

Brazil

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The adoption of the broad concept of a national system of innovation leads to the discussion on the connection between innovation policy and development policy. Once the political-institutional and geopolitical sub-systems, the sub-systems of policies and representations and the sub-systems of social and economic demand are all comprised in the definition of the national innovation system, it becomes essential to consider the social disparities and heterogeneities in the analyses of innovation policy, in addition to the productive/innovative sub-system.

This connection is even more relevant in a context of underdevelopment, marked by structural (productive and social) heterogeneity. In this case, development policies should determine the strategies that permeate other economic policies. Development policies will necessarily impact the others because if they exist they will manage these structural heterogeneities, and consequently will affect the other policies, and if they are absent, they leave the treatment of these heterogeneities to other policies.

It is worth noting that the concept of development used here emerges from the requisite to overcome the historical conditions of Latin American countries. According to Cassiolato and Lastres (2008), three main characteristics can describe the development process. First, the process is characterised by changes in the social and economic structure. Second, development is a systemic process (this characteristic of development implies the importance of interactions between parts of the national innovation system [NSI] along the learning process). The third attribute of development is the country's specificities in this process, which means that the development process is unique to each country. The Latin American

structuralist school — particularly its main contributors, Celso Furtado and Raúl Prebisch — emphasises that the heterogeneity of the social and economic structures in Latin American societies must be considered in the formulation of their development policies. Without this perception, both the structures and the logic that reproduce underdevelopment would persist. These authors identify underdevelopment as an autonomous process, with its intrinsic logic, and not as a stage in a path towards development. Therefore, the development process is not seen as a convergent movement of underdeveloped economies to developed ones. Underdevelopment is considered an autonomous and historical process in a country. The elaboration of specific policies, aimed at breaking the logic that reproduces underdevelopment, constitutes the main role of the state. The requirement of thinking of innovation policy as integrated to development policy, once innovation is recognised as the motor of economic growth, is related to the fact that such growth will not automatically imply development. In order to reach development, the innovation policy must be integrated to the development policy, which should be specific to the context of underdevelopment and, therefore, distinct from the prescriptions provided by developed countries.

Several neo-Schumpeterian authors — particularly Albuquerque, Cassiolato, Lastres, and Viotti, among others in Latin America — have been contributing in recent years to an approach that combines the structuralist and the Schumpeterian schools. This approach makes it possible to include the social issue in the debates on innovation and to start discussing policies that are appropriate for underdeveloped countries. Since 1996, Freeman has claimed that the only way to guarantee that underdeveloped countries will ‘reach’ those which are developed, in terms of standards of living, is by satisfying two essential conditions: the innovation system should respond to social and economic demands; and the economy should respond to both institutional changes and social policies (Freeman 1996: 34).

In connection with heterogeneities in the social structure, there is also the issue of regional heterogeneity. Particularly in Brazil, regional inequalities are marked by the concentration of productive, scientific and technological structures, as well as of income. Internally, such regions reproduce the social inequalities (of income) and the disparities of the productive structure of the country.

The analysis of innovation policy in Brazil should, therefore, consider the context of underdevelopment and the asymmetries related to it in its productive, social and regional structures. Even when dealing with an explicit innovation policy, with respect to the innovative and productive sub-system, other dimensions of the policy must be considered, especially the social one.

This chapter is structured in five parts. In the first of these, the historical evolution of the innovation policy is presented, with emphasis on the relations and on the dichotomies between state and market, delimiting the period of analysis of innovation policy in Brazil to the post-2006 period.¹ The second part presents a synthesis of the main institutions, programmes and mechanisms of the explicit innovation policy in the ambit of the federal government. The third part discusses the limits and the difficulties in the structure of the national system of innovation in Brazil, considering mainly the implicit policies in the country. The explicit innovation policy is presented in the fourth part, where the implicit policies are also highlighted as well as the difficulty of articulating these with the explicit policy — particularly the policy of education. In the fifth part, we discuss the goals proposed in the scope of the federal government's innovation policy for the period under analysis.

Evolution of the Current Form of State

After World War II — in the 1950s — Brazil experienced a phase where the state guided the development policy based on an industrialisation model that, at first, prescribed the establishment of state enterprises financed by international funds.

This role of the state, which contributed to promote industrialisation, was based on the idea that it was necessary to establish the scientific and technological infrastructure and the industrial foundations in the country. Since the beginning of the 20th century, the state sought to create an organisational infrastructure for R&D restricted mainly to the agricultural and biomedical areas. After this phase, the main concern was establishing sectoral R&D within organisations. Examples of these organisations were Petrobrás (the Brazilian Oil Company created in 1953 as a state-owned enterprise with the main objective of exploring Brazilian oil and which nowadays is the fifth

most important oil company in the world), the Aerospace Technical Centre (Centro Técnico Aeroespacial, CTA, established in 1954) and the National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais, INPE, founded in 1961).

Between the end of the 1950s and the beginning of the 1960s, in spite of structuralist arguments, this model was supplanted by a new one based on the attraction of foreign capital enterprises with the purpose of importing industrial technology emerging from the 'second industrial revolution' — the objective, then, was 'skipping development stages'. In order to finance the industrialisation process, the so-called (and well-known) model of imports substitution was adopted.

At that moment, the state employed an innovation policy based on the idea that it would be possible to 'skip stages' for reaching development, relying very much on foreign capital and technology.² Such an idea was opposed at that time by the nationalist vision of the structuralist school, which emphasised the importance of embedding technology in the productive structure, and considered underdevelopment as an autonomous process rather than a stage towards development.

On the assumption that the state must lead the innovation policy, the federal government decided to set up another important organisation in order to promote research and development within a strategic field for the country — agriculture. In 1972, based on the experience of the country in this field since the end of the 19th century, the Brazilian Agricultural Research Corporation (EMBRAPA) was created. This enterprise was very important for the development of technologies suited to tropical agribusiness and enabled Brazilian producers to be among the most productive ones in terms of international parameters.

The model of imports substitution industrialisation, in spite of its relative success (once it effectively promoted the industrialisation of the country) and the expressive rates of growth in the gross domestic product (GDP) (Table 2.1), has subsequently been the target of many criticisms. The main downside comes from the fact that the country remained 'closed' for too long, with its enterprises protected against international competition, which resulted in a relative technological backwardness and, consequently, loss of international competitiveness.

Table 2.1: *Real Growth Rate of Gross Domestic Product (GDP), 1950–1980*

<i>Period</i>	<i>GDP–Real Growth Rate (% p.a.)</i>	<i>Period</i>	<i>GDP–Real Growth Rate (% p.a.)</i>	<i>Period</i>	<i>GDP–Real Growth Rate (% p.a.)</i>
1950	6.80	1960	9.40	1970	10.40
1951	4.30	1961	8.60	1971	11.34
1952	7.30	1962	6.60	1972	11.94
1953	4.70	1963	0.60	1973	13.97
1954	7.80	1964	3.40	1974	8.15
1955	8.80	1965	2.40	1975	5.17
1956	2.90	1966	6.70	1976	10.26
1957	7.70	1967	4.20	1977	4.93
1958	10.80	1968	9.80	1978	4.97
1959	9.80	1969	9.50	1979	6.76

Source: IBGE (Brazilian Institute of Geography and Statistics) website, <http://www.sidra.ibge.gov.br/bda/cnt/default.asp?z=t&o=15&i=P> (accessed 19 October 2011). Authors' elaboration.

One of the main targets of this criticism was the information technology policy adopted in the 1980s which, rather differently in relation to other segments of economic activity, had its development based on firms of domestic capital. The model has been criticised because it was unable to produce internationally competitive 'information technology', as the domestic production was considered relatively 'obsolete'. However, the critics neglected the building up of human resource capabilities that resulted from this process, as well as the constitution of enterprises that turned the country into a leader in some technologies, such as bank automation.

As a consequence of such criticisms, in the 1990s the market took the leadership of the accumulation process and the state withdrew substantively from the economic environment. From this moment on, neoliberal ideas started ruling the policies of the federal government, also following the global tendency to embrace neoliberalism. In the face of this new logic, measures began to be taken aiming at the reduction of the role of the state in the economy. Privatisation, trade liberalisation and financial liberalisation, among other measures, were implemented throughout this decade. Measures such as the quick withdrawal of non-tariff barriers and suppression of trade tariffs were adopted, without the creation, at least not

immediately, of any filter or policy for protecting the enterprises and the economic activities developed in the country.³ The logic underlying all this was that market failures are less significant than the failures of state intervention.

The consequence of these market-led policies was what became known as the ‘two lost decades’ — the decades of the 1980s and 1990s — because of their relatively low or even decreasing GDP growth rates, which may be seen in Table 2.2.

Table 2.2: *Real Growth Rate of Gross Domestic Product (GDP) and Inflation Rate (IPCA), 1980–1990*

<i>Period</i>	<i>GDP–Real Growth Rate (% p.a.)</i>	<i>IPCA–Extended Consumer Price Index Growth Rate (% p.a.)</i>
1980	9.20	99.3
1981	–4.25	95.6
1982	0.83	104.8
1983	–2.93	164.0
1984	5.40	215.3
1985	7.85	242.2
1986	7.49	79.7
1987	3.53	363.4
1988	–0.06	980.2
1989	3.16	1972.9
1990	–4.35	1621.0
1991	1.03	472.7
1992	–0.54	1119.1
1993	4.92	2477.2
1994	5.85	916.50
1995	4.22	22.40
1996	2.20	9.56
1997	3.40	5.23
1998	0.00	1.66
1999	0.30	8.94
2000	4.30	5.97

Source: IBGE (Brazilian Institute of Geography and Statistics) website, <http://www.sidra.ibge.gov.br/bda/cnt/default.asp?z=t&o=15&i=P> (accessed 19 October 2011). Authors’ elaboration.

Furthermore, this policy became known as the ‘stop and go’ policy, characterised by an environment of high monetary instability and high inflation rates. Thus, whenever the growth rates became positive and exceeded 5 per cent and inflation rates accelerated, plans for stabilisation were adopted for slowing down the GDP growth. In the 1990s, following the ‘Real Plan’ (*Plano Real*) of 1994 (Plan for Economic Stabilisation), a regime of inflation targeting was adopted with its main instruments being restrictive monetary and fiscal policies, and its unique objective of holding back the inflation rate. We can see in Table 2.2 that the Real Plan succeeded, because after 1995 the inflation rate fell to a new level, although this was accompanied by a low growth of GDP.

In spite of the mediocre growth rates of the economy and a big deficit in the trade balance that accompanied it, the market continued to lead both the accumulation process and the industrial and innovation policy, which continued to be neglected by the federal government until the end of the 1990s.

The federal government returned to the inclusion of innovation in the policy agenda in 1999, although it was restricted to the Ministry of Science and Technology (MS&T). In 1999, sectoral funds were created aimed primarily to finance partnerships between the production sector and the institutions of science and technology. These funds were conceived following the diagnosis that Brazil had attained the consolidation of a wide and competent scientific and technological infrastructure, but was unable to establish an innovative production sector. In order to change this situation, it would be necessary to foster the links between the two segments of the national innovation system. Many analyses show, however, that by the end of 2006 the merit of the sectoral funds was limited to re-establish the budget of the MS&T back to the amounts available in 1995.⁴

With the creation of the sectoral funds, the MS&T started the formulation of the National Policy of Science, Technology and Innovation. The latter has instituted, or designed, mechanisms and instruments that were first implemented in the period 1999–2006. The most important among them, in addition to the sectoral funds, were the mechanisms for equalisation of interest rates and for economic subvention to firms. At the end of 2003, the new federal government of President Lula also launched the Industrial, Technological and Foreign Trade Policy (PITCE — *Política Industrial, Tecnológica e*

de Comércio Exterior). For the first time in two decades the federal government was able, again, to make use of the term ‘industrial policy’.

