Science and technology policy in transition: new challenges for Cardoso's legacy

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Abstract: Brazil has a well-developed scientific and technological capabilitiy within industrialising countries. However, this capability has not been translated into social development. The new Brazilian Worker's Party government considers it urgent to develop an S&T agenda oriented to the country's social development. I argue that the new government faces two types of difficulties in pursuing this goal:. First, the new government's science and technology policies oppose, to a certain extent, the ideological foundations and the institutional structure of the S&T enterprise inherited from former President F.H. Cardoso's administration. Second, the Worker's Party's nationalistic development goals including building technological autonomy, have to confront the strong presence of foreign capital in hi-tech sectors and an accelerated increase in technological dependency during the last ten years.

Keywords: Brazil; science and technology policy; innovation; social development; F.H. Cardoso's administration; L.I. da Silva's administration.

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1 Introduction

Brazilian infrastructure in Science and Technology (S&T) stands out within Latin American countries. Brazil leads the region in investments in Research and Development (R&D), both in the absolute amount and in relation to the GNP. The country has a well-established and diversified university system, which has educated a significant number of high level researchers. As a result, Brazil's position in the world-wide ranking of scientific production has improved substantially during the past ten years, increasing its share of the world's scientific publications more than three times (Viotti, 2003, p.22).

The country also stands out, not only at the Latin American level but also world-wide, by its extreme wealth concentration, its historical educational deficit and other significant

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socio-economic problems (World Bank, 2003). It is often said that Brazil is a country of contrasts, and the gap between its S&T achievements and its many social problems is one of them.

The new Brazilian government headed by Luis Inácio da Silva – known as 'Lula' –, leader of the Partido dos Trabalhadores (The Workers' Party), set out to face these paradoxes when it assumed the Presidency in January 2003. The triumph of Lula marked a significant political change. After the two-term government of F. H. Cardoso, characterised by neo-liberal reforms, the new left-wing government emphasises the necessity of deep social changes focusing, particularly, on reversing historical social inequality. In the programme of Lula's government, S&T are seen as crucial tools to help in the pursuit of this new social development agenda.

In this article I argue that the new government faces two types of difficulties in developing the S&T agenda oriented to the country's social development. On the one hand, the current government's goals oppose, to a certain extent, the ideological foundations and the institutional structure of S&T inherited from former president's F. H. Cardoso administration. Other obstacles, such as the geographical concentration of S&T activities, have even deeper historical roots. The controversy about these issues was quite heated during the first six months of the new administration, when a new STP was being designed.

On the other hand, there are some challenges related to the form in which Brazil had entered into the global economy during the last decade. The 1990's were characterised by drastic economic opening and privatisation policies, which led to a significant increase in foreign capital ownership and technological dependency. In addition, the economy remained strongly moored to international financial organisations. Contrasting with this landscape, the new STP is nurtured by a nationalistic conception of development, and advances goals such as enhanced technological autonomy. These goals, however, are not easily pursued within the increasingly internationalised economic conditions which are, in fact, reflected in a quite orthodox macroeconomic policy assumed by Lula's government so far.

I analyse these issues by reviewing the debates that occurred during the first six months of the new government, which reflect the transition between two approaches to STP, and also the broader challenges faced by Lula's administration. I start by discussing, in Section 2, following this introduction, the S&T approach and the main policies promoted by F.H. Cardoso's government. In the Section 3, the transition between this approach and the one conceived by the Partido dos Trabalhadores is examined through the analysis of the main issues discussed publicly. In Section 4, I consider some challenges faced by the new conception of STP. The article ends with brief final comments.

2 From the supply-oriented STP to the promotion of innovation

Although some public research institutions were established in Brazil by the end of the 19th century and the beginning of the 20th century – particularly those oriented towards agriculture and public health – it was only by the 1950s that science started to receive systematic support from the State. In Brazil, as in other countries at the time, the dawn of STP was influenced by the document written by Vannevar Bush – *Science, the Endless*

Frontier (1945). Its proposition that economic and social development occurred as a result of progress in basic science – known later as the 'linear model of innovation' – as well as its proposal of public funding for science, were reflected in the supply-biased science policy adopted and in the supporting institutions created (Schwartzman et al., 1993; Dagnino et al. 1996).[1]

While in agriculture and health the local demands motivated the development of applied research, the new system of S&T received little interest from the industrial sector, since Brazil's strategy of industrialisation by import substitution rested on technological import. The technology transfer policy, in fact, blocked the chain reaction mechanism proposed by the linear model of innovation (Barreiro and Davyt, 2000). This situation reinforced the supply bias of the S&T system, characterised by the assumption that the scientific community would best serve the economy if it was isolated from other parts of the R&D system. Thus, its actions were mainly oriented towards scientific education and basic research at universities and public research institutes.

During the decades of 1960 and 1970, however, a nationalist development project was promoted by successive military governments. The relationship between research institutions and the productive sector was decisively promoted in strategic areas such as aeronautics, telecommunications, energy, and, later, computers. The links were directly stimulated by the State, through public research institutes and R&D centres of the state-owned companies, whose function was to develop local technological capabilities and to transfer them to national firms (Schwartzman et al., 1993; Dagnino and Thomas, 2001).

The military government's development efforts in S&T were quite successful in some sectors that were strongly related to the State such as petrochemical, telecommunications, and aeronautics. However, this strategy was not able to incorporate, in a permanent manner, the private sector, whose growth benefited from the expansion of a strongly protected internal market (MCT, 2001; Velho and Saenz, 2002). The national development project did have a decisive impact in consolidating the most important components of the Brazilian system of S&T, which are: the graduate level and full time positions at the federal and state public universities; the public research institutes, and the R&D labs at the state-owned companies.

The crisis of industrialisation by import substitution became evident during the eighties and the military project ended with the recovery of democracy in 1985. After two decades of steady growth – Brazilian economy grew at 7% to 10% annual rates during decades of 1960 and 1970 – the 1980's are known as the 'lost decade', due to economic stagnation. Meanwhile, a technological revolution and radical changes in production patterns were occurring world-wide. As Castells (1999) has shown, by that time, information and communication technologies (ICT) were spreading throughout old and new production branches, changing productivity and quality standards, reshaping firm's internal and external organisation, and allowing new global production networks.

The export success of the 'Asian Tigers' was seen as a model of economic growth and technological catching-up for Latin America. Instead of the significant State intervention in industrial and S&T policies that fostered the export growth in East Asia, however, in Latin America economic liberalisation and privatisation policies were seen as the main instruments to achieve success in catching-up and competitive integration to global markets. It was assumed that technological modernisation would be achieved by technology acquisition by local firms in the global market and technology transfer carried out by multinational companies (Lastres and Cassiolato, 2001, p.135). By 1990, an

economic openness policy signaled the end of import substitution and market protection in Brazil. Some fiscal incentives and programmes such as the Brazilian Programme for Quality and Productivity were directed to the firms' ongoing processes of restructuring to adjust to the new competitive conditions.

In this context, innovation discourse spread-out in Brazil. Yet, innovation policies started to be more consistently addressed by the end of the nineties, when it became evident that privatisation and liberalisation were insufficient to promote competitiveness. On the contrary, these policies had provoked many firms' bankruptcies and losses of technological capability; they proved to be an ineffective way to transform Brazilian exports towards more technological-intensive products (Katz, 2001, pp.79–81; Lastres and Cassiolato, 2001, pp.136, 137; Viotti, 2003, p.26). A new approach in STP, oriented to promote innovation in the productive sector, was developed during the second administration of Fernando H. Cardoso (1999–2002). This Science, Technology and Innovation (CT&I) policy represents a decisive shift from the former supply-oriented STP – centred on the State and the universities – to another that emphasises the demand for innovation and gives a central role to a third actor that had been absent until then: the private firm. As will be shown later, however, this shift in policy design proved to be difficult to implement in practice.

