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EUROPEAN COMMISSION

# ERAWATCH COUNTRY REPORTS 2011: Brazil

ERAWATCH Network – Innovastrat Consultoria Ltda.

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# Executive Summary[1]

Brazil is Latin America's largest country with an area of 8.5 million km² and the only BRIC[2] in the region. Brazil is also a founder of the Mercosul and Unasul regional trade and political blocs. Brazil's population in 2010 was 190,732,694 (IBGE), accounting for about 33% of Latin America's population (2009). Its GDP in 2011 reached €1,607 (compared to €1,462b in 2010), the world's 7th largest, and the second largest among the BRICs, after China. Its GDP per capita in 2011 was €8,422 (based on 2010 population). Its 2011 growth in (current) reais was 1.8%, a sharp drop from 6.5% in 2010, which was the highest since 1980. The country's average GDP growth between 2005 and 2010 was 4.23%, the lowest among the BRICs and the 7th highest in Latin America. The country's GDP growth (in current reais) of 7.5% in 2010 followed a 0.6% drop in 2009, in the midst of the global recession, and was then highest rate since 1986, followed in 2011 by a decline to 2.7%. At present, Brazil is the 6th country at global level concerning GDP.

Brazil's scientific cooperation with the EU is based on a Scientific and Technological Cooperation Agreement signed in 2004, confirmed in 2006, and a strategic pact signed in 2007.

In 2006, overall investment in S&T represented 1.29% of GDP and in 2010 it reached 1.62% (considerably higher than 1.26% in 2003, at the beginning of the first Lula government). The goal is to reach 2.2% by 2022. In 2009, R&D intensity (GERD/GDP) was 1.17%, whereas the share of private sector R&D (of GERD) was 45.25% and the share of public sector (federal and state) R&D (of GERD) was 54.75%. BERD went from 0.51% of GDP in 2006 to 0.56% in 2009. The Ministry of Science, Technology and Innovation (MCTI) executed budget in 2011 was €2,230b, posting a real growth of 1% over 2006-2010 (170% over the ten-year period 2001-2010).

In 2010, the total number of scientists and researchers was about 234,797, of which a little over one-third held a doctorate and the majority worked in the public sector, the near totality in higher education institutions. In 2009, they published 32,000 scientific articles, representing over half of Latin America production and 2.69% of the world's scientific papers (Thomson/ISI).

The 2008-2009 economic crises initially did not have an immediate impact on the R&D expenditure and policy, as Brazil adopted a series of macroeconomic counter-cyclical measures. However, the growth of GERD fell drastically from 15.3% in 2007 to 7.0% in 2010. In addition, whereas, over 2005-2007 it had reached 24.3%, over 2008-2010 it more than halved to 11.6%. Whereas MCTI executed budget growth rate for the period 2007-2011 was a high 25.7%, it declined significantly to 7.0% over the period 2009-2011. Furthermore, in 2011, it declined by 3.3%.

The Brazilian research system has continued to expand but the capacity of research institutions and universities to interact with firms is still lacking and the advance of innovation is slow. More importantly, Brazilian firms' commitment to innovation is still weak. Brazil's BERD/GERD index at 47.3% stands as the highest in Latin America, but it is much lower than those of China (71.7% in 2009) and South Korea (72.9% 2008). The number of industrial firms doing continuous R&D in 2010 (out of a total 106.800 firms in industry, selected services and R&D sectors) was just 3,425. Next, the number of firms doing any R&D was also small (41,300: 17,679 industrial and 727 service firms, respectively of the total, albeit exhibiting a growth of 38.6% over the period 2006-2008). Of the 6 million formal SMEs in existence, only 15,000 innovated according to the 2005 Brazilian innovation survey. Although the number of innovative industrial firms has grown from 33.4% of the total in 2005 to 38.1% in 2008 and to 38.6% 2010, only 4.1% of industrial firms launched a new product or a product substantially modified for the Brazilian market. This reflects the adaptive nature of their innovation. This adaptive behaviour is associated with the low investment of Brazilian business sector in R&D, since this kind of innovation requires less technological efforts and implies an extremely low number of researchers who carry out such activities in their context, when compared with other countries. In Brazil, most of the researchers are in higher education institutions — 67.5% of the total in 2010 – whereas only 26.2% work in firms (much less than in countries with a comparable economic

[1] All values in euros converted from Brazilian real currency at 6/29/2012 ECB exchange rate. All data, unless otherwise noted, from MCTI. http://www.mct.gov.br/index.php/content/view/2043.html

[2] Group of fast-growing emerging economies formed by Brazil, India, China, Russia and South Africa.

performance). Finally, in 2010 Brazil filed just 584 patents (of all types) in the USPTO, a pale number compared to South Korea's 26,648.

Government R&D financing scope is limited. The percentage of innovative enterprises that used at least one of the different instruments of Government support for innovation in enterprises was 22.3%.