In this period, the state again took the lead in innovation policy making, by creating new instruments aiming at affecting innovation strategies of firms and positively influencing economic activity. Nevertheless, we may say that the intervention of the federal government was reticent, since it constituted a modest participation of the state in economic decisions and in defining priorities. Indeed, the PITCE did not set specific mechanisms and instruments for its implementation, which was based on those established by the Policy of Science, Technology and Innovation.

The Policy for Production Development (PDP) launched in the second term of President Lula, on the other hand, aimed at avoiding the problems of coordination shown by PITCE, by creating a structure of governance that was specially concerned with articulating the actions of the various ministries — particularly the Ministries of Science and Technology and of Development, Industry and Foreign Trade.

From a neo-Schumpeterian perspective of innovation policy, the launch of PITCE and PDP by the federal government can be deemed an advance, since it allows a clear reference to a necessary integration between the industrial policy and the scientific and technological policy. Although the National Policy of Science, Technology and Innovation was launched in the period 1999–2002, its political agenda remained restricted to the Ministry of Science and Technology in view of the resistance within the Ministry of Economy towards an industrial policy. This led to some delays in the creation and implementation of instruments that were devised in that period — for instance, the economic subvention.

Although they are seen as advancements, PITCE and PDP still do not incorporate the debate on integration of the remaining policies that comprise other NSI sub-systems as, for instance, educational, macroeconomic and social development policies. These three lines of implicit policies have, in the Brazilian case, significant impacts on the innovation system.

Failing to integrate innovation into these policies makes evident the division that prevails in the ambit of the federal government between the discussions on innovation policy and on development

policy. Such a lack of connections leads to missed opportunities with respect to the reduction of structural heterogeneities.

The extent of the academic debate and the advances in innovation policies bring evidence to the relevance of an integrated perspective of NSI, as the aim of the innovation policy is to effectively impact such a system and not only isolated agents. To face this, the integration of the innovation policy to other policies is required, together with actions which take into account the relevance of a development vision that will set the strategic guidelines for such integration. It is not a matter of reproducing an 'old-fashioned' way of policy making, but rather of devising a new way that is appropriate to the local specificities as, indeed, the neo-Schumpeterian school recommends.

Periodisation and analysis of institutions and policies of the state concerned with innovation

The periodisation, starting in the 1990s, established for the innovation policy in the ambit of the federal government, points to the government's choice for policies of a neoliberal character. Within this policy trend, innovation policy as such was not even tolerated (1994–1998) and, when the government decided to adopt one, it seemed inspired by the narrow concept of a national innovation system (practically limited to university–industry relations). In consequence, the innovation policy was restricted to the MS&T without connections to other government policies.

The genealogy of the innovation policy reflects such a neoliberal option by the government which fails to incorporate the advancements of both the academic debate on the innovative process and of policies implemented by other countries. This analysis also reflects the disconnection between the innovation policy and other implicit policies such as education and development, since, during the period studied, no integration was observed. The federal budget shows that only a few ministries have made significant expenditures aimed explicitly at innovation policy.⁵

The present analysis of policies and actions implemented in the ambit of the federal government is restricted to the performance of three institutions — the Ministry of Science and Technology (*Ministério da Ciência e Tecnologia*, MCT); the Ministry of Development, Industry and Foreign Trade (*Ministério do Desenvolvimento*,

Indústria e Comércio Exterior, MDIC); and the Brazilian Federal Agency for the Support and Evaluation of Graduate Education (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*, CAPES), subordinate to the Ministry of Education (MEC) —which present the highest expenditures and which hold policies and strategic guidelines that explicitly acknowledge the importance of innovation. The analysis of these departments also comprises their subordinate agencies which played a fundamental role in the implementation of the innovation policy. These institutions — Studies and Projects Funding Agency (*Financiadora de Estudos e Projetos*, FINEP), National Council of Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico*, CNPq), both linked to MCT, and the National Bank of Economic and Social Development (*Banco Nacional de Desenvolvimento Econômico e Social*, BNDES), linked to MDIC — are primarily related to the provision of funds and to the promotion of innovation.

The period of analysis extends from 2006 to 2010.⁶ The objective is to understand and critically analyse the main measures adopted as well as the evolution and trends of resource allocation throughout the period in question. In order to do so, the institutions and organisations under analysis will be presented according to their chronology of creation. There is a sequence of main trends in terms of the establishment of the innovation policy: in short, first the importance of science and technology policy (in the 1950s), second, of industrial policy (in the 1960s) and third, of innovation policy in a broad sense (from 2000 onwards). Two important ministries will be presented, the MS&T and the Ministry of Industry; and also CAPES, the agency subordinate to the Ministry of Education. The following descriptions will only highlight the programmes and agencies related to innovation policy.

The Ministry of Science and Technology

The Ministry of Science and Technology was created in 1985, in recognition of the relevance of this issue for the country. It is currently the main department of the federal government responsible for implementation of the explicit innovation policy. In 1999, following a long period without an explicit policy on innovation, a new policy was instituted with the creation of the sectoral funds

— resource funds that would allow the ministry to restore budget resources and to set up the new policy.⁷

In addition, the ministry has a significant participation in the industrial policies, PITCE and PDP, which comprise the explicit innovation policies in the ambit of the federal government.⁸

From 2003 on, the ministry managed to successfully submit a number of Acts to the Congress — for instance, *Lei do Bem* (Law of the Goods) and *Lei da Inovação* (Law of Innovation) — with the purpose of establishing new mechanisms for funding innovation activities, such as economic subventions and interest equalisation, as well as restructuring fiscal incentives for R&D and for innovation. Such mechanisms, although they had been created during the former government, were only implemented as of 2003. They allowed the innovation policy that was designed in the period 1999–2002 to be implemented, based on three main cornerstones:⁹ incentives to technological development and to innovation within enterprises; incentives to the creation of technological infrastructure; and incentives to the emergence of new technology-based enterprises. The credit for both these laws and the initiative of implementing the innovation policy belongs to the current government. Table A2.4 (see Annexure) summarises the main legal acts and programmes that allowed the implementation of the innovation policy.

The Law of the Goods is a mechanism for boosting innovation, which seeks to benefit, by means of fiscal incentives, those firms that perform R&D activities.¹⁰ As already emphasised, the main criticism to the concession of fiscal incentives is related to the inadequacy of such a mechanism for changing the long-term strategies of the agents in the production sector, comprising merely a secondary element in the incentive to innovation. In other words, beneficiary enterprises would invest in innovation even without fiscal incentives, once innovation is part of their long-term strategies. In addition, according to Koeller (2007), such incentives are specifically aimed at firms that perform R&D, thus carrying a restricted concept of innovation.

The Innovation Law (Law no. 10.973) was sanctioned in 2004 and had further regulation in October of 2005 through Decree no. 5563. The new law was built upon three cornerstones: the constitution of an environment appropriate to the establishment of partnership relations between universities, technology institutes and enterprises; the incentive to the participation of institutes of science and technology in the innovation process; and the direct incentive to

innovation within the firms (Arruda et al. 2006). The innovation law has been further improved by incorporating elements related to the promotion of innovation within enterprises.

The Ministry of Science and Technology consolidated in this period as the main agent in the ambit of the federal government for the design and implementation of the explicit innovation policy. Two agencies subordinate to the MCT are part of this strategy of policy implementation — the Council of Scientific and Technological Development, responsible for the concession of scholarships, and the Studies and Projects Funding Agency, responsible for the concession of financing to research, development and innovation projects.

In terms of results, it can be said that, despite the existence of tax incentives over 10 years, the number of beneficiaries is inexpressive, reaching only about 1,500 enterprises from 1993 through 2009, in a total of 300,000 industrial companies in the country.

Council of Scientific and Technological Development

The Council of Scientific and Technological Development was created in 1951, as the National Research Council, and its mission was related to the promotion of scientific research. For many years, CNPq played the role of coordinator of the National System of Science and Technology, until the creation of the Ministry of Science and Technology in 1985.

Now, CNPq is one of the agencies subordinate to MCT, being responsible for supporting research and providing graduate education aimed at consolidating and expanding both the number of graduate professionals and research in the country. The main instrument used by CNPq for accomplishing its objectives is the concession of research scholarships. These are later allocated according to different modes and directed to various levels of education, from secondary school and college to graduate and postdoctoral studies. Scholarships are divided into two main categories: individual scholarships for studies within the country or abroad, and quota scholarships.

Among the scholarships granted by CNPq, some are aimed to *stricto sensu* masters and doctoral programmes, but there are also some aimed specifically to the advancement of technology. The budget assigned to doctoral studies has presented a growing trend during the period under analysis and it constitutes one of the main expenditures of the agency.

Two programmes — Human Resources for Strategic Activities-Innovation (RHAE-*Inovação*) and Stimulus to Retention of Human Resources of Interest to Sectoral Funds (PROSET) — grant scholarships to professionals who develop R&D projects within enterprises, aiming at settling masters and Ph.D.s in the enterprises, in accordance with the logic established by the explicit innovation policy.

Furthermore, in the scope of individual scholarships for scientific development, some mechanisms of promotion are worth emphasising. One of them is the Regional Scientific and Technological Development, which aims at establishing human resources with qualifications in science, technology and innovation in regions in need of expanding the number of qualified professionals. This programme is also concerned with the matter of competitiveness of enterprises.

This modality of support incorporates, then, two fundamental issues from the point of view of the innovation policy: the question of overcoming regional inequalities and the question of integrating graduate professionals to the business area. A negative aspect of this scheme to promote innovation is the linear approach to the process, which associates innovation to basic research. This perspective permeates the procedures of granting this modality of scholarship, requiring professional qualification at graduate level and restricting the concession of ‘scholarships for retaining graduate professionals’ to the firms that develop, are applying, or have been granted research projects. Such requirements *a priori* rule out a wide group of professionals and firms that do not hold the mandatory qualifications and are not involved with scientific research, although it does not mean that they are less innovative or less able to produce innovations.

Also noteworthy is the Industrial and Technological Development (*Desenvolvimento Tecnológico e Industrial*, DTI) scholarship programme. This kind of scholarship is granted to professionals who participate in R&D projects carried out within enterprises.

On the other hand, the Scholarship for Internship/Training in the country is part of the programme Individual Scholarships for Technological Advancement. This is a very important programme for the preparation of professionals in firms that seek to enhance quality. However, as can be seen later in Table 2.3, resources available

for this modality of scholarship were gradually reducing and finally ran out in 2007.

Both scholarship programmes — Industrial and Technological Development and Internship/Training — follow the same logic of DTI, binding the concession of grants to the participation of the professional in a research project. It is therefore assumed that the innovation process is necessarily related to research and the fact that a big deal of innovations and technological advancements occur outside research laboratories is neglected. The restriction of these qualification grants to research projects limits the role that this mechanism could play in a firm.

The analysis of criteria for qualification of candidates corroborates the criticism that these scholarship programmes carry a linear vision of the innovation process in their essence. In the case of DTI, the criterion always requires experience in research, development or innovation activities. Tacit knowledge, which is highly important for innovation within companies, is neglected in this form of granting scholarships.

The priority of the agency is still put on the preparation of researchers, which is reflected in the resources allocated for the concession of the several modalities of scholarships — the major amounts of resources are allocated to doctoral and masters scholarships.¹¹

Finally, one problem faced by CNPq related to its scholarship policy is the instability of budget resources. The variation of these resources along time is not always positive, which hinders the decision-making, design and implementation of a continued policy, able to produce changes in the strategies of the agents that comprise the Brazilian innovation system.

