of 2000–2010, exports rising from 7.5 to 16.4 per cent and imports from 6.2 to 14.9 per cent. However, the contribution of the five countries varied significantly. The most notable fact is the well-known growth of China in the merchandise trade value: its exports mounted from

3.9 per cent to 10.4 per cent of world exports reaching US\$ 1.58 trillion in 2010, and imports increased from 3.4 per cent to 9.1 per cent in the same period.

**Table 2:** BRICS: Merchandise Trade Value (in billion of current US\$) and Share in World Total, 2000–2010 (percentage)

<i>Exports</i>	2000		2005		2010	
	<i>Value</i>	<i>%</i>	<i>Value</i>	<i>%</i>	<i>Value</i>	<i>%</i>
World	6,448.57	100.00	10,495.70	100.00	15,174.44	100.00
Brazil	55.12	0.85	118.53	1.13	201.915	1.33
China	249.20	3.86	761.95	7.26	1,578.270	10.40
India	42.38	0.66	99.62	0.95	221.406	1.46
Russia	105.57	1.64	243.80	2.32	400.424	2.64
South Africa	31.95	0.50	56.26	0.54	85.700	0.56

<i>Imports</i>	2000		2005		2010	
	<i>Value</i>	<i>%</i>	<i>Value</i>	<i>%</i>	<i>Value</i>	<i>%</i>
World	6,662.89	100.00	10,800.15	100.00	15,353.26	100.00
Brazil	58.64	0.88	77.63	0.72	191.46	1.25
China	225.02	3.38	660.21	6.11	1,396.20	9.09
India	51.52	0.77	142.84	1.32	328.36	2.14
Russia	49.13	0.74	137.98	1.28	273.61	1.78
South Africa	30.22	0.45	64.19	0.59	96.25	0.63

Source: UNCTAD (2010).

India also experienced a sharp increase of exports, reaching 1.46 per cent of the world total in 2010. Fostered by Chinese growth and commodities boom, the share of Brazil and Russia in world exports grew rapidly from 2000 to 2010, increasing almost four times. South Africa is the only BRICS country that still shows less than 1 per cent of world exports. On the import side, India and Russia increased their share in world imports more than fivefold. Except India and South Africa, the other BRICS countries managed to keep a surplus in their merchandise trade in 2010. In India inflows on account of invisibles have been helpful in financing the growing deficit in merchandise trade.

The BRICS economies have significantly increased their openness to international trade in the last decades. They have raised their exports and imports both in volume terms as a share of GDP, but the level of trade openness has varied quite a lot (Table 3). The greater changes occurred in China and India, particularly since the 1990s when they speeded up their international trade flows. Currently, China, South Africa and Russia are the BRICS economies with the higher levels of openness. The Brazilian economy, despite the liberalisation process in the 1990s, remains the most closed amongst the BRICS countries.

**Table 3:** BRICS: Foreign Trade (in million of current US\$) and Share of GDP (percentage)

Countries	<i>Exports + Imports</i>				
	1970	1980	1990	2000	2010
Brazil	8,719	25,412	61,212	113,762	393,379
China	4,833	38,919	114,71	474,227	2.972.960
India	4,792	28,839	51,144	93,941	540,489
Russia	–	–	349,249	136,973	627,323
South Africa	8,352	50,411	48,6	56,782	161,953
Countries	<i>(Exports + Imports) GDP</i>				
	1970	1980	1990	2000	2010
Brazil	13.0%	10.3%	14.0%	17.6%	18.8%
China	5.3%	12.9%	29.9%	39.6%	50.6
India	7.9%	15.7%	15.8%	20.4	31.3
Russia	-	-	36.1%	52.7	42.4
South Africa	45.7%	61.2%	43.4%	42.7	44.5

Source: United Nations (2010); World Bank (2011).