Fiscal incentives to promote private R&D investment address a very small number of firms (639 in 2010, against 460 in 2008) and are, moreover, heavily skewed towards large firms located in the South and South-Eastern regions. The value of R&D&I investment by those firms enjoying the fiscal incentives of the Positive Law in 2010 grew by 3.5% compared to a GDP growth of 7.5%.

Innovation grants' distribution by company size, which was initially also skewed in favour of large firms, has improved considerably. The last innovation survey (covering the period 2006-2008) revealed that the percentage of innovative firms with problems or obstacles to innovation had risen to almost 50% (Pintec 2008).

The main issues for industrial and service firms are high cost of innovation, excessive economic risks, and a shortage of qualified personnel and of finance sources in general. Among those firms that did not innovate, the main issues were market conditions, lack of experience in doing innovation and other obstacles. A different research study covering firms from the state of São Paulo identified as the main barriers to their private R&D investments bureaucracy in innovation project submission and accounting, as well as shortcomings in the allowable project scope (e.g., funding of value chain suppliers; hiring of foreign researchers and agreements with foreign research institutions).

**Knowledge Triangle.**

| | **Recent policy changes** | **Assessment of strengths and weaknesses** |
|---|---|---|
| Research policy | Consolidation of decentralisation of research planning and funding to state research foundations. | *Strengths*: increase in reach and scope of research programmes in tune with local innovation demands; and discovery of new talent.<br>*Weaknesses*: many state research foundations do not have necessary expertise and human resource capacity to select researchers and groups, much less so to monitor their evolution. |
| | Expansion of inter-government and multi-societal actors' research activities and programmes. | *Strengths*: better targeted research; stronger budgets; and broader stakeholder base.<br>*Weaknesses*: multiple, often at cross, policy goals; longer implementation time frames; and complex governance. |
| Innovation policy | Innovation one of three central drivers of National STI Strategy 2012-2015 (*Estratégia Nacional de Ciência, Tecnologia e Inovação 2012-2015* ENCTI). | *Strengths*: Strong goal convergence with industrial policy Greater Brazil Plan (*Plano Brasil Maior*) launched in August 2011; 5 out 6 goals of ENCTI regard innovation; improvements in *Innovation Law* and *Positive Law* through reformulation of implementation rules, legal requirements and administrative procedures.<br>*Weaknesses*: pressure to increase firm innovation expenditures and results increases reliance on existing and creation of new state companies; innovation and related research proposal financing and funding evaluation and selection process under extreme pressure to produce numbers results. |
| Education policy | | |

| | | |
|---|---|---|
| | Human Resources training and capacity-building one of three central drivers of National STI Strategy 2012-2015. | *Strengths*: Launch of massive (101 thousand beneficiaries by 2014) foreign multi-level (from professional training to post-doctoral) scholarships programme *Science Without Frontiers* in August 2011; national and foreign firms will award about one-fourth of scholarships; focus on relatively small number of strategic science and engineering areas. *Weaknesses*: pressured and rapid implementation increase risk of poor candidate selection; lack of adequate preparation by candidates coupled with some scholarship categories too short tenure might impair optimal return. |
| Other policies | Formulation and launch of ENCTI 2012-2015 | *Strengths*: continuity with PACTI 2007-2010; improvement in governance, representativeness and transparency with incorporation of suggestions arrived at peak 2010 National Conference on STI and approval by National Council of Science and Technology in December 2011; directives aimed at consolidation of National STI System; targeting of select strategic sectors to drive Brazilian economy; and improved governance mechanisms to increase efficiency and integration of policies, instruments and agencies, and improved results and impact monitoring and evaluation systems. *Weaknesses*: risk of excessive fragmentation of political support basis of STI policy; too many and too broad strategic sector targets alongside multiple diffuse priorities (social inclusion, S&T diffusion and climate change, among others) |

**Assessment of the national policies/measures**

| | **Objectives** | **Main national policy changes over the last year** | **Assessment of strengths and weaknesses** |
|---|---|---|---|
| 1 | Labour market for researchers | Attraction and structured support to establishment of multinationals' (Brazilian-capital and foreign) R&D centres. | *Strengths*: expansion of labour market for high-level industrial researchers; insertion in high valued-added global value chains; eventual transfer of advanced technology management practices. *Weaknesses:* largely limited to medium-technology mature industrial sectors (automobile; pharmaceutical) and energy (in particular, oil & gas exploration); unknown linkages to local supplier development, risk of research enclaves. |
| 2 | Research infrastructures | Research infrastructure one of three priority drivers of National STI Strategy 2012-2015 | *Strengths*: Budgetary reinforcement of horizontal sectorial fund for research infra-structure CT-Infra (doubled between 2010 and 2012); multiple state companies funding partnerships in provision of large scale public good infrastructure, |