Studies and Projects Funding Agency

The Studies and Projects Funding Agency was created in 1965 and is subordinate to the Ministry of Science and Technology. The institution is responsible for financing activities aimed at innovation and at scientific and technological advancement, by means of granting both reimbursable and non-reimbursable funds to companies, universities and public or private research centres.

This organisation has a number of programmes for financial support. These are divided into four main categories: (a) support to innovation within companies; (b) support to scientific and

technological institutions (STIs); (c) support to cooperation between companies and STIs; (d) support to activities in science and technology (S&T) aimed at social development. Each one of these categories comprises a group of programmes targeting different areas aimed at boosting innovation and scientific and technological development.

Most of these programmes are financed with resources from the sectoral funds and are implemented mainly by means of public bids and calls for proposals. The first sectoral funds were created in 1999 and there are currently 16 such funds whose resources are allocated for financing innovation and S&T development.¹²

One may observe an overlapping of financing priorities — programmes are created for supporting various sectors concurrently. This, in fact, indicates the lack of a strategy for the innovation policy. The projects that have been approved apparently do not follow a coherent policy, spreading over a wide range of areas. Thus, in addition to the problems inherent to the operation of such a wide and varied range of programmes, there is the risk of disconnection of supported projects from the guidelines established by the innovation policy.

One of the principles of the sectoral funds is to promote cooperation and to establish partnerships between companies and scientific and technological institutions (universities, institutes, etc.). The resources are released for the STIs and not directly to the companies, as a form of promoting cooperation between different agents of the Brazilian innovation system. All programmes financed with resources of the sectoral funds can only be implemented according to this methodology. As noted by Cassiolato:

[A] minority of firms is involved in university-industry relations; the studies suggest that, whereas many of the firms maybe do not need to establish cooperation with universities and R&D centres, many [others] do not have the required capabilities, particularly human resources, for establishing the cooperation. Kristensen and Madsen (2003) propose a labour division in the innovation system, in which the large companies specialize in relations with educational and research institutions, while the SMEs exploit the synergies with partners within the value chain (2003: 8).

The existence of qualified human resource in the companies, able to dialogue with the research institutions, is crucial for the success

of the cooperation. Small and medium enterprises may have no qualified professionals able to establish partnership relations with researchers, while large companies generally have their own R&D laboratories, and thus cooperation may end up occurring only occasionally. Furthermore, this mechanism of cooperation between the enterprises and the universities and research institutions bears an implicit linear vision of the innovation process, once it both emphasises the importance of research to the detriment of other processes that are significant for innovation, and neglects the participation of other agents of the national innovation system, who may assume a fundamental role in certain innovative processes.

In addition to these programmes, FINEP has another one, quite important for the accomplishment of activities concerning innovation funding. Economic subvention is one of the main mechanisms used by this institution. The resources available through this mechanism are not reimbursable and are granted through public bids. Economic subvention was launched in 2006 and is granted directly to the company. Each year a new bid is launched aiming at supporting a number of enterprises that have interest in investing in innovation projects.

The objective of the subvention can be summarised as follows: ‘to significantly enhance the innovation activities and to increase competitiveness of both the companies and the country’s economy’.¹³ The idea behind this mechanism is to strengthen the enterprises that aim at innovating, by means of granting non-reimbursable funding to those firms that submit innovation projects and that meet the selection criteria of the bid. Although it was designed in 2002, the subvention was implemented by FINEP in 2006. In that year, the resources allocated to this programme were 300 million Reais (0.013 per cent of the 2006 GDP) and 145 companies had their projects approved. In 2008, 450 million Reais were allocated (0.016 per cent of 2008 GDP) to the programme and 206 companies had their projects approved. The analysis of the beneficiary companies and their respective projects demonstrates that the criteria for selection of the projects are not connected to the strategic guidelines set by the innovation policy, particularly in the bids of 2006 and 2007. Most selected projects were classified by FINEP as projects on ‘general subjects’. The 2008 bid was the first to detail the kind of project

and the policy guidelines for selecting projects, leaving less room for ‘general subjects’ projects.

In December of 2009, 261 new projects (and 560 million Reais) were approved in this programme, for the three strategic areas of information and communication technology (ICT), health and defence. In the other three priority areas — biotechnology, energy and social areas — submitted projects were not recommended for implementation. However, only 229 million Reais (0.007 per cent of 2009 GDP) were spent, and this expenditure was not for these new projects, it was for projects approved in previous years.

Similarly, the resources expended in 2010 in this programme were related to projects approved in other years and corresponded to 526 million Reais (0.014 per cent of the 2010 GDP). Another bid was launched in 2010, but because of the Brazilian Court of Audit (TCU), which was examining the compliance with existing regulations about the legality of the participation of private non-profit organisations and cooperatives in the process of subvention, dissemination of the bid’s results were suspended.

Ministry of Development, Industry and Foreign Trade

In the government of the period 2003–2006, MDIC gained room as a promoter of national development. Policies for industry, technology and foreign trade acquired an excellent position as conditions necessary for development. The ministry is one of the main agents in the implementation of these policies. Some actions and programmes among those implemented by MDIC are directly addressed to innovation. Furthermore, MDIC is the main manager of the Industrial, Technological and Foreign Trade Policy (2003–2007) and the Policy for Production Development (2007–2010).

First, it is possible to highlight the actions/programmes of the Ministry of Development that are more directly related to the innovation process. Table A2.1 (see Annexure) shows some of the actions that the ministry is implementing in the scope of its contribution to the innovation policy. The programmes presented unfold into more specific actions. These involve a range of activities from tax matters to fiscal incentives aimed at small and medium enterprises. These programmes are varied and seek to embrace different niches of the domestic economy.

One of them is the programme for Incentive to Innovation in the Enterprise which has as its major objective, according to MDIC, to provide Brazilian entrepreneurs with an online service for reference regarding the search for solutions of difficulties related to the development of technological innovations. The programme comprises various initiatives that lead to different ways of implementing the policy, as can be seen in Table A2.1.

The main instrument of the programme is the concession of fiscal incentives and its main problem is the fact that it is restricted to larger enterprises.¹⁴ Many authors, like Rothwell (1983), Ergas (1987), Guimarães (2006), and Arundel (2006) emphasise that, although fiscal incentives are used by most countries (except for United Kingdom), the efficacy of such incentives suggests that they are, at best, a secondary element in public support to innovation. The authors affirm that most beneficiary enterprises would have made the investments in R&D irrespective of the concession of the benefit.

On the other hand, the programme Cooperation Enterprise/Technological Institution is based on a model where the enterprises search public R&D organisations aiming at establishing partnerships. This model is based on the assumption that small-sized enterprises are aware of the importance of innovation and interaction with universities and that they have enough capability for establishing cooperative relations. Some problems arise from this assumption. First, many small-sized enterprises do not hold a clear image about the role that universities and research laboratories may play for the growth of the firm. Second, the enterprises that hold this vision hardly have R&D facilities nor are they able to establish partnership relations with R&D institutions. In addition to these findings, one may observe a component of the old linear vision that innovation would result from basic research.

These programmes, although being pointed out by MDIC as initiatives directly aimed at innovation, have no budget resources associated to them, nor any specific tools for their implementation; this makes it difficult to implement effective actions.

The Programme of Micro, Small and Medium Enterprises, created in 2007, is inserted in the objectives of PDP, suggesting that small enterprises are highly important for the development of national production. The ministry's outlays aimed at development of micro,

small and medium enterprises have been made since at least 2004, a period that precedes the PDP. Similar to other programmes, there is a high instability of budget resources that vary significantly along the considered years. Such instabilities make both the decision-making and the implementation of continued actions by policy makers difficult.

The policy of Local Productive Arrangements/Systems (*Arranjos Produtivos Locais*, APL), according to the ministry, has the objective of ‘guiding and coordinating the governmental efforts in the induction of local development, looking for, in accordance with the government’s strategic guidelines, the generation of employment and income and the stimulus to exports’.¹⁵ This would be another form of incentive to small and medium enterprises. Despite the creation of the programme, its implementation faced huge difficulties, given the scarcity of resources and the problems for coordinating the actions with other governmental departments, as well as with banks’ and supporting agencies. According to the budget of MDIC, the resources for the APLs were almost nil in the latter years. Thus, although highlighting the importance of these arrangements for national development, and particularly for regional development, the programme has not been effectively implemented.

This programme would target not only the enterprises, but the development of the region around the arrangements. The government claims that: ‘The strategic option for operations within APLs results, fundamentally, from the acknowledgement that the policies for boosting small and medium enterprises are more effective when directed to groups of firms and not to isolated firms.’ Such a claim, however, seems contradictory to other programmes instituted by the ministry, which have action lines addressed to individual firms, such as the programme of Micro, Small and Medium Enterprises, making it difficult to prioritise resource allocation and to implement effective actions.

The relevance of the Ministry of Development, Industry and Foreign Trade for the explicit innovation policy has unquestionably grown following the implementation of the Policy for Production Development, which was instituted in May 2008. The reason is that the ministry has been appointed for coordinating the policy, having

as executive secretariat the National Bank of Social and Economic Development (BNDES), a public enterprise linked to the ministry that undertakes major responsibilities in the implementation of the policy.

The National Bank for Social and Economic Development

The National Bank for Social and Economic Development is one of the major institutions in Latin America for financing investment in production. According to the bank innovation is seen as a strategic issue for the concession of financing: The support to innovation is a strategic priority for BNDES. The aim is contributing to the expansion of innovation activities in the country and to their systematic fulfilment.

There are some lines of support to innovation, as seen in Table A2.2 (see Annexure), that unfold into lines of direct support to innovation and financing lines aimed at the industry, that would indirectly incorporate innovation. The programmes of BNDES present different formats. The Innovative Capital has its focus on the enterprises with the capability for performing innovative activities. The financing is related to the strategy of the enterprise and this is the only programme that imposes this relevant condition. The idea behind this condition is that financing projects of research and development that are not related to a broad strategy of innovation by the firm brings an implicit risk that the project may be discontinued due to crisis or failures. On the contrary, financing an innovative strategy would tend to change the perspectives and strategies of long-term investment of the firms.

The programme of Technological Innovation has its focus on new technologies, at least for the domestic market, and seems to follow the pattern instituted by the programmes of the Studies and Projects Funding Agency presented earlier. Another programme is the Technological Fund (FUNTEC) that presents, according to BNDES, the following premise: to support projects of research, development and innovation in areas of clear relevance for the country. The priority sectors are: health, renewable energies and environment. These are relevant topics for the Brazilian innovation system, since Brazil is a large country with great capacity for expanding the use of renewable energies (solar, wind power, biofuel, etc.), with one of the greatest biodiversities of the planet, and with sensitive deficiencies regarding tropical diseases among others.

The programmes offer interest rates lower than those applied in the market, but conversely to the programmes of FINEP, their financing lines are reimbursable. Technological Innovation shows interest rates of 4.5 per cent per year and Innovative Capital presents an interest rate comprising financial cost, basic remuneration set by BNDES and credit risk rate. It is important to note that there are no budget resources associated to the programmes, which makes their implementation difficult.

The programmes cited earlier were related to innovation and there are other ones associated to industry. The Programme of Support to Implementation of the Brazilian System of Terrestrial Digital TV (PROTVD) is the programme that aims to develop the domestic industry, based on technologies of digital TV, thus including various sectors, such as, for instance, software and the equipment for radio broadcasting. However, the procedures for releasing the financing to interested enterprises are not established yet; furthermore, no measures have been announced about any specific policy aimed at the creation of Brazilian enterprises that could develop such technologies in the case that no firm manifests an interest.

