# INTERNATIONAL DEVELOPMENT

## *Ideas, Experience, and Prospects*

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# Contents

## PART 2 CONCEPTS AND THEORIES

*The intellectual origin of concepts influencing current thinking on development; how these concepts have changed over time, including key debates and critical perspectives; and how they might evolve, particularly in relation to emerging patterns of development.*

## PART 3 EXPERIENCES

*How particular countries and organizations have shaped thinking on development at critical junctures, whether by challenging existing concepts or inspiring new ones, and how they have both influenced and reflected the evolution of thinking on development.*

CHAPTER 33

# INNOVATION SYSTEMS AND DEVELOPMENT

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## Introduction

From the 1950s to the 1970s the central preoccupation of the international research and policy agenda was to deal with the challenges posed by underdevelopment. During this period, structuralism was one of the main theoretical frameworks shaping the debate on the issue. Though there are many differences within this line of thought, its contributors did agree about the significant differences between countries. Some authors went even further, arguing that structural inequalities in economic and geopolitical relations were the main cause of underdevelopment. Other consensual points were that government intervention would be required to promote the structural changes necessary to overcome backwardness, and that knowledge and policies specific to the different realities would be needed.

One of the key authors of the Latin American structuralist school, Celso Furtado, argued that true development—not the economic growth that arises from mere modernization of elites—exists when there is a social project behind it. Only if there is a predominance of forces fighting for effective improvement of living conditions of the population will growth turn into development. For Furtado, the essence of development lies in the transformation of national economies where its structural complexity is manifested in a diversity of social and economic forms. Such transformation refers to structural changes in the internal relations of the economic and social system that are triggered by capital accumulation and technological innovations (Furtado 1961: 103).

The development agenda's emphasis on the connections between structural change, social conditions, and innovation changed dramatically in the late 1970s as a crisis—which combined stagnation, inflation, and unemployment—arose in developed countries and spread throughout the world. This had a parallel with the diffusion of orthodox monetary-based economic thinking, which became the hegemonic paradigm throughout the 1980s and 1990s. The leading proponents of what Toye (1987) has called the counter-revolution in development theory and policy introduced a radical neo-liberal agenda in which "development practically

disappears as a specific question, [remaining] only as the welfare achieved by the elimination of obstacles to market functioning" (Arocena and Sutz 2005: 16). The basic premise was that underdevelopment is simply the result of bad allocation of resources and that it is caused virtually exclusively by government intervention (distortion of prices and over-dimensioned public sectors). This reduced the complex problem of underdevelopment to a matter of simply following some basic economic "recipes" (get the prices right, get the property rights right, get the institutions right, get the governance right) based on emulating Anglo-American institutions throughout the world (Chang 2002). Recent efforts to articulate mainstream economic theory with some structuralist elements have also fallen short. Besides maintaining a perspective of static comparative advantages,[1] it does not demonstrate a significant understanding about the knowledge, technology, and processes involved in structural change.[2]

Significant difficulties remained in understanding the characteristics and changes of the present accumulation regime, marked by the growing intensity and complexity of knowledge and its increasing incorporation in goods and services, together with the acceleration of the process of globalization and "financerization." These limitations are even stronger with respect to understanding the challenges and opportunities faced by less developed countries (LDCs) and the resulting policy prescriptions. Most critical is the fact that thirty years of liberal policy experimentation led to a more divided world, with the gap between rich and poor widening.

In the same timeframe of the last thirty years, a fruitful alternative to the neo-liberal consensus was unfolding internationally, benefiting also from many insights provided by the development structuralist literature. It emphasized the role of innovation as an engine of economic growth and the long-run cyclical character of technical change. Freeman (1982) pointed out the importance that Smith, Marx, and Schumpeter attached to innovation and accentuated its systemic and national character. He also stressed the crucial role of government policies in coping with the uncertainties associated with the upsurge of a new techno-economic paradigm and the very limited circumstances under which free trade could promote development.

Since then the innovation systems (IS) framework—a comprehensive understanding of the processes by which societies and economies learn and acquire capabilities both to produce and to innovate—has been increasingly used for analyzing and orienting industrial and technological development. Today, research and policy activities explicitly focusing on innovation systems can be found in most countries.