The diagnosis of the country's S&T situation, as portrayed in the Livro Verde[2] [Green Book] (MCT, 2001) by the Science and Technology Ministry (STM), was an eloquent critique of the S&T supply model. Although it is recognised that the past S&T policies have developed a good research infrastructure and qualified human resources, strong criticism is directed to the lack of ability of the S&T system to integrate the productive sector. This lack of integration prevented the transformation of knowledge into innovation and innovation into competitiveness. This is clearly argued in the Livro Verde by showing the contradiction between the country's improvement of scientific performance and its very underdeveloped innovation capacity. Let's examine the main indicators that supported such a diagnosis.[3]

- *Brazil invests considerable resources in S&T*: In 1999, 0.87% of the GNP was destined to R&D (currently this Figure is 1%). The report emphasises that although this percentage is certainly inferior to the amount spent by other newly industrialised countries such as South Korea (2.5% in 1999), it is comparable to the expenditures made by some European Union countries such as Italy, which invested 1% of its GNP in R&D in 1999, or Spain, which allocated 0.9% of its GNP to R&D in the same year. In addition, it is highlighted that Brazil's investment is superior to the R&D expenditures made by any other Latin American country (MCT, 2001, p.28).

- *The country has a significant supply of high level scientific personnel*. Systematic federal investment has been made for the last three decades to develop the graduate education system at the Federal and State public universities. These resources include master and PhD scholarships as well as training programs for teachers and researchers. Between 1987 and 2000, more than 120,000 master degrees and more than 35,000 doctoral degrees were awarded. In 2000, 5,000 new PhD diplomas were granted. In the same year, the public universities and research institutions employed 49,000 scientists, of whom almost 60% were doctors (MCT, 2001, p.29).

- *Brazilian scientific productivity is increasing*. The scientific community's performance, measured in number of scientific articles published, improved continually during the last 10 years. Data from the Institute for Scientific Information shows that Brazil rose from 28th place to 17th place in the world-wide ranking of published articles in indexed journals between 1991 and 2000. In 2000, 9,500 scientific and technical articles were published. This growth places Brazilian participation in the world-wide production of science on levels similar to those of Israel and South Korea. According to the citation records, Brazilian science has begun to have more impact at a world-wide level. While between 1981 and 1985 14,000 citations of Brazilian papers were registered, between 1996–2000, there were 85,000 (MCT, 2001, pp.31,71).
- *National achievements in S&T show that the country has the potential to develop its innovative capability*. For instance, research conducted by EMBRAPA (Brazilian Company of Agricultural Research) facilitated the extension of the agricultural border towards the 'cerrado', an area considered infertile. This has decisively contributed to the rise of Brazil as one of the great world grain producers. Another example of local S&T capacity can be seen in the national oil company, Petrobrás, which developed a system for prospecting oil in deep waters. The research institutes Oswaldo Cruz and Butantan are outstanding in the health field, producing vaccines, snake venom antidotes, and medicines for tropical diseases. In aeronautics, the former state-owned Embraer Company is able to produce competitive medium-sized airplanes – the only case among the late industrialising countries. Another example is the *Pro-alcool* program, which developed an alternative renewable fuel based on ethanol obtained from sugar cane. In the recent years, Brazilian researchers have entered new areas such as genomics, participating in the World Genome Project, and nanotechnology (MCT, 2001, pp.37–38, 81).

Some comments could be made about these indicators. First, if we consider Brazil's scientific human resources not in absolute terms, but in relation to its population, they are quite scarce. Comparing Brazil to South Korea, as the report does, the gap is enormous: while Brazil had only 168 scientists and engineers per million people in 2000, South Korea had 2139 (UNDP, 2002). Second, a break was observed during the 1990s with the trend of the previous two decades to increase the resources applied to scientific training programs: the main agency – the CNPq – had its budget frozen (Zancan, 2002). Third, in spite of the growth of Brazilian scientific production, it should be highlighted that such output remains marginal in terms of world production. Archibugi and Pietrobelli (2003, p.868) emphasise that even if developing countries had increased their participation in world scientific production – and sometimes at high rates as is the case of Brazil – developed countries still produce more than 84% of it. Lastly, it is rather contradictory that at the same time that Cardoso's government was privatising state-owned firms and reducing funding or privatising public research institutions, most of the examples of Brazilian S&T achievements presented by the STM report were made by former state-owned enterprises and public research institutions.

After showing these indicators as evidence of Brazilian S&T endowments and achievements, the STM diagnosis underscores the country's poor performance in innovation. The Livro Verde highlights three particular indicators: the small number of patents granted; the insufficient private investment in R&D; and the reduced use of scientific and technical human resources by private firms.

- *The lack of innovation capacity is revealed by the reduced number of patents*: Brazil has registered a small amount of patents in the USA if compared with South Korea, another newly industrialised country, as shown in Table 1. While both countries have had a relatively harmonious evolution in their science production indicators, the gap in their relative positions in number of patents has grown radically.

Table 1 Articles and patents produced by South Korea and Brazil

	Brazil 1981–2000		*South Korea 1981–2000*	
Scientific articles published	1,889	9,511	229	12,218
Patents granted in the USA	23	113	18	3,472

Source: MCT (2001, pp.34, 71).

- *Private expenditures in R&D are low*: The private sector contributes just with 35% of the national expenditure in R&D (0.3% of the GNP) (MCT, 2001, pp.28–29).[4] South Korea, considered a paradigm of innovation among newly industrialised countries, has moved in an opposite direction. There, more than 70% of the total R&D budget is financed and performed by private companies (Kim, 2000, p.14).
- *Private companies do not absorb scientific and technical personnel*: In spite of a considerable supply of scientific and technical personnel, private firms' demand is low. In 1998, nearly 12,200 people worked in R&D activities, distributed among 1,800 firms – an average of only 6.7 people in the R&D department of each company. On average, only 12% of a firm's employees have a university education. Those with university education in sciences, engineering or computer science are 0.7% of the total. Meanwhile, nearly 3,000 people with masters or doctoral degrees are unemployed and scientists' emigration has increased (MCT, 2001, pp.66–68). Again, this situation contrasts with the South Korean case, where private companies absorb a great number of scientists, as shown in Table 2. Also, unlike Brazil, since the 1980s the Korean companies have repatriated scientists and engineers from abroad (Kim, 2000).

Table 2 Scientists and engineers in R&D activities in Brazil and South Korea

Employed by:	*Brazil (in 1996)*	*South Korea (in 1997)*
Firms	8,765	74,565
Universities	56,760	48,588
Research institutes	12,336	15,186

Source: Cruz (2000, p.6).

It is evident that this low utilisation of scientific and technical human resources is the consequence of the reduced R&D and innovative activities within the private sector. Recent statistical data reinforces the picture shown by the STM report. Between 1998 and 2000, only one third of Brazilian firms with more than 10 employees implemented a technologically new product or process. And, among those that did it, the investments were concentrated in the purchase of equipment. While those companies joined a process of technological diffusion, they did not became, *stricto sensu*, innovative

firms.[5] R&D activities are very limited, occurring in only 16% of the firms within the group that have implemented new processes or products. In addition, 90% of the private R&D expenditures are performed by large companies, particularly in the capital goods, electronic equipment, computers, and communication sectors (PINTEC-IBGE, 2002).

Similarly, a study conducted by the National Industrial Federation and the STM including 531 firms, showed that for 70% of the firms, the main strategy of technological development is the acquisition of updated technology. Meanwhile, the absorption of research personnel was not considered important, practiced by only 3% of the companies (CNI and MCT-Finep, 2001). As a result, between 1993 and 1998, the technological deficit of the country – difference between technology imports and exports – grew 1,400%, and the bill the country pays on royalties and licenses rose from $ 200 million in 1992 to $ 3.5 billions in 2001 (FAPESP, 2001).

The innovation policies designed during F. H. Cardoso's second administration aimed to promote the competitive entrance of Brazilian firms into the global market. This change of perspective in STP towards innovation policies required the redesign of the institutional structure that had been operating since the 1950s. Two main policy instruments stand out in the development of this new institutional design: the Sectorial Funds (Fundos Setoriais) and the Innovation Law. Both propose mechanisms for the incorporation of the private sector into the S&T system, targeting its transformation into a National System of Innovation. The relationship between firms, universities, and research institutions adopts a particular importance among these mechanisms.