| | | | |
|---|---|---|---|
| | | | such as oceanographic research vessels (with oil company Petrobrás and mining company Vale)<br>*Weaknesses*: excessive research offer in medium-term for an unbalanced, smaller business demand; diversion of focused research attention of state companies. |
| 3 | Strengthening research institutions | No significant change. | |
| 4 | Knowledge transfer | Implementation of the mixed Brazilian Industrial Research and Innovation (*Empresa Brasileira de Pesquisa e Inovação Industrial* Embrapii), which aims to address industry innovation demands by facilitating between scientific and technological research institutions and firms. | *Strengths*: adopts facilitation logic over innovation supply logic; partnership with peak business association National Industrial Confederation (*Confederação Nacional da Indústria* CNI) supported by the broad-based business innovation mobilisation movement *Mobilização Empresarial pela Inovação* (MEI); and makes use of existing human and physical resources of diverse research institutes (public federal, public state and semi-public).<br>*Weaknesses*: risk of mismatch of competencies of research institutions to provide firms' required innovation services in timely fashion; reinforcement of large firms, low-to-medium technology mature sector bias of public support to innovation. |
| 5 | International R&D cooperation with EU member states | Enhanced cooperation with EU and its member states. | *Strengths*: continuity in EU-Brazil government level dialogue (seminars held in September 2011 and April 2012, the latter, *Seminário Brasil-UE sobre Ciência, Tecnologia e Inovação: Próximos Passos*, stressed similitudes between ENCTI 2012-2015 and framework programme EU's Horizon 2020; strengthening of B.Bice, instrument of improvement of the Brazilian participation in the EU 7th Framework Program of Research and Development; and four largest EU members – Germany, France, United Kingdom and Italy – totalled 36,200 scholarships in the first call of the CsF programme in December 2011 (double the number of the United States) |
| 6 | International R&D cooperation with non-EU countries | Continued expansion of cooperation partners and focusing on strategic areas in cooperation with traditional partners. | *Strengths*: Strengthening of mission-oriented strategic cooperation (space with China); extension of cooperation with new strategic partners (Brazil-China Nanotechnology Research and Innovation Centre); and renewed strengthening of cooperation with traditional partners (United States); |

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# 1 INTRODUCTION

The main objective of the ERAWATCH International Analytical Country Reports 2011 is to characterise and assess the evolution of the national policy mixes of the 21 countries with which the EU has a Science and Technology Agreement. The reports focus on initiatives comparable to the ERA blocks (labour market for researchers; research infrastructures; strengthening research institutions; knowledge transfer; international cooperation). They include an analysis of national R&D investment targets, the efficiency and effectiveness of national policies and investments in R&D, the articulation between research, education and innovation as well as implementation and governance issues. Particular emphasis is given to international research cooperation in each country.

# 2 PERFORMANCE OF THE NATIONAL RESEARCH AND INNOVATION SYSTEM AND ASSESSMENT OF RECENT POLICY CHANGES

## 2.1 MAIN POLICY OBJECTIVES / PRIORITIES, SOCIAL AND GLOBAL CHALLENGES

President Dilma Rousseff, who came into office in March 2011, launched on August 4th 2011 the industrial policy Greater Brazil Plan 2011-2014 (*Plano Brasil Maior*). The policy launch had the presence of the new minister of Science, Technology and Innovation Aloízio Mercadante; the minister of Finance, Guido Mantega; and the new minister of Development, Industry, and Foreign Trade (MDIC), Fernando Pimentel, indication that it was a government-wide policy. President Rousseff thus stated: "The plan reaffirms and expands the government commitment to innovation with its slogan: 'Innovate to compete. Compete to grow.'"

The policy aims to address constant complaints by Brazilian industry, including the technology sector, about the difficulty of competing with imported goods at a time when the exchange rate went as low as R$1.5359 for every US$1 or R$0.6913 for every €1. The plan's underlying diagnostic is of an adverse international context; global economic crisis; continuing fall in Brazilian manufacturing exports; absence of domestic sector full recovery from the 2008 crisis, with a few rare exceptions; and deepening of exchange rate war and predatory competition. Therefore its main drive is to promote Brazilian firms' capability to develop innovative products and services, and expand technology skills rather than rely on agricultural and mineral commodities. The policy measures and programmes are intended to complement government's foreign exchange actions.

As, the national plan PACTI 2007-2010 expired at the end of 2010, a new one did not see the light until one year later in December 2011: the National STI Strategy 2012-2015 (*Estratégia Nacional de Ciência, Tecnologia e Inovação 2012-2015* ENCTI). The overarching strategic goal is to achieve a sustainable development with S&T&I as its main driver. The strategy addresses five challenges: reduce the scientific and technological gap that still separates Brazil from developed nations; expand and consolidate Brazilian leadership in the natural knowledge economy; enlarge the basis for environmental sustainability and the development of a low carbon economy; consolidate a new pattern of international insertion for Brazil; and overcome poverty and reduce social and regional inequalities. In order to address these issues, the strategy's three main drivers are: promotion of innovation, human resources training and capacity-building, and strengthening of S&T research and infrastructure. The related improvements in ST&I policy are aimed at refining the innovation regulatory framework, refining and enlarging S&T funding structure and strengthening the National Science, Technology and Innovation System (*Sistema Nacional de Ciência, Tecnologia e Inovação* SNCTI).