The bilateral trade flows between BRICS countries have been relatively restricted. However, since the first half of the 2000s there was a widespread increase of exports and imports flows between the five economies, but particularly a stronger presence of China as an important trade pole for the other four countries (Baumann 2009). In 2009, China surpassed the US as the main trade partner of Brazil and also emerged as the second main trade partner of India and Russia.



The converse does not however hold, as these four economies don't match their respective rankings insofar as they are neither the top import suppliers nor export destinations for China. China exports to Brazil, India, Russia, and South Africa at a more intense pace than it imports from them. In addition, the latter are concentrated on a few primary goods intensive in natural resources while China's exports are much more diversified and led by manufactured goods. Therefore, despite the fact that intra-BRICS trade has increased in recent years, the flows are still restricted in size and unbalanced in terms of the different rhythms and compositions of the BRICS bilateral commercial transactions.

In the last decades, the BRICS countries have been the recipients of significant amounts of foreign direct investment (FDI). Brazil received the greatest share of FDI of all BRICS economies until the first half of the 1980s. Although China has surpassed Brazil since 1985, Brazil continued to be a major destination for FDI during the 1990s, most notably during the process of privatisation that took place during that decade. Since the 2000s Russia and India have been strengthening their relevance as FDI inflow destinations. In 2010, the BRICS countries received 17.6 per cent of global FDI inflows. Especially since 2005, there was a sharp increase of BRICS' FDI outflows. With the exception of South Africa, BRICS countries more than tripled their FDI outflows from 2005 to 2010, raising their participation in the world total from 3.6 per cent to 11.1 per cent in the period.

**Table 4:** BRICS: Foreign Direct Investment, Inflows and Outflows Share in the World Totals

FDI Inflows (%)	Selected Years								
	1970	1975	1980	1985	1990	1995	2000	2005	2010
Brazil	2.94	4.53	3.53	2.54	0.48	1.29	2.34	1.53	3.90
China	NA	NA	0.11	3.50	1.68	10.96	2.90	7.37	8.50
India	0.34	0.32	0.15	0.19	0.11	0.63	0.26	0.78	1.98
Russian Federation	NA	NA	NA	NA	NA	0.60	0.19	1.31	3.31
South Africa	2.50	0.71	-0.02	-0.80	-0.04	0.36	0.06	0.68	0.13

(Cont.)

(Cont.)

<i>FDI Outflows (%)</i>									
Brazil	0.01	0.38	0.71	0.13	0.26	0.30	0.19	0.29	0.87
China	NA	NA	NA	1.01	0.34	0.55	0.07	1.39	5.14
India	0.00	0.00	0.01	0.01	0.00	0.03	0.04	0.34	1.11
Russian Federation	NA	NA	NA	NA	NA	0.17	0.26	1.45	3.91
South Africa	0.12	0.44	1.46	0.08	0.01	0.69	0.02	0.11	0.03

Source: UNCTAD (2010).

BRICS countries also followed different development strategies regarding FDI. Particularly remarkable has been the Chinese policy to attract multinational companies since the beginning of the 1990s. Inserted in a broader strategy aiming to expand its technological knowledge and later to strengthen the domestic industries and enterprises, China imposed conditions — such as the establishment of joint ventures and that R&D be carried out locally — that had to be met before the subsidiaries were to operate in China or sell in its markets. Brazil, Russia and South Africa — countries that liberalised their economies with few restrictions — got more portfolio investment, but most of the investment received by the manufacturing sector was used to buy up local companies. In China and India, where the capital account was not liberalised, FDI seems to have been concentrated in new investments in production and innovation.