The Scientific and Technological Development Support Funds (Fundos de Apoio ao Desenvolvimento Científico e Tecnológico), known as Sectorial Funds, started operation in 1999. They were created with the objective of articulating the research demands of specific productive sectors such as petroleum, energy, hydraulic resources, mineral resources, transportation, information technology, health, aeronautics, agriculture, biotechnology and telecommunications. There are, also, two non-sectorial funds: the infrastructure fund, created to finance infrastructure acquisition and upgrading at public universities and research institutions, and the so-called 'Green and Yellow' Fund, oriented to promote innovation in areas not contemplated by the other funds.

The financial resources to fund innovation projects come from the same productive sectors that are supported by them, through taxes applied to various activities such as technology imports, royalties and license payments, and allocation of public services to private companies, as well as from revenues derived from companies benefited by fiscal incentives. These resources – originating in and applied to the productive sector – seek to insure permanent and stable funding for innovation activities, avoiding traditional federal S&T budget fluctuations. Each fund has an autonomous administration committee, composed of representatives of the corresponding sector, the ministries related to each sector, the CNPq (National Research Council) and the scientific community, which determines the distribution of the fund's resources (MCT, 2001, p.235). The Centro de Gestão e Estudos Estratégicos (CGEE), a quasi-governmental consultant entity[6], was created to give technical support to these managing committees. The human resources for conducting research activities sponsored by the funds are mostly those of the universities and public research institutions, who have to establish specific agreements with the companies.[7]

Partnerships between public universities, research institutes and firms – a *trio* that should foster the development of the whole chain of knowledge, from basic science to specific demand of the firms (MCT, 2003) – were stimulated to promote firms innovation

through the Sectorial Funds. In practice, however, this policy has become intimately related to universities, thus facing the risk of reproducing the old supply-driven approach to S&T.

The second instrument, the Innovation Law, generated strong debate between the government and the academic community. Congress had not approved it by the end of Cardoso's administration, in December 2002. The proposal – which is still in Congress and will possibly suffer some modifications – tries to consolidate a legal structure that would allow the flexible transference of researchers and technologies from the public research institutions and universities to private companies. Its main aim is to transform the public research sector, which is considered non competitive and unable to adapt quickly to demand. The law proposes, in addition, to give greater autonomy to these public research institutions to manage public resources and to collect private funds (MCT, 2001, p.249).[8]

While a quite broad consensus was built about the Sectorial Funds, the Innovation Law project raised major controversies. Part of the academic community energetically opposes the law's conception of university-firm relationships. It is argued that this law could have adverse effects on public universities, subordinating them to market pressures. On the one hand, it could induce a very unequal development between those areas of knowledge production that are related to commercial interests and those that, even responding to social needs, are not. On the other hand, there has been considerable opposition to the privatisation of public resources – material and human – of the universities in the service of private enterprises. The press has described the last argument as 'ideological opposition' (Balthazar, 2003). Last year, the former president of the Brazilian Society for the Progress of Science[9] argued during a conference that 'the Innovation Law proposes innovation just for the industry, for the necessities imposed by the market; it does not take care of the innovation needs related to the population. Everything in this law of innovation is privatisation of the public, starting with the universities' brains' (Zancan, 2002).

It has been argued, also, that the discourse about a great alliance between universities and firms, contained in the S,T&I policy is dissociated from the reality of the local entrepreneurs, whose main strategy is not to invest in R&D, but to import technology (Dagnino, 2002). Recalling past experiences of university-firm relationship programmes, Velho and Saenz (2002) observed that the expectations put on this relationship to promote innovation are overstated. According to their research, so far, the government actions to integrate universities and enterprises have only been successful for specific projects, but have been able neither to create long term relationships, nor to stimulate firms to establish their own R&D units.

In spite of these criticisms, the scientific community has agreed in general terms with the diagnosis presented by the STM about the gap between increasing science performance and the productive sector's low capacity of innovation. The President of Unicamp, one of the country's main universities, Enrique de Brito Cruz, asserts that the innovation policy promoted at the end of the 1990's overcame the historical mistake of the Brazilian S&T policy, traditionally centred in the universities. He states clearly that the place where innovation occurs is the firm, not the university. As he declared in an interview: 'the innovation capacity of the Brazilian firms will be developed when they begin to do research, and not when they interact with the university'. The university-firms relationship – he added – would be productive and natural after the firms started to invest in R&D (Cruz, 2002; Ferraz, 2002).

The integration of the academic community into the discussion about innovation and its participation in several forums and as representatives in the Sectorial Funds committees decisively contributed to legitimise the subject. However, the STM was frequently criticised about the contradiction between 'the theoretical richness of the system designed by the STM during the last years and the delays and irregularity of the investments, due to structural or occasional economic reasons' as Vogt (2002), President of the São Paulo State Foundation for S&T (FAPESP) did. Budget cuts not only affected the Sectorial Funds, but also the CNPq, which faced bankruptcy risk during the last year of the Cardoso administration, and led to the suspension of several programs (Souza, 2003).

In fact, this disagreement between discourse and practice, as well as the recurrent emphasis on the university's role in innovation promotion, reveal something particularly important: The Cardoso government's innovation policy was not part of a broad industrial policy. Political tensions within his government alliances prevented it to develop a consistent industrial policy. However, there were some examples of industrial policies in particular branches, as is in the case of automobiles, an industry virtually revamped by a successful industrial policy in the mid-1990s (Comin, 1998).

The discussion about innovation and the new mechanisms created to stimulate it, as well as the crisis of the S&T budget, was at its peak by the time Luis Inácio da Silva initiated the electoral campaign that brought him to the Presidency.

3 From innovation policy to S&T for social development

Brazil suffers several serious social problems as a result of the historically acute inequality. Despite the improvements registered in some social indicators during the F.H. Cardoso administration, high inequality persisted. For instance, the rise of enrollment levels in elementary education as well as the rise in life expectancy decisively contributed to elevate the Human Development Index from 0,737 in 1995 to 0,757 in 2000. Such performance is not a satisfactory, however, even in the context of other Latin American countries as Argentina (HDI 0,844), Chile (HDI 0,831) or Mexico (HDI 0,796) (UNDP, 2002).

In spite of the success of Cardoso's plan to contain hyperinflation, which had corroded the purchasing power of the population, social inequality figures were not significantly altered throughout his two-term government. The Gini index, which measures inequality, is as high as 60.7, according to UNDP (2003) data. The Census 2000 showed that the richest 10% of the population control over 45.7% of the wealth. Meanwhile, the poorest 50% receive 14.5% of the wealth, and the poorest 10%, only 1% (IBGE, 2000). In a population of 170 million, 57 million are under the poverty line and hunger chronically afflicts 46 million Brazilians. The poverty level didn't experience any improvement during these years (PINAD-IBGE, 1999; Instituto da Cidadania, 2001).

Unemployment grew, reaching between 14% and 26% of the workforce in the six main metropolitan areas of the country in 2002 (SEADE-DIESSE, 2003). It is estimated that about 50 to 60% of the workers are in the informal economy, including self employed and workers who are hired illegally, without social security register (Invernizzi, 2000; PME-IBGE, 2002).

The educational system, in spite of a significant advance in enrollment at the elementary level – which reached 96% of the children – presents serious quality

deficiencies. Recent research conducted by UNESCO showed that 50% of the 15 year-old Brazilian students are under the so-called level one of literacy, which means that they are able to perform only very simple reading activities. In mathematics and sciences, the performance of Brazilian students was one of the two lowest among the 41 evaluated countries (UNESCO, 2003; Jornal da Ciencia, 2003a). This data demonstrates that the country's workforce is unable to contribute to an innovative productive sector, not to mention exercise its citizenship rights and duties.