This chapter provides a discussion of the connection between development and the IS framework. The following sections summarize how the concept of innovation systems evolved over thirty years, examine the connections between the IS framework and development thinking, and present an overview of applying the IS framework to address development challenges.

# Innovation Systems: The Evolution of the Concept

## From Innovation to Innovation Systems

Innovations are increasingly recognized as central driving forces of the transformation of economic structures and of development. Building upon the analysis of Adam Smith and

Karl Marx, Joseph Schumpeter explicitly incorporated innovation as a central variable in economic analysis. In fact, technology and technical change were important parts of the post-war debate on development. Schumpeter's concept of development contributed to this debate with two central ideas: the connection of technology with production, and the disruptive character of development.

The first idea relates innovation with economic agents, leading to the generation of new products and processes or the establishment of new markets. The second idea encompasses the understanding that the evolution of the economic system is marked by the continuous destruction of old structures and the creation of new ones. This idea was further developed by many scholars, showing how great transformations of the world economy over centuries were related to new modes of production and the diffusion of technologies, such as the steam engine, telegraph, electricity, and information and communication technologies (ICTs). Building upon the pioneering analysis of Kondratiev, the concepts of technological paradigm (Dosi 1982) and tech-economic paradigm (Freeman and Perez 1986) emphasize the disruptive character of such technologies and the opportunities presented by the resulting change in economic context.

The capacity to create, imitate, use, and modify innovations came to be seen as a determinant of successful development for both firms and countries. The emphasis on the promotion of industrialization is, in fact, directly related to the benefits and capacities that are expected to be incorporated in the economic system of less developed countries. Based on the recognition of the importance of innovations, a substantial literature has emerged, building upon the concept of innovation systems. Though it originated in economics, this framework benefited from the insights of many social sciences, including sociology, geography, and history.

The starting point was the understanding, which emerged in the 1980s, that innovation is systemic, involving interaction among agents, rather than a linear process involving discrete steps. Innovation does not rely on the performance of individual firms, but on how they interact with each other. Indeed, the number of firms and other organizations is far less important than their habits and practices with respect to learning and investment. As innovation is partially tacit, embedded in people's lived experience, organizational routines, and professional relationships; thus, learning by doing matters as much as searching for outside technology. The national level matters, as a country's development trajectory shapes its system of innovation, and firms are embedded within a confluence of economic, social, and political factors.

An innovation system refers to a group of firms and other actors who implement new products, new processes, and new forms of organization. This definition focuses on innovation as an interactive process, occurring among and between firms and other actors, embedded in a socio-economic and political context. Hence, the most fundamental characteristic of an innovation system is the interaction among actors. The concept of national innovation systems (NIS) was introduced by Freeman (1982) and Lundvall (1988). Since the 1990s, the concept has been applied in developed and developing countries.

## Narrow and Broad Approaches to Innovation Systems

With the advent of globalization, some have argued that the national character of innovation has become less relevant. In order to counter argue, the distinction between two definitions of national innovation systems is recalled.

In a narrow approach, the national innovation system is regarded as a follow-up to earlier analyses of national science and technology (S&T) policy (Nelson 1992). The key issue is to map indicators of national specialization and performance regarding innovation, research and development (R&D) efforts, and S&T organizations. The issues raised are typically related almost exclusively to explicit science policy. The analysis may include markets for knowledge—intellectual property rights and the venture capital aspects of financial markets—but hardly the broader set of institutions, in particular overall government policies, financing, and education and learning organizations.

In contrast, a broad approach to national innovation systems (Lundvall 1985) includes these additional dimensions. Early on, Freeman (1982) argued that not only was the macroeconomic performance of countries tied to innovation, but that factors beyond the realm of S&T influenced the innovative performance of firms; he noted the limited relevance of short-term competitiveness strategies—such as manipulating wages and exchange rates—and the importance of government's promoting a coherent approach to industry, science, technology, and innovation. Freeman's early study of Japan (1988) takes into account the role of firms, education and research organizations, government, financing, and other actors that influence the acquisition, use, and diffusion of innovations.