Other relevant macroeconomic indicators could be added — such as the impressive share of BRICS in international monetary reserves (about 40 per cent of the total) — but the interest in these five emerging economies goes beyond this area. Together with their expanding economic relevance, these countries are claiming a rising geopolitical influence. They have been important players in their geographic areas of influence. However, they are pushing to have an increasing voice in the international high-level decision-making institutions, particularly through reforms in the UN system and in the Bretton Woods organisations. New dialogue spaces bringing together BRICS countries, such as the IBSA (India, Brazil and South Africa), BRICS (Brazil, Russia, India, China, and South Africa), and BASIC (Brazil, South Africa, India, and China) signal concrete steps to move forward the cooperation and coordination within and amongst these countries, which intends to go further than the mere economic sphere.<sup>4</sup>

Their growing leverage in international relations together with other emerging countries is associated with a repositioning of the balance of power on the world stage, which was intensified by the recent world crisis. BRICS countries want to see these changes reflected in the institutions of global governance. Since their economies will probably continue to account for a sizeable portion of the increase in global GDP in the near future, it is expected over time that BRICS will exert increasing financial and political influence, even if limited by their considerable differences and constraints to form a coherent political bloc anytime soon.<sup>5</sup>

The increased influence of these countries took place during a period marked by intense transformations in the global society. One of these remarkable changes is the integration in the economy of a significant portion of previously marginalised segments of the BRICS population. The highly populated China and India led this process in terms of world shares, but Brazil also had an important participation (Soares and Podcameni forthcoming). The present and potential dimension of BRICS domestic markets as well as the policies adopted by some BRICS countries aiming to reduce their dependence on developed countries' consumer markets has been drawing increasing attention in the last years. According to one estimate, two billion people from BRICS will join the global 'middle class' by 2030 (Wilson and Dragusanu 2008) representing a huge impact on the demand profile with expected reflexes on global investments as well as on innovation.

Simultaneously, several hurdles remain for the BRICS to overcome. One of them is the growing social gap caused by the unequal distribution of recent economic growth. While the percentage of the population below the poverty line has decreased over the past 30 years in most of the BRICS countries, inequality is still a major issue for these economies. In fact, the BRICS countries, except Brazil, show a trend of increasing income inequality that — particularly since the 1990s — has been following the rapid economic growth. Moreover, despite the improvements in recent years, Brazil is still among the countries with the worst distribution of income, together with South Africa that found itself in an even worse situation.<sup>6</sup> In addition, India and Russia are among those with the largest percentage of the population living below the poverty line.<sup>7</sup> Furthermore, beyond the income dimension, inequality has a multi-dimensional character in the BRICS countries. This challenge

is exacerbated by race, gender, ethnic, and geographic dimensions and therefore demands more integrated solutions (Soares et al. forthcoming).

One of the problems associated with the high poverty levels and the perverse distribution of income is the limited access to quality public services — education, health, housing and infrastructure, safety and security, etc. These problems are common to the five countries, where a significant portion of the population lacks access to essential goods and services, and demand urgent redress. This situation is reflected in poor human development indices in the BRICS countries. Other undeniable challenges faced by BRICS are unemployment, poor quality employment and increasing informality.

Another evident challenge in all five countries is the huge regional disparity in human and economic development. There is also a large gap between the rural and urban population. In general, the wealthier regions are those that are more industrialised. Practically 60 per cent of the total GDP of Brazil originates in the states of the southeast. The Chinese economic development model favours the coastal provinces, while other provinces in the interior are much less developed. In South Africa, economic activity is concentrated in Gauteng province and in the western part of Cape Town. The industrial development of Russia occurred principally around cities such as Moscow, St Petersburg, Nizhny Novgorod, and Ekaterinburg. India also shows significant inequalities between the rich regions to the south and the northern regions of the country as well as between the rural and urban populations. Therefore, regional redistribution of income and access to essential goods and services is another significant challenge that these five countries have in common (Soares et al. forthcoming).