The C,T&I approach developed during the Cardoso administration did not avoid these and other complex social problems.[10] In fact, official documents referred to them. However, under this approach, its solution was conceived as the result of the economic growth that the country's better competitive position would bring. The Livro Verde expresses: 'The investments in Science, Technology and Innovation bring return in the form of a better qualified population, higher paid jobs, generation of *divisas* [export income], and a better quality of life' (MCT, 2001, pp.13, 14). Such investments would enable the country 'to learn continuously and to transform, daily, knowledge in innovation and innovation in development' (MCT, 2001, p.18). This conception of social welfare as a result of the economic growth impelled by the scientific and innovative development is not so different from the conception that guided the linear model of innovation. The stimulating role that the latter attributed to basic science, would be now accomplished by the demand of innovation – still virtually nonexistent – from the productive sector.

In other sections, however, the same document acknowledges that economic growth alone is not sufficient to promote the correction of the country's historical social distortions (MCT, 2001, pp.85, 86). But solutions to social problems are, in general, considered as a result of the innovation process, which is viewed mainly as an economic process in the Livro Verde. This approach contrasts with theoretical developments on National Innovation Systems which consider the social context in which innovation occurs as a decisive factor embedded in the system (Freeman, 1987; Lundvall, 1988; Niosi et al., 1993). Moreover, Latin American authors such as Arocena and Sutz (2003) claim that use of the National Systems of Innovation framework in developing countries has to consider particularly the social inequality dimension, in order to develop equality-driven innovation capabilities.

In October 2002, the triumph of Luis Inácio da Silva with 61% of the votes in the presidential election led, for the first time, the Worker's Party to power. This was a clear signal of popular discontent with the results of the neo-liberal policies of the previous government. The expectations of the population for Lula are enormous, expectations particularly related to the improvement of living conditions. In the Brazilian context, this means eliminating hunger, creating jobs, improving public educational and health systems, confronting regional development inequalities, and conceiving solutions for the problems of fast urbanisation, among many others.

In fact, Lula's commitment to the social agenda is reflected in the priority given to it, clearly stated in the three proposed mega-goals for his administration, which are:

- social inclusion and reduction of social inequalities
- environmentally sustainable economic growth with job creation and reduction of regional inequalities
- promotion and expansion of citizenship and democracy enhancement (MCT, 2003, p.4).

Lula has repetitively emphasised, since his electoral campaign, the strategic importance of S&T to support the development of the social agenda. He claimed the necessity of democratising S&T development, reorienting it towards the necessities of the Brazilian population (Partido dos Trabalhadores, 2002). When assuming his position as Science and Technology Ministry, R. Amaral expressed this compromise clearly:

> "The new Brazilian science and technology policy will be oriented to social change, which implies democratising the scientific knowledge, the technology and the benefits that they enable. Science and technology will contribute to this goal in two ways. On the one hand, they will contribute to overcoming the most serious social deficiencies, considered priorities by the Lula administration. On the other hand, through the development of strategic scientific and technological policies that would allow the long term national development." (Amaral, 2003)

Some months later, a document containing a proposal for Strategic Directions of the STM for 2004–2007, which is currently under public discussion, reinforced this conception of the STM's mission:

> "To design and implement a National Science and Technology Policy according to the Strategic Directions of the Federal Government, in order to use scientific and technological research as instruments of progress and promotion of social welfare." (MCT, 2003, p.4)[11]

To put in practice such declarations of principles entails a break with the previous tradition of S&T policy making. It means abandoning a deeply rooted approach that conceives social welfare as the final – but never guaranteed – product of S&T development. This approach persisted after the significant changes in STP made during the F. H. Cardoso's administration. A different approach, that considers social problems and social needs as the departure point for the formulation of ST&I policies is needed. This is the challenge that the new government set out.

The first six months of Lula's administration have been the scene of a broad debate of ideas on STP. Without any pretension to exhaust all the topics discussed, in this article I emphasise some issues that have been widely publicised through the daily press.[12] Six months are not enough time to evaluate government actions, particularly in the context of a significant political change as occurred in Brazil. In fact, the issues discussed were mostly related to political goals stated in the Workers' Party Government Programme, discourses and criticism directed towards the former and the new STM. Even if the debate of ideas was more present than the debate of specific policy measures, it is interesting to note that the issues discussed during this time already reveal the different approaches on S,T&I of the former and the new government. This debate also announced the challenges faced by the new administration.

The initial controversies were fed by definitions and actions taken by the new government that were considered contradictory with its promise of giving S&T a central role in the government's programme. The debate continued about the changes made in the organisation of S&T to accommodate the new goals, demonstrating how difficult it can be to put in practice a new S&T approach from inherited institutional structures and practices. Let's examine these questions in greater detail.

The first action of the new government in the S&T area, the appointment of the Minister of S&T, provoked a strong controversy. The controversy started as a result of ambiguous or misinterpreted declarations of the Minister about the Brazilian nuclear programme, but it advanced towards a greater questioning of the Minister and his actions.

The most influential newspaper of the country, the *Folha de São Paulo*, said: '[The minister R. Amaral] has dissatisfied technicians, academics, entrepreneurs, and even his own government colleagues' (Castanede and Constantino, 2003). The editorial page of another prestigious newspaper criticised Amaral because he did not have experience in the S&T field, and for not having presented a clear STP (O Estado de Sao Paulo, 2003). A sarcastic critic claimed that the Minister and his team were almost completing a historical achievement, making STP go ten years backwards in only two months (Nassif, 2003a).

The appointment of Amaral was not only criticised by political opponents, but also by people supporting the government. The fact that the president has granted the ministry to a representative of a minor electoral alliance[13] is considered contradictory with his pre-electoral promises to confer to S&T a central role. Thus, for example, Glaci Zancan, former president of the Brazilian Society for the Progress of Science, expressed during an interview: 'the science and technology area is not placed in the heart of the power; it was left to a Party which is not the Partido dos Trabalhadores … [and this means that] the PT did not consider the importance of the area within the whole government' (Tortato, 2003). Meanwhile, the Minister has declared repeatedly to the press his total personal commitment and of his Party to the PT's government (Paduan, 2003).

A second controversial issue that marked the beginning of the new administration was the scientific community's fierce opposition to the government's decision to reform the social security system. Although this is a political measure taken outside the S&T area, it could have strong negative impacts on Lula's STP. Since most of Brazilian scientists are public employees at universities and research centres, the reform of retirement conditions in the public sector would stimulate the early retirement of professors and investigators.

Information sources related to the universities and to the Social Security System reveal that about 20% of the professors of the Federal Universities are eligible for retirement (Leali and Paraguassú, 2003). The universities could suffer severe loses, especially because the potential retirees include about 1,500 researchers placed at the highest categories, whose experience and productivity would be very difficult to recover, even if the positions were refilled. Special compensations have been offered to these people, trying to avoid losses, but these short term measures cannot prevent the future impacts of the reform of employment conditions, which could prevent young people from following research careers in public institutions (Tortato, 2003; Pereira Filho, 2003). It is argued, also, that the early retirements represent a waste of the systematic investments made by the State in the education of a scientific workforce. Moreover, these resources would be yielded, without cost, to private universities that frequently hire personnel retired from public institutions (Marcondes, 2003).

In a recent meeting at the University of Sao Paulo, widely publicised by the press, very well-known intellectuals sympathetic to the Partido dos Trabalhadores – and even some founders of the party – manifested publicly their opposition to the social security reform proposal (Corsalete, 2003; Cariello, 2003). They emphasised that this reform would trigger a loss of experience and quality at the public universities, arguing that this is contradictory with the government's programme, which proposes to improve and expand public education. They severely criticised this initiative and attributed it to a contradiction between the government's progressive political goals and its orthodox macroeconomic policy.

In addition to these conflicts, the six first months of the Worker's Party's government has been characterised by continuous attacks directed to the STM in the daily press. Editorial pages, as well as articles written by political opponents or members of the scientific community have continually highlighted the slowness of the Ministry's actions. The critics focused on the virtual 'freezing' of the sectorial funds, the main tool for innovation stimulus. This situation made clear the difficulties faced by the new government to reorient the institutional structure and practices inherited from the previous administration to the newly proposed STP goals.