Thus, focus on interactive learning and on the localized nature of the generation, assimilation, and diffusion of innovation is in opposition to the idea that national boundaries are being loosened and that there is a tendency to a sort of "techno-globalism." Innovation is context specific. Acquiring foreign technology cannot substitute for local efforts, as a lot of local knowledge is needed to select, buy (or copy), use, and transform technologies.

## Building upon the IS Framework

A number of contributions have helped refine the idea of innovations systems. First is the recognition that *macroeconomic conditions* influence the dynamics of innovation. This was already present in the work of the OECD Expert Group on Science, Technology and Competitiveness, which met between 1980 and 1983, that pointed out the effect of financial markets, education systems, and nationally determined institutions on industry competitiveness and international specialization.

Second, a *broader understanding of the innovation process* cautions against overemphasizing R&D and encourages policy-makers to take a far-reaching perspective on the opportunities for learning. A major source of innovation relates to interactive learning that takes place among production, sales, and technological development, and that involves non-price elements of power, trust, and loyalty (Lundvall 1992).

Third, *historical processes* account for differences in socio-economic capabilities and different development trajectories. Institutional evolution creates systems of innovation with very specific local features and dynamics. The recognition that innovation is embedded in specific contexts reaffirms the importance of capturing the specificity of different actors and the type and quality of relationships, and of understanding the *role of institutions* in its broad sense—as informal and formal norms and rules (Johnson 1992).

Economic performance can be explained by how new technological systems come forward and co-evolve with and reshape existing institutions. This co-evolution is shaped by history and the social, political, and cultural dimensions that are specific to each reality. Both

Freeman and Lundvall favor a method of "reasoned history" rather than quantitative analysis based on abstract models. These authors argue that *national institutions* (both formal and informal) determine how people relate to each other, how they learn and use their knowledge, and the rate and direction of innovative activities (Johnson 1992).

Fourth, innovation requires *trust* in these institutions. The level of trust determines the degree of learning that can take place. Beyond formal and legal arrangements, trust is influenced by the level of social cohesion and solidarity, education and training opportunities, labor market and corporate laws, contract laws, arbitration institutions and collective bargaining, etc. These are all historically determined, and analysis of innovation systems has to understand their national specificities, their international differences, and how they affect development paths of different national innovation systems (Lundvall 2007).

## Innovation Systems and Development Thinking

Some of the most important conceptual pillars of innovation theory are rooted in international development (Freeman 1982; Johnson, Edquist, and Lundvall 2003). Reinert (1996) even suggests that one can find explicit connections to a discussion about development centered on the role of technology and innovation in a systemic way in the Renaissance economics debate, while other insights come from the development debates during the twentieth century.

The "Renaissance canon" of the seventeenth century already emphasized that the fundamental causes of economic welfare are *immaterial* production factors, namely, humans' productive creativity and morality. Antonio Serra (1613) pointed out that the difference between the wealth and poverty of cities and countryside, and between cities of the period, could be explained in terms of the different "qualities" of economic activities, the presence or absence of diverse occupations, and the capacity to initiate "virtuous circles" or positive feedback mechanisms. Once the focus was on production based on human creativity, emphasis was put on incentives for education, science, and entrepreneurship (Reinert 1996).

Lundvall (2007) notes that a major inspiration for the IS concept was the work of the nineteenth-century German economist Friedrich List on the "National System of Production." List discussed the opportunities for promoting development in countries lagging behind the dominant country at his time. He highlighted the capacity to acquire, use, transform, and create knowledge (mental capital) and its articulation for productive purposes (material capital). The systemic perspective was present not only in the articulation of knowledge and productive structures, but in the consideration of the role of the government and of institutions, which evolve along a specific historical process (List 1841).

Joseph Schumpeter, steeped in the tradition of the German Historical School of economics, put innovation in the center of economic analysis and stressed the disruptive character of development. These notions shaped subsequent contributions by Prebisch (1949), Singer (1950), and Myrdal (1958) on the long-term deterioration of terms of trade for primary products and of the distribution of gains between developed and developing countries. Their work constituted what became known as the "triple alliance" on the discussion of terms of trade.[3]

Many studies have similarly argued that technical change plays a central role in explaining the evolution of capitalism and in determining which hierarchies of regions and countries are formed. Furtado (1961), for instance, established a direct relation between economic development and technological change, pointing out that the growth of an economy is based on the accumulation of knowledge, understanding development within a systemic, historically determined, view. These contributions have a close correspondence with Myrdal's (1958) proposition that contexts and institutions matter, positive and negative feedbacks have cumulative causation, and cycles may be virtuous or vicious. Also central to this thinking is Hirschman's (1958) point that interdependencies among different activities are important.