The negative environmental impact of recent growth is another huge challenge to be faced by BRICS countries. According to CDIAC-UN data for 2008, the BRICS countries are responsible for emitting 35.3 per cent of the world's total CO<sub>2</sub>.<sup>8</sup> China is ranked as the world's largest emitter, accounting for 21.9 per cent followed by the United States (17.7 per cent), India (5.4 per cent) and Russia (5.3 per cent). South Africa and Brazil are responsible for 1.4 per cent and 1.2 per cent of global emissions respectively, and occupy the 13th and 17th positions internationally. If we take the example of China, we observe that fossil-fuel CO<sub>2</sub> emissions in the country have more than doubled in the 2000 decade alone. Energy efficiency is a big

problem in China and energy consumption per product is about 40 per cent higher than in the developed world. Other environmental problems are also critical. For instance, 40 per cent of river and 75 per cent of lake water is polluted leaving 360 million rural people without clean water. As in China, the environmental impacts in other BRICS countries are also mounting.

Other than extending the existing problems in BRICS countries, one general and common issue should be emphasised. This relates to the sustainability of its current growth trajectory. This is true in terms of growing inequality, increasing environmental impacts, as well as regional and other imbalances. However, there are some recent changes that may open better future prospects.

All the BRICS countries have an important role to play in shaping the future of the world economy, but China will probably have a more prominent role in this respect. The Chinese system of innovation has been undergoing some changes in order to address two new proclaimed goals: the building of a 'harmonious growth' and the development of 'indigenous innovations'.<sup>9</sup> The harmonious growth aims at reducing the growing social and environmental imbalances. China's emerging 'high-growth with low-carbon' strategy has been emphasised by recent policy decisions, together with measures directed to reduce rural-urban social gaps. The indigenous innovation goal refers to the efforts to make China less reliant on foreign technology through the building of a new kind of relationship between national and foreign players in the process of developing and using new technologies.<sup>10</sup> China is pursuing these goals especially by linking innovation to domestic needs and by giving increased priority to domestic consumption.<sup>11</sup>

For Brazil, India, Russia, and South Africa, Chinese success may lead to strategies towards strengthening domestic technological capabilities and fostering clean technologies. Nevertheless, the differentiated role of the BRICS countries in the configuration of global power and the global economy will in some way constrain the evolution of BRICS national systems for innovation. In addition, their NSIs are highly dependent on their historical development and on how the different domestic actors interpret global developments as well as how they position themselves in the national and international economies. Yet, more flexibility for setting up new industrial and technological policies may be expected.

## Introduction to Books 1–5

This book series attempts to cover five themes that are crucial to an understanding of the National System of Innovation of BRICS. The first book *The Role of the State*, edited by Mario Scerri (South Africa) and Helena M. M. Lastres (Brazil) aims at exploring the relationship between the state and the national systems of innovation in BRICS countries. An evolutionary approach has been adopted in order to capture the nature of the state in the respective countries and thus understand the historical and ideological basis for its role in the evolution of the NSI in the five countries. As a background, it is argued that debates on the role of the state in the development process, especially since the 1980s, have often focused on the apparent dichotomy between market-driven and state-driven development. This is a rather wasteful diversion, since it should be accepted as a starting premise that the state is essential to the structural transformation that is required for development.

The second book addresses an aspect of the NSI that is normally absent from the discussion: the relation between innovation and inequality. The objectives of the book *Inequality and Development Challenges*, edited by Maria Clara Couto Soares (Brazil), Mario Scerri and Rasigan Maharajh (South Africa) were to trace the trends in interpersonal and inter-regional inequality within BRICS in an evolutionary perspective and to analyse the co-evolution of inequality and the innovation system to highlight how the various elements of innovation and the production system and inequality mutually reinforce.

The book is driven to improving our understanding of this issue. The inequality concept is considered in its multi-dimensional character, embracing a phenomenon that goes beyond the mere income dimension and is manifested through forms increasingly complex, including, among others, assets, access to basic services, infrastructure, knowledge, as well as race, gender, ethnic, and geographic dimensions. The book adopts the broad approach of the national system of innovation to analyse the relations between BRICS innovation systems and inequality, departing from a co-evolutionary view.