The ENCTI main targets are: increase GERD - in 2014 GERD/GDP index will reach 1.8 compared to 1.16 in 2010; increase BERD (a goal shared with the Greater Brazil Plan)– in 2014 BERD/GDP index will reach 0.9 compared to 0.56 in 2010; increase

the innovation rate (share of industrial firms involved in innovation) in 2014 to 48.6%, compared to 38.6 in 2008 (latest year available from national innovation survey PINTEC); increase the number of firms doing continuous R&D to 5,000 from 3,425 in 2008 (excludes state firms. PINTEC); double to 12,260 by 2014 the number of innovating firms making use of the Good Law incentives, from 630 in 2009-2010; and increase the percentage of innovating firms that make use of at least one of the government innovation support measures to 30% in 2014 compared to 22.3% in 2010.

ENCTI priority programmes are (in bold sectors common to the Greater Brazil Plan): **ICT**, **Pharmaceuticals and the Health Industry Complex**, **Oil and Gas**, **Defence Industrial Complex**, **Aerospace**, Nuclear, Innovation Frontiers (biotechnology and nanotechnology), **Promotion of Green Economy** (**renewable energy**, climate change, biodiversity, and oceans and coastal zones) and Science, and **Technology and Innovation for Social Development** ( ST&I diffusion and improvements in science education, productive inclusion and social technology, and technologies for sustainable cities).

## 2.2 STRUCTURE OF THE NATIONAL RESEARCH AND INNOVATION SYSTEM AND ITS GOVERNANCE

Brazil is Latin America's largest country with an area of 8.5 million km² and the only BRIC in the region. Brazil's population in 2010 was of 190,732,694 people, accounting for about 33% of Latin America's population (2009). Its GDP in 2011 reached €1,607.1b (R$4,143b), the world's 6th largest (7th in 2010) and the second largest among the BRICs, after China. Its GDP per capita in 2011 was €8,425.7 (2010 population). The country's average GDP growth between 2005 and 2010 was 4.23%, the lowest among the BRICs and the 7th in Latin America. The country's GDP growth in 2011 slowed to 2.7%, from of a high 7.5% in 2010. This growth was led by expansion in family consumption (4.1%), followed by growth in agro-husbandry production (3.9%) and in services (2.7%). The industrial sector growth was much smaller (1.6%) and within it manufacturing industry almost stagnant (0.1%). The growth rate of the GDP per capita (in R$) in 2010 was 6.5%, the highest since 1980.

Brazil's scientific cooperation with the EU is based on a Scientific and Technological Cooperation Agreement signed in 2004, confirmed in 2006, and validated in a strategic pact signed in 2007. In the second half of 2011 and again in the first half of 2012, the EU and the Brazilian government held meetings to discuss the advancement of their cooperation in the area. Since the validation of the Agreement in 2007, the EU and the Brazilian Government held meetings every year to discuss the advancements of their cooperation in the area.

In 2006, overall investment in S&T represented 1.29% of GDP and in 2010 it reached 1.62% (considerably higher than 1.26% in 2003, at the beginning of the first Lula government), and above the PACTI target of 1.5%. The goal is to reach 2.2% by 2022. In 2009, R&D intensity (GERD/GDP) was 1.17%, whereas the share of private sector R&D (of GERD) was 45.25% and the share of public sector (federal and state) R&D (of GERD) was 54.75%. BERD went from 0.51% of GDP in 2006 to 0.56% in 2009. The Ministry of Science, Technology and Innovation (MCTI) executed budget in 2011 was €2,230b, posting a real growth of 1% over 2006-2010 (170% over the ten-year period 2001-2010). Over the same period (2006-2010), the share of public federal

and state expenditures (including expenditures on postgraduate education, which in 2010 represented 37.8% of federal and 64.4% of state total expenditures, the latter mostly of the state of São Paulo) of GERD, went from 35.5% to 36.7% and from 14.4% to 16.0%, respectively.

The Ministry of Science, Technology and Innovation (MCTI) executed budget in 2011 was €2,230b, posting a 3.3% decline over 2010. Although over 2007-2010 it had a real growth of 25.7%, this growth significantly declined over the last three years (2009-2011) to 7%.