A significant milestone was the joint effort, at the University of Sussex in the late 1960s, of Chris Freeman at the Science Policy Research Unit and Hans Singer at the Institute of Development Studies. Their contributions combined the discussions on poverty, self-reliance, and the role of science and technology. The synthesis of this endeavor is the *Sussex Manifesto* (Singer et al. 1970), prepared for the debates of the UN Second Development Decade. This document proposed that developing countries should have their own scientific and technological capability, in order not only to increase production but to improve their capacity to produce.

Inspired by these ideas, a literature emerged in the 1970s and 1980s about how firms in the less developed world acquire and develop technological capabilities (Katz 1987; Ernst, Ganiatsos, and Mytelka 1998). Key concepts of these contributions were the notions of technological capabilities and learning. Several empirical studies have shown how less developed countries have managed to develop skills, leading to more "efficient" production, at least in the short term. These studies focused mostly on the knowledge and skills required for production (where shop floor experience and "learning by doing" play an important role) and for investment, as well as adaptive engineering and organizational arrangements required for the continuous updating of product design and performance features (Dahlman, Ross-Larson, and Westphal 1987). A limitation of these studies was that they were circumscribed by the connection of technology with production.

Over the same period, Latin American authors stimulated by the structuralist approach developed a number of firm-level studies. This work not only showed successful stories of technological up-grading, but noted that a learning approach to technology ignored key elements, such as the role of institutions, the macro-economy, and conflicts over power. For example, the S&T Policy Instruments Project (Sagasti 1978) found that implicit policies (general macroeconomic, industrial, and trade policies) had a much deeper effect on innovation strategies by firms than explicit ones. Such implicit policies inhibited technological development by firms (Herrera 1975). This work also pointed out that by concentrating on learning processes within the firm, the technological capabilities literature ignored external economies associated with the capacity to generate innovations.

There was a surge in Latin America of work on innovation deriving from the need to address paradigmatic changes and problems and options deriving from the diffusion of the information technologies. Building on Furtado's (1958) study of the industrial revolution, authors like Herrera (1975) and Perez (1983) analyzed the opportunities and challenges associated with the introduction of radical changes. It was only then that the literature started to integrate the empirical work on learning inside firms with the contributions on new technologies and systems of innovation. The role of government policies in orienting the speed and direction of technological changes was also highlighted (Freeman and Perez 1988).

# Applying the IS to Development

Since the 1980s, conceptual and empirical work have co-evolved and the concept of national innovation systems has been adopted by international organizations (particularly the OECD, the European Commission, and UNCTAD) as a tool for policy making. More recently, the U.S. Academy of Science began to use it, and Sweden created a new central government institution, VINNOVA, which stands for Systems of Innovation Authority (Lundvall 2007). A set of empirical studies began to apply the innovation systems perspective to development analyses. These studies start with the country characteristics and address specific challenges, opportunities, and hurdles for their development. Such efforts have consolidated the IS framework. Drawing on work in Africa, Asia, and Latin America, they offered important inputs for its enrichment, stressing aspects that proved especially relevant for less developed countries. Such work contributed five advances in our understanding of innovation systems and development, which are described below.

## From Catch-up to Unique Development Paths

There is a frequent misleading perspective in a broad set of literature on the concept of catch-up that suggests a fundamental difference in the innovation systems of developed and developing countries. It focuses on the evolution and "shaping" of innovation systems in the former and "construction" or "creation" in the latter. As discussed above, the IS concept was inspired in part by development thinking and its emphasis on how countries could overcome underdevelopment. An important aspect is the recognition of asymmetries in (and the dual character of) the international economic and technological development process.