As shown in the book chapters, innovation can affect inequalities in different ways and through distinct trails that are influenced by national conditions, and shaped by public policy interventions. Although innovation does not constitute the main factor of influence on inequality, it is suggested that distinct strategies for technological change may lead to different outcomes in distributive terms, thus either aggravating or mitigating inequality. Based on this understanding, the book corroborates the hypothesis that inequalities need to be explicitly taken into account in development strategies since the benefits of science, technology and innovation are not automatically distributed equally. Therefore, advancing the comprehension of inter-relations between innovation and inequality may be helpful to find ways to shape the national innovation systems so that they reduce rather than increase inequalities.

The third book aims at analysing the contribution of small- and medium-scale enterprises (SMEs) in the national system of innovation. The objective of the book *The Promise of Small and Medium Enterprises*, edited by Ana Arroio (Brazil) and Mario Scerri (South Africa) is to explore three main research goals. In the first place, to provide an overview of the main characteristics of micro, small and medium firms in the Brazilian, Russian, Indian, Chinese and South African national systems of innovation as a basis to examine the contribution of SMEs to the economy of each country. A second goal is to bring to the forefront crucial issues in the discussion of industrial and technological policies for small firms, including the recent evolution and future trends of policies and instruments, their applicability and coordination, as well as a discussion of the macro-economic, legal and regulatory environment. A final research objective is to draw out initiatives to promote innovation in SMEs that address common bottlenecks in BRICS countries and that can contribute to policy design and implementation by these and other countries.

The fourth book discusses the relationship between transnational corporations and the national system of innovation of BRICS countries. In the book *Transnational Corporations and Local Innovation*, edited by José E. Cassiolato (Brazil), Graziela Zucoloto (Brazil), Dinesh Abrol (India), and Liu Xielin (China) the thesis of technological globalisation is taken with some caution, refuting the idea that R&D activities would be inexorably internationalised.

In fact, technological innovative activities in TNCs have been transformed, in relation with the financialisation of transnational corporations (TNCs), as evidenced by the rise of their intangible assets (which includes R&D, patents, and trademarks) and a reorientation of R&D expenditures towards non-scientific activities and very downstream development.

The book chapters present a detailed presentation of the relation of the position and evolution of TNC in the country. Subsequently, there is a discussion on the local factors affecting innovation by TNCs and local firms in the country. Government policy towards TNCs has been important but as the Chinese experience shows, access to local buoyant markets has also been vital. Other issues discussed refer to how the government protects local companies from the competition of TNCs. Spillovers of TNCs to local BRICS enterprises have also been analysed and the immediate conclusion is that there is hardly any convincing evidence regarding either the existence or non-existence of spillovers. An in-depth analysis of outward FDI has also been conducted.

Finally, the fifth book deals with finance and funding in the national system of innovation. The objective was to analyse institutional character and support instruments for the innovation financing process in BRICS, focusing on institutional structure and innovation policy. This book, *Financing Innovation*, edited by Michael Kahn (South Africa) and Luiz Martins de Melo (Brazil) contributes to understanding the varied approaches to the financing of innovation. It draws on the experience of five diverse countries each of which has undergone dramatic structural adjustment in the last two to three decades. The experience of the BRICS countries presents a unique set of case studies of the transition from largely closed centrally planned and state-driven economic and science policy to a more open and market-led situation. The contributing authors examine the varying approaches to the provision of support to the full range of activities that contribute to innovation ranging from scholarship support to doctoral students, to R&D tax incentives and the provision of seed capital.

The significance of financing investments in innovation has been pointed out as an important structural bottleneck that is yet to be solved by the private financial institutions. If, on the one hand, the internationalisation, deregulation and globalisation of financial



markets signals the possibility of resources at lower costs, on the other, the characteristics of investments in innovation such as the length of time needed for development, the uncertainty and the risk, point to the need of setting national institutional arrangements.