Finally, it is worth mentioning the Programme of Support to the Development of the Health Industrial Complex (PROFARMA). This programme is also one of the lines of BNDES for health. The objectives of the programme are: to expand significantly the participation of national enterprises in the domestic market; to promote the growth of their exports; to strengthen the process of R&D and innovation in the sector; to boost the improvement in quality and the certification of products and processes associated to the sector; to promote the growth and internationalisation of national enterprises of the sector; to promote consolidation of the sector; to promote the dissemination and the growing use of national software both in Brazil and internationally; to strengthen the national operations of multinational software and IT services companies that develop technology in Brazil and/or use the country as a platform for exporting.

Table 2.3 shows the number of projects and resources invested in by BNDES through its innovation funding programmes, in 2007 and 2008. It is possible to note that, during these two years, the programmes did not show a large scale, neither in terms of the number of supported projects, nor in terms of the volume of resources.

Table 2.3: BNDES: Innovation Funding Programmes, 2007/2008

<i>Programmes</i>	<i>2007</i>		<i>2008</i>	
	<i>Investment</i>	<i>No. of Projects</i>	<i>Investment</i>	<i>No. of Projects</i>
Innovative Capital	-	-	2,049,600	1
Innovation R,D&I	105,653,488	7	17,858,400	3
Production Innovation	280,420,966	11	41,814,898	9
Automotive Engineering	-	-	172,320,400	2
Innovation Profarma: Support for the Development of Industrial Health	30,341,802	5	13,055,000	3
Business Prosoft: Development of Software Industry and Services Information Technology	372,796,686	12	321,802,382	9
Supplier Protvd: Support the Implementation of the Brazilian Digital TV	-	-	8,400,909	1
Others: Technological Development	5,873,750	6	44,437,586	5
Total	795,086,692	41	621,739,174	33

Source: Vermulm and Hollanda (2009).

Note: Current values in dollars PPP.

Only information on the total funds invested in these programmes is available for 2009 and 2010, respectively, \$788 million (current values in dollars PPP) and \$1,924 million (current values in dollars PPP). This means that, at least in terms of resources invested (considered as a percentage of GDP; 0.017 per cent of the 2009 GDP and 0.037 per cent of the 2010 GDP), these programmes are advancing.

Brazilian Federal Agency for the Support and Evaluation of Graduate Education, Ministry of Education

The Brazilian Federal Agency for the Support and Evaluation of Graduate Education was created in 1951, initially in the ambit of the National Campaign for Improving Higher Education. Its

main purpose was guaranteeing the existence of specialised human resources, aiming at fulfilling both public and private needs for facing the challenge of development.

CAPES is currently subordinate to the Ministry of Education and one of its roles is to grant scholarships for human resources education at graduate level. Indeed, CAPES, in conjunction with CNPq, has been responsible for the consolidation of the graduate education system in the country and for the preparation and qualification of higher education teaching personnel. As a result, the country has also been improving its position in the ranking of scientific publications, published by the National Science Indicators (NSI), having risen from the 15th position in 2007 to the 13th in 2008, maintaining the same position in 2009.

The merit of CAPES in human resources training and in the consolidation of the educational and research system, along with CNPq, is fully acknowledged. However, there still persists a poor and fragile coordination between this policy and the explicit innovation policy, the absorption of qualified graduate professionals by the production sector being still relatively weak, as already mentioned.

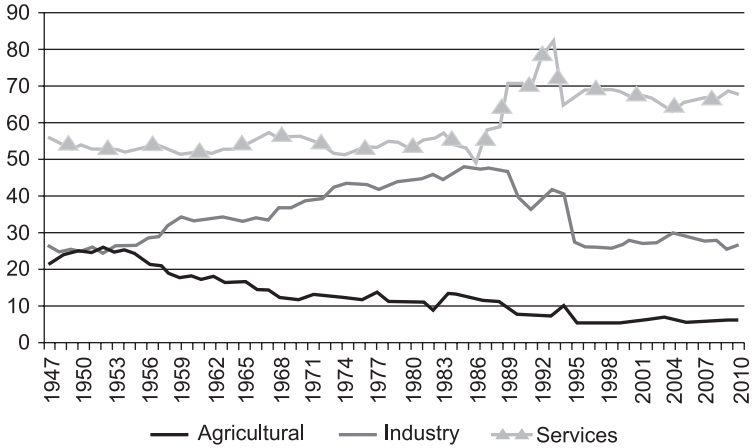
Specificities of the System of Innovation in the Country and its Relationship with the State

The evolution of the Brazilian production structure

By the end of the 1940s, the Brazilian production structure was almost exclusively based on the primary sector. It was only after World War II that the country started its industrialisation process, which was based, then, on the idea of import substitution. It focused, at first, on the establishment of an industry of non-durable consumer goods, in order to meet the demand of an urban working class that was beginning to be formed in the country. After this first period, which lasted until the middle of the 1950s, the productive structure began to become more diverse, with the entry of capital goods in the production of national manufacturers. At the same time, the service sector also started to appear, tending to increase its share in GDP throughout the period. Figure 2.1 presents the share of services,

industry and agriculture as a percentage of GDP for the period from 1947 to 2010.

Figure 2.1: *Brazil: Share of Services, Industry and Agriculture in GDP, 1947–2010 (percentage)*



Source: IBGE (Brazilian Institute of Geography and Statistics) website, <http://www.sidra.ibge.gov.br/bda/cnt/default.asp?z=t&o=15&i=P> (accessed 19 October 2011). Authors' elaboration.

The limited participation of industry in GDP observed in the period 1947–1955, is due to the collapse of the import substitution of non-durable consumer goods in the process of industrialisation. After 1955 until the early 1980s, the process of import substitution began a new phase, including durable consumer goods and capital goods, which marked the growing involvement of industry in GDP, as shown in Figure 2.1. This phase was related to the attraction of foreign-owned enterprises, with the purpose of importing industrial technology.

Based on this policy, in the late 1970s, the country attained a complex and relatively complete production structure, in terms of the sectors that comprise it. Industry was producing petrochemicals, ferrous and non-ferrous metals, fertilisers, paper and pulp and capital goods. Moreover, the country could establish an efficient infrastructure of energy, communications and transport (Cassiolato 1992).

This successful phase ended in 1980, with the Mexican crisis (Ferraz et al. 2003). The 1980s and 1990s represented reduction in capacity for the Brazilian industry in several sectors, with increased industrial concentration in some of them. Moreover, during this period many Brazilian companies were acquired by foreign capital, and several mergers and acquisitions took place, including those resulting from the privatisation process sponsored by the government.

Table 2.4 presents the composition of the industrial output of general industry for the period from 1996 through 2007.¹⁶ The main observation is that the sectors intensive in natural resources, such as oil refining (16.5 per cent), beverages and food (16 per cent) and metallurgy (7.9 per cent), augmented their participation in the total industrial production during these years. The sectors intensive in technology such as machinery and equipment for offices and informatics goods; electronic devices and communication equipment; other equipments (that includes the aeronautics sector) either decreased or maintained their low participation in the total industrial production for the same period.

Table 2.4: *Brazil: Composition of the Industrial Output of General Industry, 1996–2007*

Sectors	Years						
	1996	2004	2005	2006	2007	2007– 1996	2007– 2004
General Industry	100	100	100	100	100.0	Difference in %	
Extractive Industries	2.2	3.4	4.2	4.1	4.0	1.8	0.6
Manufacturing Industries	97.8	96.6	95.8	95.9	96.0	-1.8	-0.6
Beverages and Food	17.2	15.4	15.8	16.0	15.1	-1.3	0.5
Tobacco	1.1	0.7	0.7	0.7	0.7	-0.4	0.0
Textiles	3.3	2.2	2.0	2.0	1.9	-1.3	-0.2
Clothing	2.3	1.3	1.4	1.5	1.8	-0.8	0.2
Leather, Leather Artefacts and Footwear	2.2	1.9	1.6	1.6	1.5	-0.7	-0.4
Wood Products	1.1	1.6	1.4	1.3	1.3	0.2	-0.3
Pulp and Paper Industry	3.7	3.8	3.3	3.4	3.4	-0.3	-0.4

(Cont.)

(Cont.)

Sectors	Years						
	1996	2004	2005	2006	2007	2007– 1996	2007– 2004
Edition, Recording and Press	4.9	2.9	2.9	2.9	2.8	–2.0	–0.1
Oil Refining	7.0	14.0	16.3	16.5	15.5	9.5	2.5
Chemicals	12.7	11.0	10.2	9.9	10.2	–2.8	–1.1
Rubber and Plastic Goods	4.1	3.4	3.4	3.4	3.3	–0.7	0.0
Non-metallic Products	3.4	3.3	2.9	3.2	3.1	–0.2	–0.1
Metallurgy	5.4	9.2	8.1	7.9	7.9	2.5	–1.3
Metallic Products	3.8	3.1	3.6	3.2	3.6	–0.6	0.1
Machinery and Equipment	6.8	5.9	5.2	5.4	5.8	–1.4	–0.5
Machinery and Equipment for Offices and Informatics Goods	0.5	0.5	0.5	0.6	0.6	0.1	0.1
Devices and Machines	2.6	1.9	2.4	2.2	2.6	–0.5	0.3
Electronic Devices and Communication Equipments	3.5	2.3	2.0	2.1	1.7	–1.5	–0.2
Hospital and Medical Devices	0.8	0.7	0.8	0.8	0.8	–0.1	0.1
Assembly and Manufacturing of Motor Vehicles	8.1	7.8	7.9	7.9	8.6	–0.2	0.1
Other Equipments	0.8	2.0	1.7	1.9	2.0	1.0	–0.1
Furniture and Other Industries	2.2	1.6	1.5	1.6	1.6	–0.7	0.0
Recycling	0.0	0.1	0.1	0.1	0.1	0.0	0.0

Source: IBGE (Brazilian Institute of Geography and Statistics) website, <http://www.sidra.ibge.gov.br/bda/cnt/default.asp?z=t&o=15&i=P> (accessed 19 October 2011). Authors' elaboration.

In summary, the last two decades have not been favourable, to say the least, for industry and agriculture, which have been losing their share in GDP. For industry the situation was even worse, since the sectors most intensive in technology lost share in relation to commodities. Only from 2005 to 2010 (with the exception of 2009, when the Brazilian industry suffered the impacts of the global financial crisis that hit the world in 2008) a small, timid recovery in the share of industry in GDP can be observed, which reflects the reversal in governmental policy, with the reintroduction of industrial policy as the subject, as noted earlier.

The main specificities and heterogeneities of the Brazilian innovation system

The main specificities of the Brazilian innovation system are its structural (and innovative) heterogeneities, which are also reflected in the outstanding regional disparities. The policy for industrialisation adopted until the 1970s could be considered successful once the country got to forge a complex and complete industrial structure in terms of economic activities and size of enterprises.

This infrastructure, however, is largely concentrated in the south-eastern and southern regions of the country. Table 2.5 presents the participation by region in the gross added value, which represents the differences in the production structure of the regions.

Table 2.5: *Participation by Region in the Brazilian Gross Value Added at Basic Prices*

<i>Year</i>	<i>North</i>	<i>Northeast</i>	<i>Centre-West</i>	<i>Southeast</i>	<i>South</i>
2002	4.82	13.25	9.06	55.73	17.14
2003	4.88	13.03	9.21	54.90	17.97
2004	4.90	12.70	9.10	55.80	17.40
2005	5.00	13.10	8.90	56.50	16.60
2006	5.10	13.10	8.70	56.80	16.30
2007	5.00	13.10	8.90	56.40	16.60
2008	5.10	13.10	9.20	56.00	16.60

Source: IBGE (Brazilian Institute of Geography and Statistics) website, <http://www.sidra.ibge.gov.br/bda/cnt/default.asp?z=t&o=15&i=P> (accessed 25 October 2011). Authors' elaboration.