**Main actors and institutions in research governance**

Brazil's research system is still mainly funded by the public sector (51.6% of GERD in 2009 – further to 52.7% in 2010 estimate, slightly up from 49.9% in 2006). Conversely, the share of the private sector decreased from 50.1% of GERD in 2006 to 48.4% of in 2009, and further to 47.3% in 2010 estimate. The federal government continues to be the main source of public funds with 69% in 2009 (71.2% in 2006). There have been strong efforts by the 27 units of the federation (26 states and 1 federal district) to increase R&D funding, thus their share of GERD increased from 14.4% in 2006 (or 30.4% of public expenditures to 16.0% in 2009 (same in 2010 estimate; again 30.4% of public expenditures). However, this growth was skewed, for in these states' expenditures the share of expenditures with graduate education grew considerably from 58.4%% to 61.5% over the period (reaching 64.4% in 2010 estimate. That is, their actual expenditures on R&D are declining.

The research system has not changed much of its main institutional features and competitive funding pattern since the creation in 1951 of the main research funding agency, the National Council for Scientific and Technological Development (CNPq). It is linked to the Ministry of Science, Technology and Innovation (MCTI), which was created in 1985, and added "innovation" to its name in August 2011. The few changes concern a partial privatisation in the 1990s of a few public research centres in electric energy and telecommunications research.

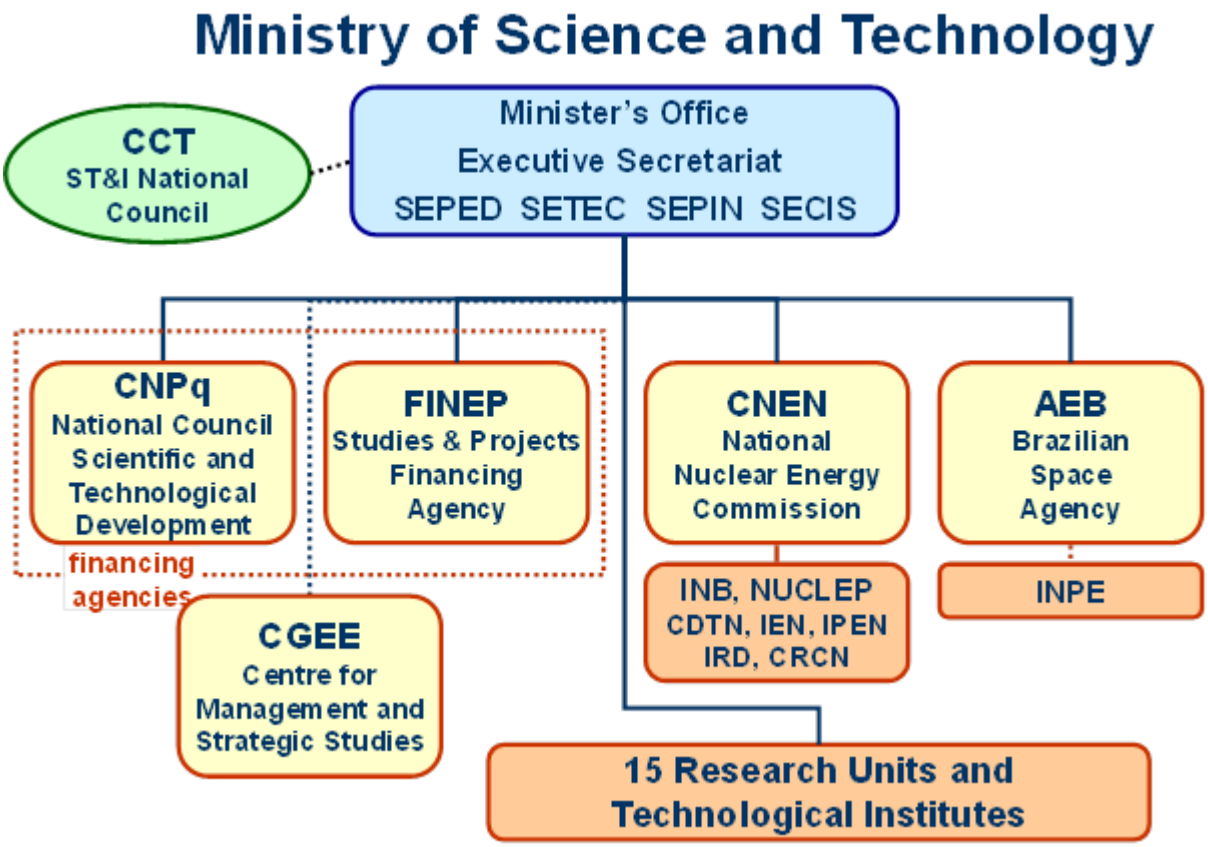
The counterpart innovation agency under MCTI is Finep, which administers (since 1971) the main block fund for innovation funding, financing and risk financing: the National Fund for Scientific and Technological Development (FNDCT), created in 1969. After two decades of financial instability, the Executive and Legislative branches, from 1997, undertook a major reform of the FNDCT, constituting various sectorial funds to generate revenues and ensure an autonomous and continuous source of revenue for the FNDCT. The revenues are generated from a variety of levies, fees and contributions and existing taxes, as for example: levies on result of the exploitation of natural resources owned by the Union, portions of the Industrialized products tax (IPI) of certain sectors and of the Contribution for Intervention in the Economic Domain (CIDE) imposed upon payments for the use or purchase of technological knowledge and/or technology transfer from abroad. In 2007, with the enactment of the Law of FNDCT (Law No. 11,540/07) – followed by Decree No. 9,638/09 regulating its operation, detailing his management model, instituting the functioning of its Board and providing for the use of new grant instruments, which guarantee an accumulation of assets and estate – the FNDCT started to be organised as an accounting fund, with own resources. There are currently seventeen sectorial funds in operation, fifteen linked directly to the FNDCT and two administered by other agencies of the Federal Government – the Fund for the technological