## Notes

1. This is also true in Latin American countries, where it is being applied and understood in close connection with the basic conceptual ideas of the structuralism approach developed in the region since the 1950s under the influence of the Economic Commission of Latin America and Caribbean. In fact, since the mid-1990s, the work of RedeSist — the Research Network on Local Productive and Innovative Systems — based at the Economics Institute of Rio de Janeiro, Brazil, has been using such a dual frame of reference.
2. See, for instance, Mytelka and Farinelli (2003); Freeman (2003); Chesnais and Sauviat (2003).
3. The following data on BRICS countries' value added by sector (per cent of GDP), 1980–2009 is based on the UNCTAD *Handbook of Statistics* (2010).
4. The IBSA Dialogue Forum was established in June 2003 in Brasilia, Brazil.  
BRIC was formally constituted in June 2009 at a summit of the four countries in Yekaterinburg, Russia. In 2011, South Africa joined the group, which changed its denomination to BRICS.  
BASIC of the G4 was formed during the international climate change negotiations in December 2009 in Copenhagen, Denmark.
5. There are several economic and geopolitical factors that restrict a greater convergence of interests among BRICS countries in multilateral negotiations. The analysis of these constraints goes beyond the limited scope of this concept note, but we could cite the aforementioned relatively low degree of trade complementarities between BRICS as an important one.
6. In 2008, Gini indexes were respectively 0.54 and 0.67 according to Brazilian and South African national institutes of statistics.
7. According to World Bank statistics, the population below poverty line was 28.6 per cent in India and 30.9 per cent in Russia in the mid-2000s.
8. It is important to mention that CDIAC-UN data considers only global carbon dioxide emissions from the burning of fossil fuel, but not emissions from deforestation or other greenhouse gases, including methane.

9. See the AeA research team's 'China's Fifteen-year Science and Technology Plan', in Competitiveness Series, *American Electronics' Association*, Vol. 14, April 2007, p. 2.
10. The US Information Technology Office in Beijing refers to indigenous innovation as a term combining three distinct elements: *yuanshi* (original, or genuinely new); *jicheng* (integrated, or combining existing technologies in new ways); and *yinjin* (assimilated, or making improvements to imported technologies). See <http://www.usito.org/> (accessed 8 January 2013).
11. In November 2008, China launched a US\$ 584 billion anti-cyclical package. According to the HSBC report on climate change (Robins 2009) almost 40 per cent of the total package resources were allocated to 'green' themes. Among others, it combined the search for a lower carbon pattern with the offering of better transport conditions for lower income people placed in rural areas, fostering a niche for the development of innovations capable of attending to the specificities of this domestic market segment.

## References

- Arocena, R. and J. Sutz, 2003. 'Knowledge, Innovation and Learning: Systems and Policies in the North and in the South', in J. E. Cassiolato, H. M. M. Lastres and M. L. Maciel (eds), *Systems of Innovation and Development: Evidence from Brazil*. Cheltenham: Edward Elgar, 291–310.
- Baumann, R., 2009. 'El Comercio entre los Países "BRICS"', LC/BRS/R.210, Comisión Económica para América Latina y el Caribe (CEPAL), Santiago de Chile, August.
- Carbon Dioxide Information Analysis Center–United Nations (CDIAC–UN), 2008. 'Global, Regional, and National Fossil-Fuel CO<sub>2</sub> Emissions'. <http://cdiac.ornl.gov/trends/emis/overview.html> (accessed 1 March 2011).
- Cassiolato, J. E. and H. M. M. Lastres, 1999. *Globalização e Inovação Localizada: experiências de sistemas locais no Mercosul*. Brasília: Instituto Brasileiro de Informação em Ciência e Tecnologia.
- , 2008. 'Discussing Innovation and Development: Converging Points between the Latin American School and the Innovation Systems Perspective', Working Paper no. 08-02, Globelics Working Paper Series, The Global Network for Economics of Learning, Innovation, and Competence Building System.
- Cassiolato, J. E., H. M. M. Lastres and M. L. Maciel (eds), 2003. *Systems of Innovation and Development: Evidence from Brazil*. Cheltenham: Edward Elgar.