Table 2.6 presents the structure of income distribution in the country, marked by considerable disparities that characterise the socio-regional heterogeneity.

Table 2.6: *Per Capita Income by Region*

<i>Regions</i>	2001	2002	2003	2004	2005	2006	2007	2008
Centre-West	6,590	8,770	8,930	9,350	9,200	9,230	10,210	10,550
North	3,910	4,190	4,220	4,510	4,560	4,740	5,230	5,290
Northeast	2,970	3,230	3,180	3,310	3,470	3,580	3,860	3,880
South	7,640	7,980	8,350	8,560	8,320	8,400	9,480	9,450
Southeast	8,480	9,250	9,070	9,460	9,750	10,040	11,030	10,960

Source: Instituto de Pesquisa Econômica Aplicada (IPEADATA) website, <http://www.ipeadata.gov.br>. (accessed 1 November 2011). Unit: R\$ 2000.

Note: The per capita household income is defined as the ratio between the sum of monthly income of all family members living in the house and the number of family members. It is deflated by the INPC index.

Besides unveiling outstanding social inequalities, the information shows a strong concentration in both the income and production structure in the southern and south-eastern regions. These differences in the production and social structure of the country that distinguish the Brazilian innovation system, somehow determine the path of reproduction, growth and evolution of this system.

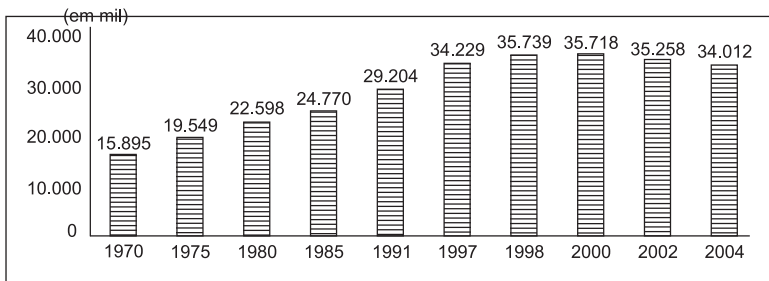
Another important specificity is related to the educational system. In the scope of the public system in Brazil, elementary education is mostly under the responsibility of municipalities; states account primarily for secondary education; and higher education is mainly provided by the federal government. The education system is complemented by private schools and universities.

According to the Law of the National Education Guidelines (*Lei de diretrizes e Bases da educação*, LDB), in force since 1966, ‘it is the responsibility of the federal government to regulate and monitor higher education institutions, including private ones, and furthermore to promote the distribution of material and financial resources to states and municipalities for them to invest in their secondary and elementary schools’ (Dantas 2008: 1).

The major concern of the educational policy during recent decades has been the ‘universalisation’ of elementary education, a goal that was achieved, with a significant growth in the number of

enrolments. The current concern is put on the quality of education, which has proved to be low according to a number of indicators.¹⁷ Figure 2.2 clearly shows the yearly evolution in the number of enrolled students. A significant increase is observed from 1970 to 1997. Subsequently, the beginning of a low decrease in the number of enrolments is observed. However, if this evolution is compared in relation to the Brazilian population in the years 1970 and 1997, the percentage growth is low (respectively 17 per cent and 22 per cent, according to Dantas [2008]).

Figure 2.2: *Evolution in the Number of Enrolments in Elementary Education*



Source: IPEA (2006) in Dantas (2008: 6).

In addition, the rate of conclusion for elementary, secondary and higher education is quite low: ‘Only 84% out of practically 100% children at school starting age enrolled in the 1st grade of elementary education get to complete the 4th grade; 57% complete elementary school and only 37% complete secondary education’ (IPEA 2006: 129 *sic passim* in Dantas 2008).

The access to quality education also reflects the income concentration prevailing in the country, with private schools, whose students comprise the higher income ranges, being better ranked in the tests that assess quality of education. Differences regarding the education of youngsters according to income ranges are expressive. In the first age range (0–6 years), the access to education by the highest income ranges (50.6 per cent) is very much higher than that of the lowest income ranges (28.9 per cent). In the age range of 7 to 14, quantitative differences decrease. As for the last age range (18–24 years) disparities are again remarkable, with the highest income youths showing greater access to education than those with the lowest income. Such inequality in the access to education in Brazil aggravates existing differences, contrarily to what should happen.

Another fact that reflects the education policy in Brazil is the difference in investment across the education levels — elementary, secondary and higher education. Table 2.7 shows that expenditure per student for public elementary education is much lower than expenditures for higher education. Such disparity, added to the fact that most of the students that access the university pertain to the 5th highest income quintile, as seen later in Table 2.11, emphasises the aggravation of inequality. Dantas (2008:9) claims that: ‘Brazil is the country, in the whole world, with the highest investment per student, in relative terms, for public higher education: no other country spends, per student enrolled in higher education (including graduate courses) a sum not even close to the equivalent of per capita GDP.’ The expenditure on public higher education is crucial; however, restricted access to this educational level is a major problem to be faced by the public policy.

Table 2.7: *Public Direct Investment per Student*

Year	Total	Basic Education	Children’s Education	Elementary Education		Secondary Education	Higher Education
				1st to 4th Grade or First Years	5th to 8th Grade or Final Years		
2000	2051	1707	1953	1680	1714	1628	18872
2001	2157	1799	1792	1687	1897	1883	18952
2002	2250	1862	1763	2058	1911	1385	18778
2003	2188	1838	1971	1936	1840	1544	15981
2004	2355	1935	2068	2047	2069	1415	15926
2005	2380	2016	1922	2250	2142	1406	15908

Source: IPEA (2006) in Dantas (2008).

Note: Current values in dollars PPP.

Concurrently, the production sector undergoes a lack of qualified personnel, as shown, for instance, in researches conducted by RedeSist (Research Network on Local Innovative Production Arrangements and Systems) and as signaled by the Survey on Technological Innovation (PINTEC 2005).

In PINTEC 2008, interviewed enterprises indicated either high or medium importance to the lack of qualified personnel as one of the problems and obstacles to the development of innovative activities. In the frequency ranking of mentioned problems, the lack of qualified personnel stands at the third position (57.8 per cent) for industrial companies, behind the problems of economic character (costs of innovation and economic risks). For the enterprises in the segment of services, such a problem has been identified as still more serious: for selected services (publishing, telecommunications, information technology) companies (70.4 per cent), it was the first in the ranking; and for the R&D enterprises (46.7 per cent), this problem stood in the fourth position (it is important to underline that in 2005, it was ranked in sixth position). Although it has not appeared in all economic activities as the main problem or obstacle to innovation, the participation of the enterprises that indicated the lack of qualified personnel as being of high or medium relevance is quite significant (from 46.7 per cent for R&D enterprises to 70.4 per cent for selected services enterprises).

Explicit and Implicit State Policy towards Science, Technology and Innovation

The government of the period 2003–2006 began in a context characterised by inflation acceleration, in spite of the regime of inflation targets that implied the raise of interest rates and a restrictive fiscal policy. In this domestic scenario, the macroeconomic policy for 2003 remained unchanged and tied to the regime of inflation targets, using restrictive fiscal and monetary policies as instruments for reaching the ‘target’ — in spite of the historical promises of changing the economic policy by the Workers’ Party, the winner in the elections. This policy meant the rise of interest rates, rise of economic surplus with reduction of federal outlays, particularly investments, and appreciated exchange rates.

In spite of a negative domestic scenario, there was a favourable context from the international point of view, with increasing demand for commodities boosted by the growth of China and that of the main global economies.

The characterisation of explicit and implicit innovation policies is based on the concept of a broad national system of innovation adopted in this study, as already noted. As implicit policies, which

in the case of Brazil have a significant impact, we will consider the macroeconomic policy as well as social development and educational policies. The analysis of the policies, both explicit and implicit, will focus on the period 2003–2010, with emphasis on the period 2007–2009.

Explicit policies

Although retaining the macroeconomic policy of the former administration, in November of 2003 the federal government launched the Industrial, Technological and Foreign Trade Policy, taking a favourable stand towards an industrial policy. The objectives of PITCE were:

The Industrial, Technological and Foreign Trade Policy seeks, in the short run, to reduce the country's external restrictions and, in the medium and long run, to equate the development of key-activities, so that to generate capabilities that allow Brazil to raise its competitiveness in the international scenario (BRASIL 2003: 9–10).

Thus, the government sought to implement a policy that could provide support to the domestic production sector by means of the strategies presented earlier in this chapter. Many criticisms can be raised against this policy. However, the merit of the government in restoring the importance of the innovation policy is undeniable. Furthermore, such a policy spans several federal institutions, not restricting the issue to the Ministry of Science and Technology, as the former government had done.

Some of the criticisms of the implementation of this policy, as observed by Koeller (2007), concern the difficulties faced in defining its guidelines, besides the problems of coordination that hindered its implementation. Laplane and Sarti (2006: 284) raise further criticisms: 'Until the end of 2005, this process resulted in a quite comprehensive set of initiatives, at very different stages of planning and implementation. There was a huge prevalence of horizontal actions.'

The actions of PITCE were structured according to three axes:

(a) Horizontal action lines

- (i) Innovation and technological development
- (ii) International insertion
- (iii) Industrial modernisation
- (iv) Production capacity and scale

(b) Strategic options

- (i) Semiconductors
- (ii) Software
- (iii) Capital goods
- (iv) Pharmaceuticals and medicines

(c) Activities with future perspectives

- (i) Biotechnology
- (ii) Nanotechnology
- (iii) Biomass/renewable energies

In spite of the establishment of action lines and the choice of strategic sectors and activities that bear future perspectives and that may contribute to the restructuring of the Brazilian production sector, PITCE did not set a governance structure or specific mechanisms for its own operation. Its implementation was through the mechanisms created by MCT for operating the National Policy of Science, Technology and Innovation, particularly the public bids of the sectoral funds and the economic subvention. The overlapping of policies and the fact that these mechanisms were under the coordination of other institutions, not the MDIC, and thus also answered to other political priorities, hindered the implementation, the analysis and the monitoring of PITCE.

Thus, the government of the period 2007–2010 instituted, in May 2008, the Policy for Production Development, for facing the following challenges: to expand the supply capacity; to keep the robustness of the balance of payments; to enhance the innovation capacity; and to strengthen the micro and small enterprises (MSEs). For this purpose, the policy proposed four macro-goals:

Expansion of fixed investment: INVESTMENT/GDP — Goal for 2010: 21 per cent (R\$ 620 billion). Situation in 2007: 17.6 per cent or R\$ 450 billion. Average annual growth of 11.3 per cent between 2008 and 2010.

Rise in private expenditures on R&D: PRIVATE R&D/GDP — Goal for 2010: 0.65 per cent (R\$ 18.2 billion). Situation in 2005: 0.51 per cent or R\$ 11.9 billion. Average annual growth of 9.8 per cent between 2007 and 2010.

Expansion of exports: PARTICIPATION IN GLOBAL EXPORTS — Goal for 2010: 1.25 per cent (US\$ 208.8 billion). Situation in 2007: 1.18 per cent or US\$ 160.6 billion. Average annual growth of 9.1 per cent between 2008 and 2010.

Stimulation of MSEs: NUMBER OF EXPORTER MSEs — Goal for 2010: increase by 10 per cent in the number of exporter MSEs. Situation in 2006: 11,792 enterprises.

For doing this, the government defined 25 priority sectors that would be focused on in this policy. These economic sectors are divided into three main areas: programmes for advancing strategic areas; programmes for strengthening competitiveness; programmes for consolidating and enhancing leadership.