The budget granted to the sectorial funds was retained while a commission was assigned to its evaluation. The editorial page of the newspaper *Folha de S. Paulo* claimed that the STM was determined to blow-up the management model conceived for the Sectorial Funds, risking the loss of everything that had been advanced in the S&T area during the Cardoso's government (Folha de S. Paulo, 2003). Many academics also questioned this impasse. Ennio Candotti, recently elected President of the Brazilian Society for the Progress of Science, and a severe critic of the S&T Ministry, objected that after several months, the government is still discussing what to do with the Funds and has not attempted to create any new Fund directed to social areas (Candotti, 2003).

The STM recognised the merit of their predecessors in conceiving the Sectorial Funds, but disagreed with its management model. The Ministry faced difficulties in attempting to reconcile the Sectorial Funds – whose management was autonomous – to the goals of the new STP (Souza, 2003). In addition, the ministry tried to eliminate the CGEE, a social organisation whose contract with the STM to give technical consultancy to the Funds was valid until 2006. The Minister, as well as the Secretary of Industrial Technological Policy have questioned the functions of that organisation, saying that it had assumed an inappropriate role as policy maker, a prerogative that both consider exclusive of the Ministry (Nassif, 2003b). This disagreement clearly reflects differences about the way the previous government implemented reduction of the State's role in the S&T area. The CGEE generated a great discussion, and many academics came out in defense of its performance and institutional structure, considered modern and similar to existing institutions in industrialised countries (Caldas, 2003; Cruz, 2003).

The burden of the inherited institutional structure is also revealed by the difficulties in changing the innovation bill sent to Congress at the end of Cardoso's administration. As assumed, the new government immediately pulled the bill off the fast track in Congress. However, faced with the pressure of industry associations which called for the approval of the innovation law, the STM agreed to review it and send the bill back to Congress by September 2003. The academic community, one of the main affected actors, considers that hiatus inadequate for promoting the necessary discussion of the law. However, some discussion rounds coordinated by the STM have occurred since May 2003.

During the recent annual meeting of the Brazilian Society for the Progress of Science it was emphasised that an innovation law involves issues not yet completely defined by the present government, such as the roles of the educational and research institutions, industrial policy and intellectual property rights. According to José Cassiolato, from the Federal University of Rio de Janeiro, the proposed innovation law would alter completely the operation of the Brazilian university system. In addition, he stated that the bill is a replica of the French Innovation Law of 1982, and therefore, inadequate to the Brazilian economic and industrial context. For Francelino Grando, secretary of Informatics and Technology Policy at the STM, the innovation law project is not mainly directed to innovation – because it does not propose effective mechanisms to stimulate

innovation – but to make more flexible the management and control mechanisms of public research institutions and universities. He warns that the bill could even allow 'cannibalism' of the universities' public resources by private sector through the proposed transfer of researchers from public institutions to private enterprises (Jornal da Ciencia, 2003b, 2003c).

In this context, should the government push for passage of the controversial innovation law, it is likely to provoke strong opposition to the rest of its STP program. Even if it is possible to make some changes, the whole conception of the law seems to be contradictory with the government's declared goals on innovation and public universities.

Finally, the decentralisation of S&T is another example of the obstacles put up by the inherited structure against the attainment of new objectives. Although reversing the historical geographic concentration of S&T activities was already a goal of the previous government, it has currently been elevated to a high-priority. Reversing geographic concentration is now conceived as a necessary condition for S&T to contribute to national development goals, which include overcoming regional economic and social inequality. According to the S&T Minister, the geographic decentralisation of S&T activities is a precondition for reversing the concentration of earnings, the wealth, and the land, as well as for the regional development (Paduan, 2003). 'We will not have a national project – he said – if we continue stimulating the distance between the Southeast region and the rest of the country' (MCT Noticias, 2003). However, the STM commitment to reverse S&T concentration has been received by the scientific community with certain apprehension, and even faced opposition.

For historical reasons, universities, research institutes, scientific personnel and public funding for S&T are concentrated in the Southeast region, particularly in the affluent State of São Paulo. Most of the so-called centres of scientific excellence – strongly promoted during recent years with the support of the World Bank – are in this region.[14] Although there are public universities and public research centres throughout the country, the differences between the top universities and the rest are strong and had been reinforced by emphasising the quantitative approach to scientific productivity. In fact, the emphasis on the number of papers published in high impact journals favoured the scientists who work in the best equipped and best financed universities of the Southeast. This, in turn, made it easy for them to gain more public support and to gather private funding from selling research or consultancy services.

Table 3 shows the unequal distribution of S&T resources among the different regions of the country. It can be observed that the federal resources destined through the CNPq for research and graduate education are overwhelmingly concentrated in the Southeastern region, which receives almost 60% of the total. The three major universities of the Southeastern region – University of São Paulo, State University of Campinas and Federal University of Rio de Janeiro – receive 27% of CNPq's graduation scholarships and 23% of the research support budget (CNPQ-SUP, 2003). The investment per capita is also much higher in the Southeastern region than the others. Additional resources provided by State governments reinforce even more the unequal distribution of federal funding. Although several States have foundations for the promotion of S&T – Fundações de Amparo à Pesquisa (FAPs) –, the one of the State of São Paulo – FAPESP – categorically surpasses all the rest in dynamism and budget (Vogt, 2002; Adam, 2003).

Table 3 S&T expenditures within Brazilian regions

Regions	*North*	*Northeast*	*Centre-West*	*Southeast*	*South*
Federal resources through CNPq – Average 1999–2001 (In millons R$)	12.44	61.86	29.6	256.603	72.54
% of total CNPq's resources	2.87	14.28	6.83	59.25	16.75
CNPq's investment per capita in each region –Average 1999–2001* (R$ 1,00)	0.96	1.30	2.54	3.54	2.89
S&T State Government's budget-1999 (In million R$)	6.6	97.7	30.4	832.3	158.1
% of all State Government's resources allocated to S&T	0.59	8.58	2.70	73.98	14.05

*Calculated according to the resident population in year 2000.

Source: MCT (2001, pp.25, 63).

Given these conditions, it is not surprising that the performance of the diverse regions is very uneven. For example, nearly 60% of almost 12,000 existing research groups in the country are in the Southeast. It is also there that the majority of graduate programs are located, including those which receive the highest scores in evaluations made periodically by CNPq (Chairmovich, 2003). In terms of productivity, the scientists of the State of São Paulo are responsible for more for than 50% of the total publications of the country, and the University of São Paulo alone produces 25% of them (Vogt, 2002; Neto, 2002). During the year 2001, the universities of the State of São Paulo produced 3.000 out of the total 6.000 new PhDs (MCT Noticias, 2003).

The decentralisation policy has faced some resistance at the centres of excellence. It is claimed that diluting scarce resources could put at risk the high levels of quality and productivity barely attained during the last decade (Adam, 2003; Chairmovich, 2003). Conversely, those on the periphery of national science emphasise the necessity of democratising resources and the practice of science itself. In addition, they consider important the construction of local scientific and technological capacity in order to face specific regional problems. However, as Neto and Carvalho (2003), and Ferreira (2003) point out, the problems of these less developed regions might not attract the interest of the First World journals and might not fit into the relevance and productivity criteria currently dominant at the centres of excellence.

4 The challenges of ST&I policy for social development

During the last half century, S&T policies practiced in Brazil had been fed by different conceptions about the capacity of S&T to foster economic and social development. The supply-driven approach conceived development as a result of a relatively independent dynamic of science. Although it certainly fostered the construction of a considerable research infrastructure and the education of scientific workforce, its contribution to the solution of the main social problems was limited. Due to its relative autonomy, science dynamics tended to be more tied to the problems provoked by the advancement of science in the developed countries than to the local problems.

The military nationalistic development approach tried to orient S&T to self-sufficiency and national security objectives. Although the essential components of the national system of S&T had consolidated during that period and several successful experiences of technological autonomy had been reached, the military's policy strategy did not contribute to the social development of the country. This failure reflected not only the suppression of the democratic liberties, but also, in spite of the accelerated economic growth during the decades of 1960 and 1970, a significant concentration in the distribution of wealth, leaving a considerable part of the population completely excluded from the fruits of growth.