- Chesnais, F. and C. Sauviat, 2003. 'The Financing of Innovation-related Investment in the Contemporary Global Finance-dominated Accumulation Regime', in J. E. Cassiolato, H. M. M. Lastres and M. L. Maciel (eds), *Systems of Innovation and Development: Evidence from Brazil*. Cheltenham: Edward Elgar, 61–118.
- Economist, The*, 2010. 'A Special Report on Innovation in Emerging Markets', 15 April.
- Freeman, C., 1982. 'Technological Infrastructure and International Competitiveness', Draft Paper submitted to the OECD Ad Hoc Group on Science, Technology and Competitiveness, Organisation for Economic Co-operation and Development, Paris. [http://redesist.ie.ufrj.br/globelics/pdfs/GLOBELICS\\_0079\\_Freeman.pdf](http://redesist.ie.ufrj.br/globelics/pdfs/GLOBELICS_0079_Freeman.pdf) (accessed 24 September 2012).
- , 1987. *Technology Policy and Economic Performance: Lessons from Japan*. London: Frances Pinter.
- , 2003. 'A Hard Landing for the "New Economy"? Information Technology and the United States National System of Innovation', in J. E. Cassiolato, H. M. M. Lastres, and M. L. Maciel (eds), *Systems of Innovation and Development: Evidence from Brazil*. Cheltenham: Edward Elgar, 119–40.
- Freeman, C. and C. Perez, 1988. 'Structural Crisis of Adjustment, Business Cycles and Investment Behaviour', in G. Dosi, C. Freeman, R. Nelson, G. Silverberg, and L. L. Soete (eds), *Technical Change and Economic Theory*, London: Pinter, 38–66.
- Furtado, C., 1961. *Desenvolvimento e Subdesenvolvimento*. Rio de Janeiro: Fundo de Cultura.
- , 2002. *Capitalismo Global*. São Paulo: Paz e Terra.
- Global Environmental Facility, 2008. 'Index Table — Biodiversity'. <http://www.thegef.org/gef/node/1805> (accessed 16 February 2011).
- Herrera, A., 1975. 'Los Determinantes Sociales de la Política Científica en América Latina', in J. Sábato (ed.), *El Pensamiento Latinoamericano en Ciencia-Tecnología-Desarrollo-Dependencia*. Buenos Aires: Paidós, 98–112.
- Hirschman, A., 1958. *The Strategy of Economic Development*. New Haven: Yale University Press.
- Instituto de Pesquisa Econômica Aplicada (IPEA), 2008. 'PNAD-2007: Primeiras Análises: Pobreza e Mudança Social', *Comunicados da Presidência*, 1(9), Instituto de Pesquisa Econômica Aplicada, Brasília.
- International Monetary Fund (IMF), 2011. 'World Economic Outlook Database', September 2011. <http://www.imf.org/external/pubs/ft/weo/2011/02/weodata/index.aspx> (accessed 4 October 2011).
- Johnson, B. and B.-Å. Lundvall, 2003. 'Promoting Innovation Systems as a Response to the Globalising Learning Economy', in J. E. Cassiolato,