For each of these areas, the policy mechanisms available have been identified, and sorted out according to four types:

- (a) Incentive mechanisms: credit and financing, venture capital and fiscal incentives;
- (b) Governmental purchasing power: purchases by the government and by state companies;
- (c) Regulatory mechanisms: technical, public health, economic, and competition regulation;
- (d) Technical support: certification and metrology, trade promotion, management of intellectual property, business and human resources capacity building, intra-governmental coordination and liaison with the private sector.

Most of these mechanisms of support to innovation already existed. The policy sought to organise such mechanisms according to the areas and sectors set as priorities, aiming at informing the enterprises, sharing responsibilities among the various institutions and coordinating the various instruments in support of those primary sectors and areas.

Furthermore, indicators for measuring the policy progress in each priority sector or area were identified and goals were set. This represents an advance regarding PITCE which did not establish goals. However, a more meticulous analysis of goals and challenges raises some doubts regarding the criteria that guided their definition: whether they were based on international parameters; whether the background of priority sectors and areas was considered (and, in this case, since a long time there were no specific policies, if adjustments were made accordingly to expected impacts by means of a coordinated use of policy instruments); whether analyses were carried out about the needs and the impacts of the advancement of these sectors and areas on the national innovation system; or whether the country's development strategy was considered. No information was obtained during the elaboration of the present study that could allow the analysis of the criteria used for setting goals and priorities.

The implementation of the PDP began in May of 2008. Therefore, it is still too soon to evaluate its results. Nevertheless, it is possible to highlight some positive aspects, as well as some issues of concern. Among the positive aspects, we may cite the attention on the governance of the policy and on 'sharing responsibilities' among the various institutions responsible for its implementation.

As for the issues of concern, two of them stand out: the first one regarding the high number of sectors and areas considered, besides the possibility of including new segments, as indicated by the policy statement itself.

In terms of official documents, the policy proposal is based on a systemic vision of the production system, as it is clearly stated in the following guideline expressed in the PDP: Systemic Actions — with focus on factors that generate positive externalities for the whole production structure. That is, the idea that the actions undertaken have an impact on other areas of the production structure, besides being dependent, for their accomplishment, on many governmental agencies.

The policy formulation took into account the dialogue with other policy proposals available in ministries, as well as in some organisations of the civil society, such as: the Programme for the Acceleration of Growth (*Programa de Aceleração do Crescimento*, PAC), promoted by the federal government with the objective of overcoming the 'bottlenecks' of infrastructure; PACTI, the Action Plan for Science, Technology and Innovation launched by the Ministry of Science and Technology aiming at enabling the implementation of the National Policy of Science, Technology and Innovation, and that takes responsibility for coordinating some priority sectors and areas defined by the PDP; and policies of the Ministries of Labour and Employment (Ministério do Trabalho e Emprego, MTE), the Ministry of Health (Ministério da Saúde, MS) and the Ministry of Education (Ministério da Educação, MEC); besides the attempt of liaising with the National Confederation of Industry (Confederação Nacional da Indústria, CNI), an institution of the civil society.

In spite of the discourse, the excess of priorities, besides bringing risks of failure due to problems of operationalisation, seems to not ascribe much importance to the systemic character of the innovation process that would imply the choice for segments and economic activities capable of generating changes in the productive and

social structure of the country. The innovation policy must reflect, according to Gadelha (2001:152), the ‘systemic character of the entrepreneurial environment and the specificity and diversity of the evolution patterns of industrial structures’.

The second matter of concern regards the mechanisms of the policy, that are the same as those created in former years. In this case, the worries refer not so much to the old instruments, but rather to the way in which they will be implemented, since many problems with implementation have already been identified in previous years.

The liaison with other policies seems to be advancing insofar these are explicitly aimed at innovation. In other words, the connection of the PDP with PACTI seems to be working, since this policy has innovation as one of its objectives. However, in respect to the remaining policies, the liaison is apparently unsuccessful, as for instance with the Education Policy, coordinated by the Ministry of Education, through the Plan for Development of Education (PDE).

The Action Plan for Science, Technology and Innovation for National Development was designed by the MCT with the purpose of both consolidating the national system of science, technology and innovation (S, T & I) and expanding innovation within enterprises. The plan was formulated for the years 2007–2010 and has the following as its strategic priorities: expansion and consolidation of the National System of S, T & I; promotion of technological innovation in the enterprises; R, D & I in strategic areas; S, T & I for social development.

The priorities of the ministry are mainly focused on strengthening the national scientific infrastructure and on technological innovation, being based on the legal framework comprised by the already mentioned Law of the Goods and Law of Innovations.

The main goals presented by PACTI for 2010 were the following:

Investment in R, D & I: 1.5 per cent GDP in R, D & I (1.02 per cent in 2006); 0.64 per cent federal government and 0.21 per cent state governments.

Innovation in the enterprises: 0.65 per cent of investments in R, D & I made by the private sector (0.51 per cent in 2006).

Training of human resources: 95,000 scholarships by CNPq; 68,000 in 2006, with focus on engineering and other areas related to PITCE plus 65,000 scholarships by CAPES.

S & T for social development: 400 Vocational Technical Centres (*Centros Vocacionais Tecnológicos*); 600 new *telecentros* (community

centres for Internet access); OBMEP: 24 million students and 10,000 scholarships.¹⁸

PACTI selected 13 strategic sectors which gain special attention within the policy regarding the development of R, D & I.¹⁹ However, conversely to the PDP, it does not set specific objectives, goals and mechanisms for each sector, showing the horizontal character of the policy. The chosen sectors also make part of PDP (although this latter has been formulated subsequently to PACTI), which expresses the beginning of integration between the various governmental departments explicitly related to the innovation policy.

Similarly to PDP, the mechanisms and the legal framework used by PACTI for implementing its guidelines are: non-reimbursable resources (sectoral funds), financings, venture capital, economic subvention, fiscal incentives (Law of the Goods), human resources training and capacity building, law of innovation. Again, the criticism directed to these instruments is related rather to the way they are implemented and to the lack of coordination between them, than to the mechanisms themselves.

Implicit policies

In the Brazilian case, the social and economic contexts and the policies designed for these two domains of NSI assume a significant relevance either as obstacles or as opportunities for the development and the evolution of the NSI.

As already discussed, the macroeconomic policy that characterised the Brazilian economic environment during the period under analysis — and the beginning of the 2003–2006 and 2007–2010 governments — became an obstacle to the implementation of the innovation policy, once it assumed the characteristics of what Coutinho (2005) called a pernicious macroeconomic regime.

This macroeconomic policy, characterised by the regime of inflation targets — whose current target is 4.5 per cent with a possible variation of two percentage points — adopted as its main instruments the interest rates, which were kept high during the whole period of analysis, and a regime of fluctuating exchange rates and restrictive fiscal policies, with strict goals fixed for primary surplus.

In this context, Laplane and Sarti highlight (2006: 273) that: ‘As of 2003, Lula Government has, on the one hand, effectively withdrawn the prevailing veto to an industrial policy, by implementing the

Industrial, Technological and Foreign Trade Policy (PITCE); but, on the other hand, it kept the same regime of economic policy.’

What is emphasised by Laplane and Sarti is exactly the fact that Brazil was able to propose an industrial policy after two decades of banning, which, for being inserted within a pernicious macroeconomic regime, can hardly reach favourable results. The reason is that the high interest rates discourage investments, imposing negative effects also on the investments in innovation activities.

Furthermore, the regime of fluctuating exchange rates has occasionally over-appreciated exchange rates, stimulating imports to the detriment of the domestic production sector. This movement creates a vicious circle insofar as the lack of investments in innovative activities leads to losing competitiveness, thus increasing the stimulus to imports, particularly of goods with greater value added and of more intensive technology. Consequently, it leaves to the domestic production sector the production of commodities and of goods and services of lesser value added and less intensive in technology. In brief, it jeopardises the production restructuring required for social and economic development.

The restrictive fiscal policy has significantly reduced investments by the federal government, thus hindering investments with infrastructure which became bottlenecks to production. This policy reduced the budget available to ministries for policy implementation, by allocating the resources as contingency reserves, thus affecting also the budgets aimed at the innovation policy.

Such a policy resulted in a slowdown of GDP real growth rates, with a reduction in GDP real growth rate, from 2.7 per cent in 2002, to 1.10 per cent in 2003; returning to growth in 2004, with a rate of 5.70 per cent, fostered especially by a favourable international context, as we may see in Table 2.8.

In the Brazilian case, the macroeconomic policy, seen as an implicit policy, became one of the main obstacles to the evolution and growth of the national innovation system. Thus, conditions were placed for the reproduction of an asymmetric system that hampers the integration of the innovation policy with the other policies. The reason was the choice in favour of a restrictive macroeconomic policy as of 1994, which has as its main adjustment variables the interest rates and the exchange rates.

The option for this macroeconomic policy, which subsumes a neoliberal perspective, prevented the adoption of a development policy and hindered the adoption and implementation of a broad innovation policy — that is, one that would embody the advances of the systemic vision. Therefore, it restricted this policy to a narrow vision about the NSI — defined as explicit innovation policy.

Table 2.8: *Real Growth Rate of Gross Domestic Product (GDP), Inflation Rate (IPCA), Interest Rates, 2001–2008*

<i>Period</i>	<i>GDP: Real Growth Rate (% p.a.)</i>	<i>IPCA: Extended</i>	
		<i>Consumer Price Index Growth Rate (% p.a.)</i>	<i>Interest Rate (TJLP % p.a.)</i>
2001	1.30	7.67	9.5
2002	2.70	12.53	9.9
2003	1.10	9.30	11.5
2004	5.70	7.60	9.8
2005	3.16	5.69	9.8
2006	3.97	3.14	7.9
2007	6.09	4.46	6.2
2008	5.16	5.90	6.1
2009	-0.64	4.31	6.0
2010	7.49	5.91	5.9

Source: IBGE (Brazilian Institute of Geography and Statistics) website, <http://www.sidra.ibge.gov.br/bda/cnt/default.asp?z=t&o=15&i=P> (accessed 25 October 2011). Authors' elaboration; and BNDES website, http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt. (accessed 1 November 2011). Authors' elaboration.

Note: References for GDP values: for 1995–2006, National Accounts System Reference 2000 (IBGE/SCN 2000 *Annual*); for 2009 and 2010, preliminary results estimated from Quarterly National Accounts Reference 2000.

From 2003 on, with particular emphasis on 2004 and 2005, the domestic market began to get stronger, mainly because of the social development policy established by the government, whose main programme was the Bolsa Família (Poor Family Support Pension).

The establishment of 'Bolsa Família' was specifically addressed to the Brazilian social context, characterised by deep income inequalities, which also reflect the significant regional and intra-regional

disparities. In 2009, Brazil presented a GDP of US\$ 1,998,985 billion (in dollars PPP) and a per capita GDP of US\$ 10,344.22 (in dollars PPP). Even so, there were 39.6 million poor people and 13.4 million indigents in 2009 in Brazil.²⁰ The heterogeneous social structure, with strong income concentration, affects the patterns of demand and consumption. Existing regional differences and disparities of purchasing power result in a broad heterogeneity in the national pattern of demand, thus affecting the production structure.

The production structure often presents, within the same plant, distinct production methods, in order to comply with different consumption patterns. In order to break up these differences that allow reproduction of the underdevelopment process, it will be necessary to set policies, among which should be those of income transfer, aiming at including population into the market.