development of telecommunications (FUNTTEL) and the Audio-visual Sector Fund (FSA), to which FINEP serves as the financial agent. Of the fifteen sectorial funds which have their revenues tied up to the FNDCT, thirteen disburse resources exclusively to specific sectors and are denominated in the programmatic structure of vertical actions, while two are called transversal, since they may support projects of any sector of the economy – the Yellow Green Fund (FVA) and Infrastructure Fund (CT-Infra). Of the two transversal funds, the FVA is geared to support University-business interaction, while the CT-Infra supports the improvement of infrastructure of scientific and technological institutions (ICTs).

In the last few years, the BNDES under MDIC increased and multiplied its innovation finance programmes, both horizontal and sectorial (for example, for the software and pharmaceuticals industries), re-launched a university-industry cooperation fund (Funtec), and rekindled its risk financing innovation programmes, including the launch of a seed capital programme (Criatec). Next, an inter-ministerial advisory agency for industrial policy (*Agência Brasileira para o Desenvolvimento Industrial* ABDI) was created in 2006, under the executive management of MDIC.

Furthermore, the number and the volume of research funding by state research foundations have grown significantly over the past decade. This follows the long standing example of the São Paulo state Research Support Foundation FAPESP. Finally, there has been a continued effort on the part of the federal government to decentralise research, and more recently innovation, funding for the benefit of FAPs.

**Figure 1: Overview of the Brazil's research system governance structure**



Source: "Structure of the Research System" in Brazil Country Fiche.

**The institutional role of regions in research governance**

Brazil is a federation composed of 26 federal States plus the Federal District *(Distrito Federal*) and a total of 5,565 municipalities. Primary (basic) mandatory education is a shared responsibility of states and municipalities. While municipalities are responsible for pre-school (childhood) education the states are responsible for secondary (middle school) education.

The federal government is largely responsible for higher education. However, in the state of São Paulo, the state-level higher education system is much larger and important than the federal one. States are all equal in terms of overall powers and responsibilities.

In terms of research, there is no specific responsibility for the states, but all fund S&T, mainly through scholarships and research projects, via their so-called research support foundations (FAPs). Their resources for research funding come from a state constitution mandate determining a percentage of gross fiscal revenues (in the case of the oldest foundation (1960), Fapesp of the state of São Paulo, which also receives additional revenues from a state endowment, the share is 1%). The 24 FAPs in 24 states and in the Federal District (only the two states of Roraima and Rondônia do not yet have a FAP) are usually linked to a state secretariat of S&T, development or planning. In recent years, several FAPs have also supported thematic network-based projects and even more recently, innovation projects in cooperation with universities and research organisations, or in the form of direct grants to firms. Up to March 2012, 16 states had promulgated a state Innovation Law, three had drafted a project and the Federal District is in the process of approving its law. A handful of those states established innovation funds to provide competitive grants to firms.

In 2010, the share of states GERD of total GERD was 16% (or 0.19% of GDP; down from 16.26% in 2007 or 0.18% of GDP), but without expenditures with postgraduate education it was 5.70% (5.89 in 2007). Total state GERD as share of total states receipts fell from 1.72 in 2001 to 1.37% in 2010 (1.38% in 2007). The four states with the largest shares in relation to their total receipts were: São Paulo, Southeast region (3.36% versus 4.90 in 2001), Paraná, South region (1.86%), Santa Catarina (1.59%) and Rio de Janeiro, Southeast region (0.96%).

Research performance and public R&D expenditures are heavily concentrated in the country's Southeast region (GERD of 2.22% of total receipts, largest, versus 0.20% for the North region, lowest), notably in and by the state of São Paulo. The São Paulo state GERD of €1.94b (R$5,012m) in 2010 represents about 0.5% of its GDP and accounts for 72% of Brazil's total states GERD. However, postgraduate education accounts for 78% of São Paulo state GERD (the share of postgraduate education of total states GERD is 68%).