## I I Introduction

- H. M. M. Lastres and M. L. Maciel (eds), *Systems of Innovation and Development: Evidence from Brazil*. Cheltenham: Edward Elgar, 141–84.
- Lastres, H. M. M., 1994. *The Advanced Materials Revolution and the Japanese System of Innovation*. London: Macmillan.
- Lastres, H. M. M. and J. E. Cassiolato, 2005. 'Innovation Systems and Local Productive Arrangements: New Strategies to Promote the Generation, Acquisition and Diffusion of Knowledge', *Innovation: Management, Policy & Practice*, 7(2): 172–87.
- Lastres, H. M. M., J. E. Cassiolato and M. L. Maciel, 2003. 'Systems of Innovation for Development in the Knowledge Era: An Introduction', in J. E. Cassiolato, H. M. M. Lastres and M. L. Maciel (eds), *Systems of Innovation and Development: Evidence from Brazil*. Cheltenham: Edward Elgar, 1–33.
- List, F., 1841. *National System of Political Economy*. New York: Cosimo.
- Lundvall, B.-Å. 1988. 'Innovation as an Interactive Process: From User-Producer Interaction to the National System of Innovation', in G. Dosi, C. Freeman, R. Nelson, G. Silverberg, and L. L. Soete (eds), *Technical Change and Economic Theory*. London: Pinter, 349–69.
- , 1992. *National System of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter.
- , 2009. 'The BRICS Countries and Europe', in J. E. Cassiolato and V. Vitorino (eds), *BRICS and Development Alternatives: Innovation Systems and Policies*. London: Anthem Press, xv–xxi.
- Myrdal, G., 1968. *Asian Drama: An Inquiry into the Poverty of Nations*. London: Penguin Books.
- Mytelka, L. K., 2000. 'Local Systems of Innovation in a Globalized World Economy', *Industry and Innovation*, 7(1): 15–32.
- Mytelka, L. K. and F. Farinelli, 2003. 'From Local Clusters to Innovation Systems', in J. E. Cassiolato, H. M. M. Lastres and M. L. Maciel (eds), *Systems of Innovation and Development: Evidence from Brazil*. Cheltenham: Edward Elgar, 249–72.
- Perez, C. 1983. 'Structural Change and the Assimilation of New Technologies in the Economic and Social System', *Futures*, 15(5): 357–75.
- , 1988. 'New Technologies and Development', in C. Freeman and B.-Å. Lundvall (eds), *Small Countries Facing the Technological Revolution*. London: Pinter, 85–97.
- Ravallion, M., 2009. *The Developing World's Bulging (but Vulnerable) 'Middle Class'*. Washington DC: World Bank.
- Robins, N., 2009. 'A Climate for Recovery: The Colour of Stimulus Goes Green', HSBC Global Research, <http://www.research.hsbc.com> (accessed 2 December 2011).
- Rodríguez, O., 2001. 'Prebisch: actualidad de sus ideas básicas', *Revista de la CEPAL*, 75: 41–52.

- Schumpeter, J. A., 1982 [1912]. *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle (1912/1934)*. New Jersey: Transaction Books.
- United Nations Conference on Trade and Development (UNCTAD), 2009. *UNCTAD Handbook of Statistics 2009*. Geneva; New York: United Nations. <http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx> (accessed 15 March 2011).
- , 2010. *UNCTAD Handbook of Statistics 2010*. Geneva; New York: United Nations. <http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx> (accessed 15 March 2011).
- United Nations, 2010. 'United Nations Statistical Databases', United Nations Statistical Division. <http://unstats.un.org/unsd/databases.htm> (accessed 20 March 2011).
- , 2010. 'United Nations Commodity Trade Statistics Database', United Nations Statistical Division. <http://comtrade.un.org/> (accessed 20 March 2011).
- Wilson, Dominic and Raluca Dragusanu, 2008. 'The Expanding Middle: The Exploding World Middle Class and Falling Global Inequality', Global Economics Paper no. 170, Goldman Sachs, 7 July.
- World Bank, 2010. 'World Economic Indicators Database 2010'. <http://data.worldbank.org/data-catalog/world-development-indicators> (accessed 25 March 2011).
- , 2011. 'World Development Indicators Database 2011'. [http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP\\_PPP.pdf](http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP_PPP.pdf) (accessed 1 July 2011).