These policies can be regarded as opportunities for producing the required changes in the productive structure, if they are integrated to a policy of social and economic development. They should have innovation as one of their main guidelines, being therefore integrated also to the innovation policy. As for this latter, it should not be restricted to technological innovation, but rather should also consider other kinds of innovations such as organisational, in processes, etc., thus incorporating the systemic vision of the innovation policy.

'Bolsa Família', the federal government's programme aimed at income transfer, assumes a key role for the enhancement of domestic demand. According to the Ministry of Social Development and Food Security:

Family Pension Programme (FPP) is a programme for direct transfer of income with conditionalities that benefit families in situation of poverty (monthly per capita income between R\$ 60.01 and R\$ 120.00) and in situation of extreme poverty (monthly per capita income below R\$ 60.00), in conformity with Law 10836, of 9 January, 2004 and the Act no. 5209 of 17 December, 2004.²¹

The programme establishes the following conditions for families to access the benefits: Families with monthly per capita income of up to R\$ 137.00 appropriately registered in the Unified Register of Social Programmes (CadÚnico) are entitled to benefit from the Family Pension Programme.²²

Table 2.9: Evolution of Benefits of RGPS, BPC and 'Bolsa Família' (Poor Families Pension), 2000–2007 (Million Benefits/ Families)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
General Regime of Social Security RGPS (1)	17.5	17.9	18.9	19.5	20.5	21.1	21.6	22.1	22.8	23.5	24.4
Continuing Social Benefit/ Social Security Act - BPC/ LOAS (1) (2)	1.2	1.3	1.6	1.7	2.1	2.3	2.5	2.7	2.9	3.2	3.4
Family Grants — Bolsa Família (3)	-	-	-	3.6	6.6	8.7	10.9	11.0	10.5	12.3	12.8

Source: Ministry of Planning, Budget and Management website, <http://www.planejamento.gov.br> (accessed 1 November 2011). Ministry of Social Development and Fight against Hunger website, <http://www.mds.gov.br> (accessed 1 November 2011). Ministry of Social Security website, <http://www.mpas.gov.br> (accessed 1 November 2011). Authors' elaboration.

Note: More than 60 per cent of these benefits had values equal to one minimum wage.

(1) Issued benefit.

(2) Does not include Life Monthly Pension (*Renda Mensal Vitalícia*, RMV).

(3) Family supported.

The programme has been effectively improving the purchasing/consumption power of lower income families, thus impacting even the country's structure of income distribution. The Gini Index for Brazil, of 0.54 in 2009, has presented a positive, although slow, evolution towards income de-concentration.

Thus, policies for social inclusion play a very important role in the formation of the Brazilian system of innovation. Social policies are not restricted to income transfer; health and education policies, for instance, are also important for the formation of the NIS.

The NIS also comprises the sub-system of capacity building, which integrates the scientific, technological and educational perspectives. This sub-system is fundamental for the NSI, being included both by the broad definition of NSI and by its strict concept. The capacity and capabilities of the agents in the economy depend to a large extent on their education level. The assimilation, learning and use of knowledge as input to innovation depend on these characteristics of the agents. When the agents present better qualifications, at the levels of both basic and higher education, the learning process becomes easier in view of their enhanced capacity for assimilating and disseminating new knowledge.

Based on this diagnosis, the federal government, through the Ministry of Education, developed the Plan for Development of Education (PDE). The programme can be organised according to four main lines: basic education, higher education, vocational education, and literacy.

PDE was formulated based on a systemic concept, where the various territorial and social dimensions are taken into account for the implementation of the programme. Therefore, the territorial and the educational matters are interconnected through the notion of educational arrangement. It can be said that the programme is founded on the following assumptions: (a) systemic vision of education, (b) territoriality, (c) development, (d) collaborative regime, (e) accountability and (f) social mobilisation.

These assumptions are meant to support the elaboration of a programme that seeks to reduce educational disparities in the country and, thus, intends to reduce social and territorial inequalities. The idea of a systemic model is helpful insofar as it does not isolate the various education levels. Furthermore, it connects education to territorial and development matters and highlights its potentiality to contribute to social matters and equity in the country. Thus, it is sought to build an education system that is connected to the multiplicities prevailing in the country.

Despite the appropriate discourse to meet the country needs, the PDE is still very recent for evaluating its results. The programme was launched in 2007, and its implementation was gradual throughout the

country and was only completed, according to the original schedule, at the end of 2010.

Nevertheless, the main indicator available for monitoring the PDE is the Index of the Basic Education Development (*Índice de Desenvolvimento da Educação Básica*, IDEB) — which is based on two major national assessments — School Census and Evaluation System of Basic Education (SAEB). This indicator is biannual and the latest available data, for 2009, demonstrate compliance with the targets set for this year.

Outcomes of State Policy and State Institutions on the NSI

There is a great deal of difficulty for assessing the outcomes resulting from the innovation policy and the efforts by federal government institutions responsible for its implementation in the period 2003–10. Such difficulty stems from the complexity in identifying and detaching the causality relation between innovative advances in the production sector and explicit and implicit policies.

Still, the impact of implicit policies, especially the macroeconomic policy, on the NSI is evident. This policy reflected on an economic environment unfavourable to investments, because of high interest rates and overestimated exchange rates that were adopted in this period.

On the other hand, the analysis of the goals of explicit policies becomes restricted to the goals of the government policies in the period 2006–2010, since the governmental policies of 2003–2006 — the PITCE and the National Policy of Science, Technology and Innovation (PNCTI) — did not define goals and indicators for evaluation. This means that the goals and indicators set for the PDP specially its macro objectives and PACTI will be considered.

Before analysing the compliance with the goals in 2010 — the target date of the policies — it is worth highlighting that almost all of them are input goals. That is, they refer to expenditures in R&D, investments, infrastructure building or scholarship grants, except for the goals related to exports that refer to outcomes such as participation in global exports. Specifically regarding innovation, the main goal refers to both rise in participation of R&D private investments and rise in investments in R&D in relation to the GDP.

The systemic vision of the innovative process is neglected, once innovation is associated exclusively to R&D and the policy fails to recognise that the learning process, the main tool of innovation, may occur through varied forms. Besides the systemic vision, the characteristics of the national production system and of the social structure also seem to be ignored. The existing heterogeneity, distinct characteristics of consumption, income concentration, and regional disparities that would lead to further measures, to other kinds of 'efforts' and, consequently, goals, were not taken into account.

Thus, the Action Plan is limited to a small sphere of action possibilities. In no moment was it sought to strengthen the learning process and knowledge building in enterprises, so that they would be able to improve their innovative capacity. The intangible factors of the enterprises gain no prominence in the policy of the ministry. In a society where tacit knowledge is relevant for innovation, policy should contain mechanisms and tools aimed at its main input (knowledge). Furthermore, in restricting innovation to the technological feature it reduces the possibilities of action a great deal.

Although the arguments point to the lack of indicators able to provide responses to the systemic vision, and this is why the goals are still linked to traditional indicators, the counter-argument is that, in fact, the proposed measures are still based on a linear vision of the innovation process and the goals and indicators only reflect this reality.

As to the progress towards goals, the current situation of indicators proposed by the two policies PACTI and PDP which together represent the explicit innovation policy in force, can be summarised as follows:

Action Plan on Science, Technology and Innovation for National Development — PACTI²³

- Investment in R, D & I/GDP (%): 1.5 per cent GDP on R, D & I in relation to GDP (1.02 per cent in 2006), 0.64 per cent federal governments and 0.21 per cent state governments — according to the Ministry of Science and Technology, in 2010 the indicator was 1.16 per cent (preliminary data).
- Innovation in firms: 0.65 per cent of investment in R, D & I made by the private sector (0.51 per cent in 2006) — according to the Ministry of Science and Technology, in 2010 the indicator was 0.55 per cent (preliminary data).

- Formation of human resources: 95,000 scholarships by CNPq; 68,000 in 2006, focus on engineering and other areas related to PITCE, and 65,000 by CAPES — according to the Ministry of Science and Technology, the indicator for 2009 was 70,601.

Policy for Production Development — PDP²⁴

- Expansion of fixed Investment: INVESTMENT/GDP — Goal for 2010: 21 per cent. Situation in 2007: 17.6 per cent — According to the Brazilian Institute of Geography and Statistics, the indicator was 18.4 per cent in 2010.
- Rise of the private expenditures in R&D: PRIVATE R&D / GDP — Goal for 2010: 0.65 per cent (R\$ 18.2 billion). Situation in 2005: 0.51 per cent or R\$ 11.9 billion — according to the Ministry of Science and Technology, in 2010 the indicator was 0.55 per cent (preliminary data).
- Expansion of exports: Participation in Global Exports — Goal for 2010: 1.25 per cent. Situation in 2007: 1.18 per cent. According to the Brazilian Central Bank it was 1.36 per cent in 2010.

As already emphasised, there are 25 sectors that should be served by the PDP. The aim is to establish a policy for strengthening these sectors, by means of a horizontal policy. Thus, these macro objectives permeate such sectors, which gain special attention in order for the goals to be reached. The instruments applied in the implementation of these macro objectives, as detailed earlier, are: accelerated depreciation, funds for emerging enterprises, FINEP resources (R\$ 6 billion between 2008 and 2010 — under responsibility of BNDES).

The data indicate that the goals of investments in R&D were not reached as much considering expenditures in the country as a whole, as taking into consideration only the expenditures by the enterprises. In spite of a growing trend of these indicators, such growth proved to be slow. The proposed investment goals also presented a growing trend and the exports goal was reached. It is worth stressing that exports had a significant increment due to increases in of both demand and prices of commodities in the global market. It does not necessarily mean that such increment resulted from the PDP. The two indicators, as well as the indicators of investments in R&D, are subject to international conditions, which have been unfavourable since 2008 (particularly following the second half of the year).

Conclusions and Recommendations Targeting Improvements in the NSI with Specific Emphasis on the Role of the State

The role of the state in the Brazilian innovation system was crucial for the formation of a scientific and technological infrastructure as well as for the industrialisation of the country. In recent years, particularly from 1999 on, the federal government has assumed a pro-innovation stand by designing and implementing a specific policy for promoting innovation.

As discussed in this study, the explicit innovation policy adopted in the period 1999–2002 was still restricted to the Ministry of Science and Technology, and was opposed to the macroeconomic policy then in force. Only after 2003 has this policy been incorporated by other ministries, particularly by the Ministry of Development, Industry and Foreign Trade. Even so, as it was discussed here, the general guidelines remain the same in both periods.

Although this policy has targeted the enterprises, its evaluation suggests that the mechanisms and instruments created for promoting innovation within enterprises have some characteristics that hinder the advance of NSI. Among them, some stand out:

- (a) a bias towards technological innovation, prioritising the mechanisms for support to research and development, to the detriment of other important innovative activities — thus ignoring (or neglecting) the heterogeneity of the production structure, which entails distinct levels of capacity.
- (b) a focus on partnership relations between enterprises and scientific and technological institutions, which makes the integration of the other agents participating in the innovation process difficult.
- (c) implementation forms still based on a linear model of innovation.

In 2007 and 2008, further changes were made in the policy: new guidelines were designed and priority sectors and areas were selected. The governance structure of the policy was modified, but, at the same time, there was the maintenance of old instruments and mechanisms, although proposing a connection between them. The already discussed establishment of goals for this new policy indicates a progress, since in the former policy there were practically no short-term goals. Even so, these goals raised concerns regarding

the implementation of such instruments and mechanisms, since they were expressing a linear vision about the innovation process. They possibly only were reflecting the lack of more appropriate indicators, pointing out the need for investments by the policy in the formulation of new indicators. However, a concern remained as to whether the goals would only be expressing the lack of audacity by the explicit policy of innovation.