It is therefore unrealistic to expect a linear process of catch-up, in the sense of an accelerated process of constructing and strengthening similar institutional and productive structures to those of a leading country—thus following the same path as the leader. The only dimension in which an effective "reduction of the leader's advantage" is proposed is in the capacity to acquire, use, transform, and create knowledge, applying it for productive purposes. This relates to the substantive challenge of "borrowing" and adapting technologies that the technological lead countries control, through a combination of reverse engineering, licencing, sending scholars abroad, inviting foreign firms and experts, and engaging in international scientific collaboration (Lundvall 2007). The institutional setup could be adapted, redirected, and even enriched, but necessarily based on its specific characteristics, determined by its historical evolution process. Thus, the resulting institutional, scientific, technological, and productive setup that would allow a country to catch up with the leaders would necessarily be specific and unique.

Underdevelopment is not a phase in a country's linear development, but a result of structural and historical elements in a global context, in a certain sense complementary to the existence of developed countries (Furtado 1961). This perspective calls for the construction of a unique path that takes into account the specific natural, social, and cultural contexts. Development is not a matter of "creation" or benchmarking innovation systems, as there is no linear catch-up path to be followed. Every country has different institutions and more or less developed scientific, technological, and productive capabilities in different areas. Even

in the poorest countries there are productive activities, formal or informal structures and processes of knowledge generation and diffusion, and institutional and political setups. In any country one can find innovations, even if only incremental. Thus, every country has an innovation system.

Such considerations are even more relevant after five years of deep international crisis, which underline the limitations of catch-up policy based on modes of production that make extensive use of natural resources.

There are at least two important corollaries to this discussion: (i) there is no inevitable trend from any given stage of progress to another supposedly superior, and (ii) development has to be understood as a historical process specific to each country and not as a universal process. National and local conditions may lead to completely different paths and to a growing diversity instead of the standardization and convergence suggested by the more radical theses about the influence of globalization on national and sub-national systems. Therefore, the importance of elaborating and answering questions about the type of development being pursued, about its sustainability, and about how innovation systems are geared toward sustainability should not be overlooked.

## The Broader Context

The IS framework recognizes that the evolution of any economic system depends to a large extent on its place in the *hierarchy and power structure* of the world economy. It also takes into account the *micro*, *meso*, and *macro dimensions* and their linkages as important for the understanding of a country's performance. From this derives the following conclusions: that macroeconomic systems contain and condition the microeconomic decisions that form the standards of financing, corporate governance, international trade, competition, and technical change; and that innovation strategies (and outcomes) depend on and reflect macroeconomic regimes and geopolitical forms of insertion in the world economy.

Macroeconomic instability and vulnerability can hinder learning and the creation and diffusion of innovations. Problems such as high external debt and high interest rates constrain technological and industrial development. The "implicit" policies related to macroeconomic contexts in developing countries are of much greater importance than specific innovation policies (Herrera 1975; Sagasti 1978; Coutinho 2003).

## Knowledge, Learning, and Innovation

Besides the complex processes of knowledge generation, diffusion, and use, the innovation system framework stresses the capabilities among organizations to generate, diffuse, and use knowledge. Studies focusing on less developed countries, regions, and localities underline the importance of understanding learning and innovation efforts in all kinds of organizations, even those far behind the technological frontier. A broad set of studies focused on "traditional sectors," such as the clothing and furniture industries and agriculture. From a development perspective, knowledge and innovation processes with far-reaching impacts are not the only ones worthy of consideration: in countries with little economic dynamism, centered on traditional activities, even minor transformations of production processes, organizational aspects, product variety, or elements that enable access to new or broader markets may have

considerable impact. Such modest innovations, commonly overlooked and ignored in official S&T indicators, translate into a substantial increase in the ability to produce and compete on a sustained basis, generating income and jobs and enhancing living standards. Innovation includes any element of novelty that is new to the agent that introduces it. A broad search for elements of novelty can reveal much innovation occurring in places where standard indicators would suggest that very little is going on (Cassiolato and Lastres 1999). This has inspired recent attention to "grassroots" or "below the radar" innovation.