In the last few years there has been an effort on the part of the federal government to decentralise research (and more recently innovation) policy by transferring research programmes to state agencies which run the programme locally. The first was CNPq's

First Research Programme (PPP) to fund young researchers' projects, launched in 2004, followed by Finep's Programme for Supporting Research in Enterprises (PAPPE), launched in 2006, providing research grants to individual researchers in order to work with a university to assist in a technological development. PAPPE is co-funded with FAPs. It operates in 20 states and funded 599 projects in 540 firms until 2009. Its last 2006 budget was of €8.4m (R$21m). Finally, there is PAPPE's successor, the on-going PAPPE Subvenção programme. It aims at decentralising the flagship programme of direct innovation subsidies for innovation for the provision of grants to firms. The programme has been implemented in 17 states and had total expenditures of €103m (R$265m) until 2010, benefiting 414 firms. In addition, it was launched in 2010, the Programme of Subsidies for research in micro and small enterprises in the North, Northeast and Midwest (*Programa de Subvenção à Pesquisa em Microempresas e Empresas de Pequeno Porte do Norte, Nordeste e Centro-Oeste* PAPPE Integração) with a €34m budget (R$88m).

The research funding of state research agencies are generally allocated through competitive calls and are distributed at Fapesp, for example (percentages for 2009) as follows: 42% to research projects, including thematic projects; followed by 36% for scholarships; and special programmes for strategic areas and support to technological innovation with 11% each.

**Main research performer groups**

In spite of recent efforts towards research decentralisation, the research performance is still centralised in the Southeast, and to a lesser extent, South regions. The Southeast region accounted for 67% of the demand for the National Institutes of Science and Technology (INCT) programme, followed by the South and Northeast regions (11% each). Total FAPs counterpart resources accounted for 35% of the programmes total €235.4m (R$607m, main public federal funders are FNDCT/Finep and CNPq), and three South-eastern states FAPs (FAPESP of São Paulo; FAPERJ of Rio de Janeiro and FAPEMIG of Minas Gerais) accounted for 86% of that contribution. In the total disbursements (2008-2010) of the INCT predecessor programme the National Programme of Centres of Excellence PRONEX, co-funded by CNPq (2/3) and FAPs (1/3), amounting to €87.6m (R$225.9m), the Southeast region share was 28.7%, followed by the South (22.6%) and Northeast (21.9%) regions.

In fact research performance is concentrated mainly in two states: São Paulo and, to a lesser extent, Rio de Janeiro. The latter is the former capital of the country and inherited several government research institutes. It is also home of the largest federal university (Federal University of Rio de Janeiro, UFRJ). Moreover, it is home to the largest public and general enterprise, the oil and gas exploration company Petrobrás, which has its corporate research, centre in the state. Moreover, it has significant research expenditures in-house and externally, focussing mainly in thematic university-network research and more recently in university-based thematic corporate labs.

Sao Paulo has a highly developed state university system with multiple tiers. It includes at the first tier two of the largest and most productive public research universities in the country with the University of Sao Paulo (*Universidade de São Paulo* USP) and the University of Campinas (*Universidade de Campinas* UNICAMP). It also hosts a few key state government agricultural research centres and the

majority of private enterprises' R&D centres. The majority of the research is executed at universities, followed far by public research institutes, among which the public agricultural research company Brazilian Enterprise of Agricultural and Husbandry Research (EMBRAPA), which is linked to the Ministry of Agriculture, Husbandry and Supply (MAPA), has a major role. It maintains research centres spread around the country. The Oswaldo Cruz Foundation (FIOCRUZ) is linked to the Ministry of Health (MS), and headquartered in the city of Rio de Janeiro.

The research system developed into an effective system over the past decade - in spite of its still unbalanced geographic productivity and low-network based research execution. By contrast, the innovation system, which began to be structured in earnest from 2005 with the passing of the federal innovation law, still presents key structural holes such as a small number of networks involving industry, regional and local authorities, weak private sector research in terms of number of firms, own expenditures and government incentives with limited scope and reach.

## 2.3 RESOURCE MOBILISATION

### 2.3.1 Financial resource provision for research activities (national and regional mechanisms)

Until the mid-1990s, research policies in Brazil were geared mainly to public research, particularly individual researchers in universities and, to a lesser extent, public research organisations (PROs). They often faced the problem of a lack of financial resource continuity, mainly due to cyclical budgetary constraints and a generally fragmented allocation linked to a highly segmented allocation policy with a multiplicity of disconnected target areas. Universities employ 57% of researchers and research institutes 6% (2008). In 2010 (last year available), higher education expenditures (graduate education expenditures in public federal and state budgets plus private) reached €2,631m, accounting for 26.1% of GERD. Total public (federal and state) expenditures on graduate education accounted for 50% of total public expenditures on R&D.