From the perspective of the implicit innovation policy, the conclusion is that the linear vision hinders the liaison between the explicit policy and the other policies. Particularly in the Brazilian case, three implicit policies are noteworthy: the macroeconomic, the educational and that of social development. The analysis demonstrates that the need for integration surpasses the matter of ‘taking advantage of opportunities’. Non-integration became an obstacle to the explicit policy of innovation, preventing or hindering the accomplishment of outcomes. Moreover, the evaluation indicates that integration between policies is crucial for the social and economic development of the country.

On 2 August 2011 the ‘Plano Brasil Maior’ (Brazilian Major Plan) was launched, establishing industrial policy, technology, services, and foreign trade of the federal government for the period 2011–2014. The new policy sets out some changes in the legal framework for innovation among which are public procurement and the protection of domestic industry. Despite these changes, it is too early to assess the implementation and results of this policy.



Notes

1. The period before 2006, particularly 1995 to 2006, was the subject of the first report of the BRICS Project.
2. The model of industrialisation adopted had the structuralist approach as its fundamental framework, with special emphasis on the ideas of the Brazilian economist Celso Furtado who proposed by that time the idea of ‘embedded technology’ (or technical base) in the production structure. In the debate of the 1960s the Latin America structuralist school pointed out the need to adapt technologies, which would later be called internalisation of technical advance.
3. After the first impact of economic liberalisation, *ad hoc* regimes were adopted protecting those segments with major weight — either

economic or political — for example, the automotive regime, which protected the automobile industry, and the protection to the textile sector.

4. See, for instance, Pereira (2005).
5. In considering expenditures with research, development and innovation by ministry, the study opted for ministries that are not sectoral, given the difficulties for identifying such expenses in sectoral ministries. Furthermore, previous data surveys have shown that in most sectoral ministries such expenditures were not significant.
6. The analysis was based on information available on the websites of the ministries and related departments. In these sources, we looked for identifying programmes, actions and instruments that made explicit reference to the innovation policy. In addition, information on budget execution was organised for these ministries and departments, in some cases for specific programmes, for the whole period of the analysis, including the estimates for 2009. Again, it is worth recalling that the former period (1995–2005) makes up part of the first report of BRICS Project.
7. As mentioned before, the innovation policy of the period 1995–2006 was discussed in the previous report of BRICS Project.
8. According to the concept of innovation policy used in this study.
9. See ‘Uma Visão Geral’, Ministério da Ciência e Tecnologia, Secretaria de Desenvolvimento Tecnológico. Brasília, 2006 and ‘Relatório de atividades 1999, Diretrizes para 2000’, Ministério da Ciência e Tecnologia, Secretaria de Desenvolvimento Tecnológico. Brasília, dezembro 1999; and ‘A Política Brasileira para a Inovação na Década dos 1990s’, mimeo.
10. According to MCT, the Law of Goods (Law no. 11.196, of 21 November 2005), in its Section III, automatically authorises the use of fiscal incentives by the juristic persons that accomplish technological research and development of technological innovation. Among these incentives, it’s possible to highlight income tax deductions for expenditures with R&D activities, which may reach a value of up to twice the expenditures of the firm. The other incentives are: income tax deduction, reduction of tax on industrialised products, accelerated depreciation of equipments, accelerated repayment, credit of income tax withheld at source on money remittance to other countries for payment of royalties; reduction to zero of the rate of income tax withheld at source in money remittances to other countries. All these incentives are bound to the implementation of R&D activities.
11. The masters’ and doctorate education is very important for a country. Policies for preparing researchers should not be discontinued. However, this should not be the only way for implementing a policy for scholarship granting if the aim of the policy is to induce innovation in the production sector.

12. See Table C in the Annexure.
13. FINEP's website <http://www.finep.gov.br/pagina.asp?pag=30.80.30> (accessed 15 May 2009).
14. In the Brazilian legislation, fiscal incentives are granted only to firms that declare actual rather than projected profits for purposes of corporate income tax.
15. MDIC's website <http://www.desenvolvimento.gov.br/sitio/interna/interna.php?area=28&menu=300> (accessed 12 May 2009).
16. There was a structural break in series between 2007 and 2008 due to change in the National Classification of Economic Activities (CNAE) which was launched in the version 2.0 following the International Standard Industrial Classification of All Economic Activities (ISIC) rev. 4. Therefore, it is not recommended to compare for the whole period since 1996.
17. Programme for International Students Assessment (PISA), created by OECD; The System for Assessment of Basic Education (*Sistema de Avaliação da Educação Básica*, SAEB) of MEC; among others.
18. Brazilian Mathematics Olympiad of Public Schools.
19. Areas bearing future possibilities: biotechnology and nanotechnology, information and communication technologies, health products, biofuels, electricity, hydrogen and renewable energies, petroleum, gas and mineral coal, agribusiness, biodiversity and natural resources, Amazonia and semi-arid, meteorology and climate changes, spatial programme, nuclear programme, national defence and public security.
20. The lines of extreme poverty or indigence shown on *Ipeadata* are estimated based on a methodology developed by the commission IBGE-IPEA-CEPAL that defined a list of basic needs foods which satisfy the nutrition requirements for each Brazilian region. From the information about the total amount of calories per day, the amount consumed and the unit price, the expenditure was calculated for each product and its sum, resulting in the line of extreme poverty per person. The line of poverty is defined as twice the line of extreme poverty. (*Ipeadata*, <http://www.ipeadata.gov.br>. The *Ipeadata* site is provided and managed by the Institute of Applied Economic Research (Ipea), Brazil. According to the site *Ipeadata*, it is committed to providing high quality information from reliable data sources).
21. See the website of the Ministry of Social Development and Fight against Hunger, <http://www.mds.gov.br/> (accessed 29 October 2009).
22. The family income is calculated by adding the monthly incomes of all individuals of the household (such as wages and retirement pensions). This value must be divided by the number of people who live in the household, thus resulting in the per capita income of the family.
23. The other indicators are not available yet.
24. The other indicators are not available yet.

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Annexure

Table A2.1: MDIC Programmes Related to Innovation

<i>Programme</i>	<i>Action/Instrument</i>	<i>Methods of Operation</i>
Incentive to innovation within firm	Tax incentives	Related to computing of net profit, actual profit and tax on the net profit
		Tax on industrialized products — IPI
		Accelerated depreciation
		Income tax withheld at source
	Cooperation enterprise / Technological research institution	Sharing laboratories and equipment
		Technology transfer
	Cooperation company/ Technology institution	ICT partnership/Company
	Incentives for business software	Centre-west, north and northeast
	Incentives for industries of hardware and automation	Other regions of the country
Grant for innovation in enterprise	Acquisitions made by CNPq	
Project in cooperation with the European Union		

(Cont.)

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<i>Programme</i>	<i>Action/Instrument</i>	<i>Methods of Operation</i>
	Project network technology centres and Brazilian SMEs	
	Project support international insertion of Brazilian SMEs	
Local productive arrangements — APLs		
Micro, small and medium enterprises		
	Productive development policy	

Source: MDIC website, <http://www.desenvolvimento.gov.br/sitio> (accessed 1 November 2011). Authors' elaboration.

Table A2.2: *BNDES Programmes Aimed at Innovation*

Innovation
Innovative Capital Line
Technological Innovation Line
Technological Fund — FUNTEC
CRIATEC Programme
Industry
Programme for Support to the Implementation of the Brazilian System of Terrestrial Digital TV — PROTVD
Programme for Financing to Enterprises from the Brazilian Aeronautical Production Chain — PRO-AERONÁUTICA
Programme for Support to the Development of the Health Industrial Complex — PROFARMA
Programme for the Development of Software and Information Technology Services Industry — PROSOFT

Source: BNDES website, http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt (accessed 1 November 2011). Authors' elaboration.

Table A2.3: Brazil: Legal Framework of Innovation Policy

<i>Laws</i>	<i>Main Objective</i>
1993 — Law 8.661	Created tax incentives to foster enhancement of the technological capacity of manufacturing and agricultural enterprises taking part in one of the programmes: Programme for Industry Technological Development (PDTI) and Programme for Agricultural Technological Development (PDTA).
1997 — Law 9.532	Reduced the tax incentives established by Law 8.661/93, by approximately 50%.
2000 — Law 10.168	Created a tax: Tax on Intervention in the Economic Field, <i>Contribuição de Intervenção do Domínio Econômico</i> (CIDE), to finance the programme <i>Programa de Estímulo à Interação Universidade-Empresa para o Apoio à Inovação</i> .
2001 — Law 10.332	Re-established the tax incentives created by Law 8.661/93. Also instituted the grant for enterprises taking part in the PDTI or PDTA, and mechanisms for subsidising interest rates.
During the period 1999–2002, 12 sectoral funds were created	Provided support for the development of R&D projects in partnership between scientific and technological institutions and enterprises. The funds related to the following sectors: petroleum and natural gas, energy, water resources, transport, mineral resources, aerospace, telecommunications, information technology, health, aeronautics, biotechnology and agribusiness. There were also the <i>Verde-Amarelo</i> funds, Amazon Fund, and funds for infrastructure.
2004 — Law of Innovation Law 10.973	Aimed at promoting interaction between scientific and technological institutions of the federal government and enterprises. This law also created new tax incentives for the innovative process within firms, establishing a grant for enterprises taking part in a project under the <i>Fundo Nacional de Desenvolvimento Científico e Tecnológico</i> (FNDCT).
2004 creation of two further sectoral funds	Related to the naval and coastal sector and to the Amazonian area; aimed at developing new technologies and stimulating the innovative process.
2005 — <i>Lei do Bem</i> — Law 11.196	Also related to tax incentives for technological innovation. This law replaced Law No 10.637 (2002) and its main instruments are: tax exemption, accelerated depreciation and the possibility of grants

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<i>Laws</i>	<i>Main Objective</i>
	for researchers and graduates (masters and doctors). The difference between this new law and the former is that the mechanisms for tax incentives became automatic; previously, it was necessary to participate in the PDTI or the PDTA.

Source: Presidência da República website, <http://www4.planalto.gov.br/legislacao/legislacao-1/leis-ordinarias> (accessed 1 November 2011). Authors' elaboration.

Table A2.4: *Brazil: Total Scholarships in the Country and Abroad Granted by Federal Agencies 1997–2008*

<i>Year</i>	<i>Total</i> ($A=B+E$)	<i>In the Country</i>			<i>Abroad</i>		
		<i>Total</i> ($B=C+D$)	<i>CNPq</i>	<i>CAPEs</i> (D)	<i>Total</i> ($E=F+G$)	<i>CNPq</i>	<i>CAPEs</i>
1997	37.4	34.9	13.3	21.6	2.480	1.1	1.4
1998	35.0	32.9	11.7	21.1	2.140	791	1.3
1999	32.9	31.0	11.2	19.8	1.855	596	1.3
2000	32.0	30.3	11.5	18.7	1.772	562	1.2
2001	37.2	34.4	12.0	22.4	2.794	716	2.1
2002	38.1	35.1	11.8	23.3	2.955	744	2.2
2003	39.7	36.8	12.3	24.5	2.859	460	2.4
2004	41.9	38.9	13.6	25.3	3.003	499	2.5
2005	44.2	40.9	14.8	26.1	3.297	403	2.9
2006	48.6	45.0	16.1	28.9	3.578	347	3.2
2007	52.1	48.4	16.8	31.5	3.740	487	3.2
2008	62.6	58.9	17.9	41.0	3.740	526	3.2

Source: MCT (Ministry of Science and Technology) website, http://www.mct.gov.br/index.php/content/view/2050/_b__i_Bolsas_de_formacao_e_pesquisa_b__i_.html (accessed 1 November 2011). Authors' elaboration.