Directly related to this discussion is the emphasis on accumulating capabilities and knowledge for sustained competitiveness. This emphasis stands in clear opposition to the supposed comparative advantages of developing countries, such as low-price products, low labor cost, and the intense use of natural resources (Fajnzylber 1988). Countries that depend on the import of existing technologies need substantial learning efforts in order to absorb and effectively use these technologies. The capacity to learn (having access to the means and opportunities) turns out to be much more important for inclusion than the access to ICTs. Thus, overcoming the "learning and knowledge divide" constitutes a much more fundamental challenge for policy action than targeting the "digital divide" (Arocena and Sutz 2003). Once more, empirical investigation in developing countries reveals a diversity of learning based on the very use of knowledge that results in modified technologies, adapting them through minor modifications and combinations to address specific problems and needs (Cassiolato, Lastres, and Maciel 2003).

Such innovation often relies in part on knowledge that is not directly linked to the formal education and S&T system. Important transformations and the key elements for the sustained use of limited resources often derive from knowledge that is rooted in a specific territory and that relates to specific conditions and cultural habits and practices. This perception gave rise to considerable research efforts focused on the use of "traditional" or "indigenous" knowledge and its articulation with more formalized and technological knowledge (Lastres, Cassiolato, and Maciel 2003).[4]

This broader and systemic understanding of knowledge and innovation also has clear advantages for less developed countries and encourages policy-makers to consider opportunities for learning and innovation in any productive activity, not just in sectors considered dependent on advanced technology (Mytelka and Farinelli 2003). As innovation is essentially a context-specific and socially determined process (Freeman 1988), acquiring technology from abroad cannot substitute for local effort. A lot of local knowledge is required to select, buy (or copy), transform, and use technology. Such findings have helped broaden the scope of S&T policy, but there is still a long way to go.

## Addressing Specific Development Challenges

The IS framework is also useful for addressing specific development challenges, such as environmental sustainability, social development, education, housing, health, and infrastructure (sanitary, transport, communication). In order to tackle such challenges it is necessary to search for convergence and interaction among many different actors with different interests, power positions, and capabilities. It has been suggested that the evolution of innovation systems should be oriented toward specific *development challenges*. This may have implications for policy choices related, for example, to the priority given to certain technologies (high-tech

and with pervasive impacts) or types of institutions, such as the creation of "world class" niches and firms.

A more focalized approach argues for targeting action toward innovation intended to advance social and environmental outcomes, such as adequate provision of food, health, education, and housing systems. These issues have been studied and targeted in policy action under the headers of social and environmental innovations. A framework for analyzing these types of innovations stresses the importance of close interaction with the people who stand to benefit from the outcomes: in this view, empowering and engaging intended beneficiaries is fundamental. Successful cases involve people as protagonists in user innovation, drawing on their experience and knowledge to design solutions according to their needs. For example, participation by poor people has proven critical for diffusing soil conservation techniques, capturing rainwater in semi-arid areas, and using ICTs in basic education. Considering the broad and diversified set of actors, institutional setups, and knowledge types involved in understanding and addressing these development challenges, a systemic approach is useful.

The characteristics of the productive agents—their formal or informal character and their size—can also be seen as critical for promoting socio-economic development. Thus, much research has specifically addressed issues like informality, inclusion and exclusion, and the challenges faced by small enterprises. The threats and obstacles faced by these agents, and their integration into the economy to help them move away from subsistence toward sustained competitiveness, are a major challenge for policy (Freeman 2000).[5]

## Emphasis on the Territory and Interaction

The issues discussed underline the importance of understanding the social process that facilitates innovation within a specific territory (the definition of which extends beyond geography and considers social, economic, and political factors). This territorial dimension is particularly important for addressing development issues.

First, the experience of many developing countries—Brazil is an outstanding example—showed that aggregate or average levels of social development, output, income, performance in specific sectors, or technological fields hide huge imbalances. The historical trajectory of many developing countries led to a great heterogeneity of the productive and social structures. In large countries like Brazil, India, and Mexico, one can find both advanced and very archaic production and innovation systems within the same sector or technology field.[6] Local areas that are less dynamic in economic terms often present considerable challenges related to social development. More generally, every productive activity has to be understood within that particular location's specific social, cultural, institutional, and natural context.

In this context, a main challenge of the innovation system framework is understanding how specific structures evolved, which are the specific challenges and potentialities, and how specific policy initiatives could foster the learning and innovation processes and induce a dynamic and sustainable local development process. The needs are specific, and so must the initiatives be. In many cases job and income generation on a sustained basis, preventing the disruption of social structures and poverty, may be the most important goal for public policy.