In the S, T&I model developed during the F. H. Cardoso administration, innovation was seen as a source of competitiveness for entering the global market, and competitiveness was seen as the key to economic growth and improvement in living conditions of the population. Social inequalities, however, remained, and this was not a situation exclusive to Brazil. Almost anywhere in the world, including the developed countries, frantic competition in global markets has brought increasing social inequality.[15]

The approach proposed by the government of Luis Inácio da Silva is different from all the previous. In it, the point of departure for S,T&I policy making are social goals. ST&I policy is, then, inserted in broad social polices, such as reducing social and regional inequality, and in urgent social goals as, for example, eradicating hunger. The government faces a great challenge in attempting to prevent the new perspective from being reduced to a mere change of rhetoric.

The main points discussed during the first six months of the new government have shown that the inherited structure and the forms of operation of the S&T system present some obstacles that it is necessary to surpass. The new policy approach does not start from a *tabula rasa,* but from a preexisting institutional structure of S&T activities, criteria of resource distribution that reinforce centralisation, sanctioned forms of operation, and legitimised criteria of scientific quality and relevance. All of this is subject to debate in light of the new proposed goals.

To change this operational structure entails high risks: the whole system could be paralyzed, de-activated, or even destroyed. The risk is even higher when considering the short time of a presidential term – four years. In fact, this dilemma appeared clearly when the operation of the Sectorial Funds had been delayed, while the STM studied how to fit them into the new S&T objectives. It has been made clear, also, in the discussion on the innovation law, whose approach to university-firm relationships may put the public universities under market forces, at precisely the time when the Lula administration is stressing the commitment of public universities to broader social needs. The dilemma is also present in the different points of view on S&T decentralisation which, at heart, confronts different conceptions of scientific productivity, quality and relevance.

The innovation issue has special connotations in the new political context and raises challenges that are still more complex. The government's development plan enlarges the vision of innovation. Until now, innovation policies had been particularly oriented to competitiveness in global markets. Besides addressing this important issue, and according to objectives such as social inclusion and social development, the promotion of innovation also considers essential the development of local capacity of innovation oriented to support an import substitution policy. Also, it takes into consideration the necessity of fostering innovation in other productive contexts, such as small family enterprises and cooperatives, which provide the income of an important part of the population (MCT, 2003).

Will the new government be capable of controlling this plan, which contains a considerable nationalistic bias, in the context of the strong demands made by international funding organisations and the increasing pressures for the rapid integration of Brazil to the Free Trade Area of the Americas? In addition to the historical conditions that determine the low innovation capacity of Brazilian industry, the government faces the strong rise in foreign ownership of production, particularly in the most technologically intensive sectors and within the basic industries and services pervasively privatised during F. H. Cardoso's administrations. Is it possible to think about the integration of these foreign-owned sectors into an innovation policy guided by goals such as national social development and enhancement of technological autonomy?

The innovation policy oriented to import substitution will face other problems inherited from the recent past. These include the destruction of considerable parts of the productive chains caused by the accelerated liberalisation of the economy after 1990 and the destruction of S&T capabilities historically accumulated by state-owned firms and public research institutions. They were both severely affected by liberalisation and privatisation policies during the 1990s.

To stimulate innovation, from large companies to family or cooperative production, as the government proposes, requires a decisive confrontation of the educational problem. Neither the population's low schooling average of six years, nor the poor quality of the public education, are compatible with the skilled workforce that a successful innovation policy requires. Innovation literature and the experience of the late industrialised countries recognise the importance of the learning process that occurs at the shopfloor level (Amsdem, 1989; Coriat, 1992; Viotti, 2003). The education issue also entails facing international pressures, as those related to education policies promoted by the World Bank and adopted in Brazil during the last decade, which had emphasised quantitative advances in enrollment rates at the elementary level. Moreover, the educational question transcends the economic rationale in the government agenda, as it is an indispensable condition for reducing inequality and enhancing citizenship.

The complexity of the current dilemma between the possibilities of national development and those of global integration is also present in the question about what areas of science and technology must be developed. Several decades of social studies of science and technology have made clear the social conditioning embedded in knowledge and innovation. Thus, for example, the most productive industrial technologies cannot be isolated from their labour-saving bias frequently observed at the plant level, and sometimes at the branch level. This places a tension between technological modernisation and the central government's goal of creating jobs in the context of low growth rates and squeezing the formal labour market. This issue has been scarcely discussed – or at least, the discussion has had little public diffusion – during the first six months of the Lula's government. Nevertheless, it is a great challenge to define how the efforts and resources will be distributed in the development of 'top' science and technology, which is overwhelmingly conducted by industrialised countries – and of course, particularly important for international competitiveness – and an alternative strategy of knowledge creation and innovation dynamics that could be able to satisfy the specific social demands that the country already faces, as well as new demands that will arise as the result of the economic democratisation (Dagnino and Thomas, 2001). This dilemma is not new, but it adopts a special relevance in the context of the significant political change occurring in the country.

Finally, another intricate challenge is to reconcile, in the near term, the goals of wealth distribution and social inclusion with the goal of orienting S&T to the satisfaction of social needs of the poorest sectors of the population. At the present, one third of the population is practically excluded from market consumption and another considerable part of it has very limited access to goods and services. Even if efforts and resources are committed to the development of S&T in areas which are relevant for the poorest population, its fruits will be trapped behind the market barrier if this situation does not change quickly.

5 Conclusions

The combination of relatively advanced scientific and technological development with tremendous social inequality in Brazil exists in other developing countries as well. For this reason, Brazil's explicit commitment to using STP to serve social development goals should be closely observed over the next three years, because it will yield very important lessons for other industrialising nations that share similar social challenges. On the one hand, it will be important to assess the degree to which the government succeeds in making the necessary changes in the institutions and mechanisms that support the ST&I policy in order to promote a more harmoniously distributed scientific and technological development throughout the country, and to make S&T a more effective tool to support a socially sustainable development. On the other hand, it will be enlightening to observe how the tensions between the national project of scientific and technological development, and the constraints imposed on the country's political choices by the global market and the international financial and trade institutions, evolve.

Innovation policies deserve particular attention. The development of the new government's approach to innovation, which combines the objectives of external competitiveness and satisfaction of internal demands, will bring new empirical data and, perhaps, new perspectives for theoretical and political reflections on the innovation process in Latin American countries. These perspectives could considerably enrich our understanding of science, technology, and social development, which has tended to be analyzed through the prism of the experiences of industrialised and South-East Asian countries, both very different from Latin America in their historical, economic and geopolitical conditions.

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References

Adam, D. (2003) 'Brazilian science: under new management', *Nature*, www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/v423/n6938/full/423379a_fs.html&content_filetype=PDF, No. 423.

Amaral, R. (2003) Solenidade de Transmissão do Cargo de Ministro de Estado da Ciência e Tecnologia. Discurso do Ministro, Brasília, www.mct.gov.br/ministro/conferencias/2003/transmissao.htm, Jan 2.

Amsden, A.H. (1989) *Asia's Next Giant. South Korea and Late Industrialization*, Oxford University Press, New York.

Archigugui, D. and Pietrobelli, C. (2003) 'The globalisation of technology and its implications for developing countries. Windows of opportunity of further burden?', *Technological Forecasting and Social Change*, No. 70, pp.861–883.

Arocena, R. and Sutz, J. (2003) 'Inequality and innovation as seen from the South', *Technology in Society*, No. 25, pp.171–182.

Balthazar, R. (2003) 'MCT quer mudar projeto de Lei de Inovação para evitar evasão de cérebros', *Valor Econômico*, São Paulo, May 30.

Barreiro, A. and Davit, A. (2000) 'Un análisis histórico de las actividades de cooperación de la Oficina Regional de Ciência y', *Tecnología de la UNESCO para América Latina y el Caribe (ORCYT/UNESCO)*, 1949–1999', IV ESOCITE, Campinas, Brazil.