Second, most learning occurs locally. Each agent possesses a specific and limited set of knowledge, and new knowledge is generated and diffused via interaction among different

kinds of networks. Even if the new information and communication technologies enable greater codification and anonymous diffusion of knowledge, an ample set of empirical findings stresses that tacit knowledge is fundamentally important. Diffusion requires a close, essentially personal, interaction among organizations and people.

Research and policy efforts addressing the issues cited above have focused on the local dimension and so-called local (or regional) innovation systems. Different conceptual and analytical frameworks have emerged for analyzing productive and innovative activities in the local dimension (e.g., industrial districts, clusters, and *milieu innovateur*).[7] For example, case studies of the textile and clothing and electronics industries in Taiwan and Korea confirmed that inter-firm linkages, including subcontracting arrangements, were crucial channels of technological learning—in some cases, even more important than foreign direct investment (Gee and Kuo 1998). In Africa, Djeflat (2003) analyzes the local flows of knowledge in Maghreb countries and the incentives that support innovation among small and medium-sized enterprises, and Baskaran and Muchie (2005) discuss the role of regional economic poles for development in South Africa. In Latin America several initiatives incorporating the notion of IS have been introduced, covering industries such as aerospace, biotechnology, automobile, software, textiles/apparel, agro-industry, tourism, footwear, and music and other creative industries (see, e.g., López and Lugones 1999; Vargas Alfaro 2000; Segura-Bonilla 2000; Cassiolato, Lastres, and Maciel 2003).

Since 1997 the Brazilian research network RedeSist (Resarch Network on Local Innovation and Production Systems) has focused on innovation systems in the context of a large developing country. Seeking to apply the IS framework to this reality and combining it with the Latin American development thinking led to the consolidation of the conceptual and analytical framework of Local Innovation and Production Systems (Cassiolato, Lastres, and Maciel 2003). This framework has been applied to the analysis of over two hundred innovation and production systems in different regions of Mercosur countries to capture dynamic evolution of systems in advanced (such as aircraft production) and traditional manufacturing (textiles and clothing) and in agriculture and services (including audiovisual), as well as in informal activities and traditional knowledge and technologies that affect local production and development.

These studies have focused primarily on knowledge and learning processes for capacity building, and the link between innovation and development challenges. They stress that the specific territory in which production, learning, and innovation take place constitutes a key unit of analysis, as each territory or country faces specific challenges and takes a very specific development path. Further, they suggest that there is not necessarily a contradiction among economic, technological, and social/environmental goals and that a systemic perspective is essential to envisage the potential convergence of these goals and to guide policy action in that direction.

## Conclusion

This chapter has argued that the innovation system (IS) approach represents a powerful instrument for understanding and orienting policies to promote learning, innovation, and competence building processes in all countries, including so-called less developed countries.

The chapter has articulated some advances and advantages of this approach: it positions innovation and learning—understood as systemic, specific, and cumulative processes—as central elements of development; it sheds new light on how organizations generate, assimilate, and diffuse knowledge; and it encourages consideration of how different actors are linked across agriculture, extractive industries, manufacturing, and services.

As discussed above, in Latin America and especially in Brazil, the convergence of this new way of understanding production and innovation with the knowledge accumulated by the structuralist school has contributed to extending the list of arguments in favor of a systemic approach—notably by considering inequality as a main cause of underdevelopment and stressing the role of government intervention in this respect, and by highlighting the need to develop and use contextualized knowledge and policy models capable of dealing with the specific realities of different countries and regions. It is important to orient the innovation systems to attend to development needs: addressing capabilities to enhance food security and nutrition; to improve access to housing, education, health, and culture; and to promote the expansion of substantive freedoms, that is, participation in public life and political processes (Sen 1999).

A closer look at the performance of Brazil in the last ten years reveals important facts and tendencies capable of inspiring and invigorating the innovation and innovation policy debate. Particularly relevant are the outcomes of the "Brazil Without Misery" anti-poverty plan.[8]

With the per capita income of the poorest 20 percent of the population rising by more than 8 percent per year, the country has been able to reduce extreme poverty by half in five years (from 17.5 percent in 2003 to 8.4 percent in 2009). A significant part of these transformations is due to a significant increase in the minimum wage and a better implementation of public transfers, especially the *Bolsa Família* cash transfer program; however, the productive insertion of the low-income population was even more instrumental in increasing per capita income. Expanding and improving public services such as health care, education, and housing has also contributed to the recent transformations (Brazil 2011).

The results of the Brazil Without Misery plan reinforce two main arguments of this chapter. First, in order to achieve development it is necessary to tackle inequalities, and therefore that objective should be at the center of the research and policy agendas. This requires widening the perception of innovation systems, understanding that innovation is not restricted to a group of "advanced" actors, activities, and regions of the world. This will probably shed light on the group of activities capable of mobilizing productive inclusion and improving essential public goods and services. Second, the above results underline the need to overcome the trap of ignoring territories and contexts and dissociating economic from social development, in both research and policy programs—hence the importance of understanding production and innovation systems centered in activities such as health, sanitation, etc.

However, the adoption of the innovation system framework is not without its problems. Many initiatives are based on a distortion of the original concept, which reflects remnants of the linear innovation model and the narrow definitions of innovation as synonymous with formal science and technology. This has led to highly problematic attempts to subordinate all academic scientific work to a very limited economic logic. Calling attention to the usual resistance and misuse of new and more advanced concepts, Reinert and Reinert (2003) warn that "by integrating some Schumpeterian variable to mainstream economics we may not arrive at the root causes of development. We risk applying a thin Schumpeterian icing on what is essentially a profoundly neoclassical way of thinking." Time, history, geopolitics, and

specific territorial conditions are fundamental to the analysis of how production and innovation capabilities are acquired, used, and diffused.

It is worth mentioning the challenges of working with new concepts, particularly those aiming to capture and evaluate intangible resources or involving high levels of inequality and informality. The complexity inherent in the requirement to include simultaneously many different dimensions, actors, and institutions would puzzle the uninformed analyst. Reductions have to be made, but their implications have to be considered.

As argued in this chapter, innovation is essentially a social process. If the main development constraint of a region or a country is misery eradication, innovation has a very relevant role in the provision of possible solutions. This of course requires focusing on production and innovation systems capable of contributing to new forms of inclusive, cohesive, and sustainable development.

There are both challenges and significant opportunities to the development and use of more advanced approaches to understanding and orienting innovation. Facing them will lead to new avenues of possibilities, from broadening and refining concepts and methodologies to transforming them into more advanced and useful instruments. By discussing experiences already in place, we hope this chapter will contribute to expanding our knowledge about innovation and its role in development.

## Notes

1. Using the examples of Japan and South Korea in the past and of China today, Rodrik (2011) criticizes the so-called new structural economics in this regard.
2. As pointed out by Stiglitz (2011) in a critique of the new structural economics, "focusing on absorbing and adapting, and eventually producing knowledge, provides markedly different perspectives on development strategies than those provided by the neoclassical model" which center on increasing capital and the efficient allocation of resources.
3. All three authors played an important part in the setting up of the UN. Prebisch became Executive Secretary of the UN Economic Commission for Latin America, Myrdal became Executive Secretary of the UN Economic Commission for Europe, and in 1947 Singer joined the Economics Department of the UN on a provisional assignment that lasted 22 years.
4. Muchie (2007) and Adeoti and Adeoti (2010), for example, discuss the importance of such knowledge for the transformation of agriculture in Africa.
5. These discussions converge with those proposed by Berry (this volume), underlining equality and inclusiveness as central guidelines for promoting human satisfaction in a broad sense.
6. Some critics may argue that most of these structures do not actually constitute a system. This relates to the mistaken view of an innovation system as an object. It is a rather a framework of analysis. Wherever goods or services are produced, there will be a system around them comprising different activities and actors, particularly those associated with the acquisition of raw material, machinery, and other types of input. These systems range from extremely simple, modest, or disjointed to highly complex and articulated.
7. Though some authors suggest that these concepts are equivalent to the local IS concept, we claim that the IS framework offers a broader and more comprehensive tool for understanding links with an entire system and the interactive learning processes.

8. In June 2011, President Dilma Roussef announced a new multibillion-dollar anti-poverty plan called *Brasil Sem Miséria* ("Brazil Without Misery") designed to eliminate dire poverty in the next four years.

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