Caldas, R. (2003) 'CGEE', *Jornal da Ciência*, 2313, July 4, http://www.jornaldaciencia.org.br/Detalhe.jsp?id=11061

Candotti, E. (2003) 'Fundos Setoriais', *Jornal da Ciência*, 2291, June 3, http://www.jornaldaciencia.org.br/Detalhe.jsp?id=10243

Cariello, R. (2003) 'Manifesto de alarme contra a proposta do Governo de Reforma da Previdência é firmado por intelectuais', *Folha de S. Paulo*, São Paulo, June 11.

Castanede, E. and Constantino, L. (2003) 'Sem respaldo, Amaral vira peso no governo', *Folha de São Paulo*, São Paulo, April 22.

Castells, M. (1999) *La Era de la Información*, Siglo XXI, México.

Chairmovich, H. (2003) 'Fomento e reconhecimento', *Jornal da Ciência*, 2311, July 2, http://www.jornaldaciencia.org.br/Detalhe.jsp?id=10989

CNI/MCT-Finep (2001) *A Indústria e a Questão Tecnológica*, CNI, São Paulo.

CNPQ-SUP (2003) *Statistical Data*, www.cnpq.br/servicos/estatisticas/ series2003.htm

Comin, A. (1998) *De Volta Para o Futuro. Política e Reestruturação Industrial do Complexo Automobilístico nos Anos 90*, CEBRAP/Annablume, São Paulo.

Coriat, B. (1992) *Pensar al Revés. Trabajo y Organización en la Empresa Japonesa,* Siglo XXI, México.

Corsalete, C. (2003) 'Intelectuais petistas abrem guerra contra a reforma', *O Estado de São Paulo*, São Paulo, June 11.

Cruz, C.H. de, B. (2000) 'A universidade, a empresa e a pesquisa que o país precisa', *Revista Humanidades*, mimeo. Early version (1999) No. 45.

Cruz, C.H. de, B. (2002) 'Quem faz inovação?', *Correio Brazilienze*, Brasília, October 20.

Cruz, C.E. de, B. (2003) 'A gestão estratégica do conhecimento', *Folha de S. Paulo*, São Paulo, May 8.

Dagnino R. (2002) 'Um discurso dissociado da realidade', *Jornal da Unicamp*, http://www.unicamp.br/unicamp/unicamp_hoje/jornalPDF/195espag02.pdf, October 21, No. 195.

Dagnino, R., Davit, A. and Thomas, H. (1996) 'El Pensamiento en Ciencia, Tecnología y sociedad en Latinoamérica: una interpretación política de su trayectoria', *Redes*, Vol. 6, No. 7, pp.13–51.

Dagnino, R. and Thomas, H. (2001) 'Planejamento e políticas públicas de inovação: em direção a um marco de referência latino-americano', *Planejamento e Políticas Públicas*, No. 23, pp.205–229.

FAPESP (2001) *Indicadores de Ciência, Tecnologia e Inovação em São Paulo*, http:// www2.fapesp.br/indct/indica.htm.

Ferraz, E. (2002) 'Inovar é fazer pesquisa, não interagir com a universidade', Interview with C.H. Brito Cruz, reitor da Unicamp, *Portal Exame*, http://www.gr.unicamp.br/artigos/ artigo_portal_exame_out2002.htm, September 10.

Ferreira, R. (2003) 'Democratizando a atividade científica', *Jornal da Ciência*, 2310, July 1, http://www.jornaldaciencia.org.br/Detalhe.jsp?id=10949

Folha de S. Paulo (2003) 'Fundos setoriais', Editorial, *Folha de S. Paulo*, São Paulo, April 21.

Freeman, C. (1987) *Technology Policy and Economic Performance: Lessons from Japan,* Pinter, London.

Galbraith, J.K. (2002) 'Is inequality decreasing? debating the wealth and poverty of nations', *Foreign Affairs*, Vol. 81, No. 4.

IBGE (2000) *Censo Demográfico*, http:// www.ibge.gov.br.

Instituto da Cidadania (2001) 'Projeto Fome Zero. Uma proposta de política de segurança alimentar para o Brasil', http:// www.lula.org.br/assets/projeto_fome.pdf.

Invernizzi (2000) 'Novos rumos do trabalho. mudanças nas formas de controle e qualificação da força de trabalho brasileira', *Science and Technology Policy Program*, PhD Dissertation, Unicamp, Campinas.

Jornal da Ciência (2003a) 'Brasil fica em 37º lugar em avaliação internacional que mostra desempenho de alunos de 41 países', *Jornal da Ciência*, 2311, July 2, http://www.jornaldaciencia.org.br/Detalhe.jsp?id=10986.

Jornal da Ciência (2003b) 'Proposta de moção pede ao MCT mais tempo para discussão do projeto de Lei da Innovação', *Jornal da Ciência*, 2321, July 16, http://www.jornaldaciencia.org.br /Detalhe.jsp?id=10986.

Jornal da Ciência (2003c) 'Representantes de várias entidades dão sugestões à Lei de Inovação', *Jornal da Ciência,* 2366, September 17, http://www.jornaldaciencia.org.br/ Detalhe.jsp?id=12814

Katz, J. (2001) 'Cambios en la estructura y comportamiento del aparato productivo latinoamericano en los años 1990: Después del Consenso de Washington, qué?', In Dutrénit, Gabriela *et al*. *Sistema Nacional de Innovación. Temas para el Debate en México*, Universidad Autónoma Metropolitana, México, p.45–84.

Kim, L. (2000) 'The dynamics of technological learning in industrialization', *INTECH-UNU*, Discussion Paper Series No. 2000-2007, Mastricht.

Lastres, H. and Cassiolato, J.E. (2001) 'Globalização e os sistemas de inovação no Mercosul nos anos 90: implicações para políticas', in Gimarães, Nadya A.y Martin, Scott (orgs) *Competitividade e Desenvolvimento, Atores e Instituições Locais*, (Eds.): Senac, São Paulo, pp.127–148.

Leali, F. and Paraguassú, L. (2003) 'Professores universitários aposentados terão bolsa de R$ 3.000 para continuar a lecionar', *O Globo*, Rio de Janeiro, June 11.

Lundvall, B. (1988) 'Innovation as an interactive process: from user-producer interaction to National Systems of Innovation', in Dosi, G. *et al.* (Eds.): *Technical Change and Economic Theory,* Pinter, London.

Mani, S. (2001) 'Government, Innovation and Technology Policy, an analysis of the Brazilian experience during the 1990s', *INTECH/UNU*, Discussion Paper Series No. 2001–2011, Mastricht.

Marcondes, C.B. (2003) 'Pesquisador critica reforma da previdência', *Jornal da Ciência* 2310, July 1, http://www.jornaldaciencia.org.br/Detalhe.jsp?id=10951.

MCT (2003) 'Orientações Estratégicas do Ministério da Ciência e Tecnologia para o período 2004–2007', Proposta para Discussão, http:// www.mct.gov.br/sobre/ ppa/Default.htm.

MCT-Ministério da Ciência e da Tecnologia (2001) *Livro Verde. O Debate Necessário: Ciência, Tecnologia, Inovação. Desafio Para a Sociedade Brasileira*, MCT/Academia Brasileira de Ciências, Brasília.

MCT Noticias (2003) 'Ministro quer descentralizar a produção científico-tecnológica', *MCT Noticias*, January 24. www.mct.gov.br/comunicacao/textos/default.asp?cod__tipo=1 &cod_texto=3115.

Nassif, L. (2003) 'Hipotecando o futuro', *Folha de São Paulo*, São Paulo, February 15.

Nassif, M.I. (2003) 'Dilema do governo é decidir quem faz política de C&T'', *Valor Econômico,* São Paulo, April 17.

Neto, J.M.M and Carvalho, H.B.A. (2003) 'Os parias s da ciência', *Jornal da Ciência*, 2305, June 24, http://www.jornaldaciencia.org.br/Detalhe.jsp?id=10776

Neto, R.B. (2002) 'Aumenta abismo entre pesquisa e inovação no Brasil', *Folha de São Paulo*, São Paulo, September 27.

Niosi, J. *et al.* (1993) 'Nacional systems of innovation: in search of a workable concept', *Technology in Society*, Vol.15 N. 2, pp.207–228.

O Estado de São Paulo (2003) 'A política científica no limbo', Editorial, *O Estado de São Paulo*, São Paulo, April 22.

Paduan, R. (2003) 'Crescimento da C&T não cabe só ao poder público, afirma Amaral', *Portal Exame*, http://www.portalexame.abril.com.br June, 25.

Partido dos Trabalhadores (2002) *Programa De Governo*, http://www.lula.org.br/ obrasil/programa.asp.

Pereira Filho, A. (2003) 'USP pode ter aposentadoria de 22% dos professores', *Folha de S. Paulo,* São Paulo, June 15.

PINAD-IBGE (1999) *Pesquisa Nacional por Amostra de Domicílios*, http:// www.ibge.gov.br.

PINTEC-IBGE (2002) *Pesquisa Industrial – Inovação Tecnológica*, Instituto Brasileiro de Geografía e Estatística, http://www.ibge.gov.br.

PME-IBGE (2002) *Pesquisa Mensal de Emprego*, Instituto Brasileiro de Geografia e Estatística, http:// www.ibge.gov.br.

Salles, S. (Ed.) (2000) *Ciência, Tecnologia e Inovação*, A reorganização da pesquisa pública no Brasil, Komedi, Campinas.

Schwartzman, S. *et al.* (1993) *Science and Technology in Brazil: a New Policy for a Global World*, http://www.schwartzman.org.br/simon/scipol/newpol.htm#_1_10.

Seade–Diesse (2003) *Pesquisa de Emprego e Desemprego*. http://www.dieese.org.br/ped/ped.html.

Souza, W. (2003) 'Uma política para os fundos setoriais', *Folha de S. Paulo*, São Paulo, June 30.

Tortato, L. (2003) 'Presidente da SBPC prevê: pesquisadores-bolsistas de alto nível tentarão antecipar a aposentadoria', *Folha de S. Paulo*, São Paulo, May 26.

UNDP (2002) *Human Development Report*, http:// hdr.undp.org/reports/.

UNDP (2003) *Human Development Indicators*, http://www.undp.org/hdr2003/indicator.

UNESCO, (2003) OECD/UNESCO Study identifies regional disparities in student performance, july', http.//portal.unesco.org/en/ev.php@URL_ID =13234&URL _DO=DO_TOPIC& URL_SECTION=201.html.

Velho, L. and Saenz, T. (2002) 'R&D in the public and Private Sector in Brazil: complements or substitutes?', *INTECH/UNU Discussion Paper Series*, http://www.intech.unu.edu/ publications July.

Viotti, E.B. (2002) 'National learning systems. a new approach on technological change in late industrializing economies and evidences from the cases of Brazil and South Korea', *Technological Forecasting and Social Change*, No. 69, pp.653–680.

Viotti, E.B. (2003) 'Technological learning systems, competitiveness and development', *Paper Presented to The First Globelics Conference – Innovation Systems and Development Strategies for the Third Millennium*, Rio de Janeiro, November pp.2–6 http://www.ie.ufrj.br/globelics/pdfs/GLOBELICS_0036_Viotti.PDF.

Vogt, C. (2002) 'Ciência, tecnologia e inovação: urgências', *Folha de S. Paulo*, São Paulo, October 17.

Wade, R. (2001) 'Winners and losers', *The Economist,* April 26.

Weller, Ch. E. and Hersh, A. (2002) 'Free markets and poverty', *The American Prospect*, Vol. 13, No. 1.

World Bank (2003) *Inequality in Latin America and the Caribbean: Breaking with History?* http://wbln0018.worldbank.org/LAC/lacinfoclient.nsf/Category/By+Category/32D7C0BACEE5752A85256DBA00545D3F?OpenDocument.

Zancan, G. (2002) *Financiamento Da Ciência e da Tecnologia no Brasil*, lecture, Curitiba, Brasil, September 11.

Notes

[1]The two main federal research and scientific human resources funding institutions, the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) [National Council for Scientific and Technological Development] and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) [Coordination for High Level Manpower Education] were created in 1951, only one year after the National Science Foundation in the United States.

[2]Issued by the end of Cardoso's administration as part of the preparation of a National Conference on S&T, the Livro Verde remains the most complete diagnosis and proposal of ST&I policy under Cardoso's second term.

[3]I maintain the indicators of 1999 and 2000 presented by the Livro Verde, but they present some variation in 2003.

[4]Considerable discussion exists about the quantification of the private investments in R&D. On this topic, see Mani (2001, p.21) and Velho and Saens (2002, p.41).

[5]Some Latin-American researchers on innovation consider inappripiate to transfer the neo-shumpeterian analitical framework developed to analyse innovation in industrialised countries to the different situation of the late industrialising countries, where the difusion of technologies and learning processes occur instead of innovation *strictu sensu*. See Dagnino and Thomas (2001) and Viotti (2002).

[6]In 1995, the F. H. Cardoso administration promulgated a 'State Reform' that proposed significant modifications in the relationship between the State, the public institutions and the public functions. The Reform proposed four levels for the State's activities:

- strategic nucleus and
- executive agencies, both charged with those activities that are exclusive of the State
- 'social organisations' (quasi governmental), for activities that are not exclusive State activities
- market production, which involved the privatisation of the former State-owned companies.

The social organization institutional format was proposed for public research institutions; however, this transformation had not been completed. For further information see Salles (2000).

[7]The Sectorial Funds are the most visible tool for innovation promotion developed during Cardoso's administration. However, other incentives to private investments in R&D, such as fiscal incentives, were created at the same time.

[8]For an analysis of the problems faced by public research institutions in the context of the State Reform see Salles (2000).

[9]The Brazilian Society for the Progress of Science is a civil institution founded in 1948 to promote scientific and technological as well as educational and cultural development within Brazil. It is characterised by its independence in relation to the government and its critical activism in S&T issues.

[10]By the end of Cardoso's second term, in 2002, the Minister of Science and Technology, Ronaldo Sardenberg launched the 'Science and Technology Program for Development', gathering diverse initiatives oriented to the solution of social problems, such as support to familiar agriculture, nuclear applications in the health area, ethnic minorities problems, etc. (http://www.mct.gov.br/prog/programact.pdf).

[11]The document refers to the three mega-goals referred to in MCT (2003).

[12]This debate has taken place through the main newspapers such as Folha de São Paulo, O Estado de São Paulo, O Globo, Valor Econômico, Gazeta Mercantil, etc. In the academic sphere, the Jornal da Ciência, a daily on line journal of the Brazilian Society for the Progress of Science, with wide diffusion within the scientific community, has been a privileged forum of discussion.

[13]Roberto Amaral is a leading figure of the Partido Socialista Brasileiro (PSB), a left-wing Party which never jointed the PT as other left-wing parties did by the time of the foundation of the PT. In fact, during the first round of the presidential election, the PSB's candidate often acted as Lula's strongest opposition.

[14]Through initiatives as 'Knowledge for Development' presented in the 1998 World Development Report, the World Bank has promoted 'scientific excelence centers' trhougouth the developing countries. This policy attempted to prevent the dissolution of the research potential of those countries within the massive expansion of university education (Dickson, 2003) 'Does the World Bank really care about science?' *SCIDEVNET,* 07/04/2003. The Cardoso's government made a clear disctintion between a few universities with excellence level and the rest of the federal universities – they are 51 between universities and other centers of tertiary education –, whose primary goal was considered to be education and not research activities.

[15]The UNDP (2003) has described the 1990's as the 'decade of desperation' because of the backward movement experienced in the poorest countries' living conditions. Several studies show that the inequality grew in the world during this decade, as much between countries, as within them (see Wade, 2001; Weller, 2002; Galbraith, 2002).