In spite of federal government efforts to increase R&D expenditures the 2008 global economic affected public R&D&I investments in the coming years, when budgetary cuts became deeper. Between 2007, when it hit a high, and 2011, the index MCTI Treasury-originated (budgetary resources originated from Other Sources/ Own Resources represented 7.6% of total executed budget in 2011) from Executed Budget/Congressional Budget Proposal (*Lei de Orçamento Anual* LOA) went down from 82.9% to 71.8%. The similar index for most important block fund in MCTI's budget, the FNDCT, drop was even more severe. It dipped from 93.4% to 65%. Between 2007 and 2011, the shares of FNDCT and of the other main block fund (CNPq) in MCT executed budget fell from 33.4 to 33.5% and from 16.3 to 15.6%, respectively. Over the 2008-2011, period the growth winners were the Nuclear Programme, from 10.1% to 15.2% and Personnel expenditures, from 26.7% to 30.4%. Further, MCTI's 2012 congressional budget proposal suffered 22% cuts by the Executive, amounting to €600m.

ENCTI total planned public (federal and state governments – state research support foundations FAPs, and state companies) expenditures over the period 2012-2015 total €28.8b (R$74.6b) distributed according to the main sources: MCTI (39.1%), Ministry of Education MEC/Capes, higher education promotion agency (16.8%), FAPs (13.7%),

Ministry of Development and Foreign Trade MDIC/BNDES, national state bank for economic and social development + Inmetro, national institute of standards and metrology (9.7%); MME/Petrobrás, oil and gas, and Eletrobrás, electricity generation and transmission state companies (8.9%), Ministry of Defence MD (5.3%), Ministry of Health MS (2.8%), Ministry of Agriculture, Husbandry and Supply MAPA/ Embrapa, state agricultural research enterprise (2.6%).

ENCTI's aim is to raise the R&D intensity (GERD/GDP) from 1.19% in 2010 to 1.80% in 2015. Some of the challenges addressed by the new multi-year strategy are sustainable investments to ensure stability and deflect inflationary pressures, the expansion of human resource training capacity and research infrastructure, as well as strengthening innovation capacities of firms.

Accordingly, BERD is planned to grow from 0.50% of GDP in 2010 to 0.90% in 2014 (€8.031b or R$20.710b). In order to achieve this target, BERD annual growth rate will have to increase from 15% (2000-2010) to 27% (2010-2014).

### 2.3.2 Providing qualified human resources

Between 2000 and 2010, the total number of graduates increased by 155%, from 324,732 to 826,928, a significant quantitative leap but still with notorious qualitative shortcomings. In this same period the formation of engineers went from 22,873 to 55,427 graduates, an increase of 142%, which is significant, although it has not occurred in the desirable speed. As a result, the proportion of total trainees in engineering regained the level observed at the beginning of the decade (around 7%), after a gradual decline over the years (5.1% in 2006).

CNPq and CAPES granted 3,777 scholarships abroad in 2009, with an increase of 35% with respect to 2001. Of these, 456 correspond to the area of engineering, an increase of less than 1% compared to the same year, and 400 at exact and Earth Sciences, a decrease of 16%, which contrasts strongly with the areas of Agrarian Sciences and Humanities, which showed an increase of 79% and 66%, respectively.

### 2.3.3 Evolution towards the national R&D&I targets

The Science without Frontiers (CsF) programme, regulated by Decree No. 7,642/2011 provides for the granting, by the Federal Government, 75,000 grants, being 27,100 scholarships for PhD-sandwich abroad; 24,600 for undergraduate sandwich scholarships abroad; 9,790 for full doctorate abroad, 8,900 for postdoctoral fellowships abroad, 2,660 of stage Senior abroad, training of specialists of 700 companies abroad, 860 fellowships to young scientists of great talent and 390 fellowships to researchers special visitors (major scientific leadership). The business sector is offering approximately 26,000 grants, totalling 101,000 scholarships and fellowships for the 2011-2015 period.

On the innovation front, there is a process to transform FINEP into a financial institution — in 2011 its credit resources for corporate innovation finance increased from €698m to €1.93b (R$1.8b to R$5b) — and there are efforts towards the creation of new sector funds that may fill the gap of public resources for innovation and contribute, among other things, to increase private fundraising for this activity. In this sense, the MCTI studies and negotiates with other Federal Government agencies the opportunity to increase revenue from some of the existing funds, on the basis of new criteria of redirecting governmental receipts (as in the case of the CIDE technological contribution), unstable sources of revenue (as in the case of the

sectorial funds for Space and for Transportation) and changes in the regulatory framework (the mineral sector and the oil and natural gas sector).

Between 2007 and 2010 (latest year available) BERD (which comprises expenditures by state companies such as Petrobrás, the leader in R&D expenditures, internal and external acquisition) increased (after a drop in 2008), going from €6,739m to €9,328m. However, as share of GDP, BERD initially grew to then experiment a slight decline: 0.52% in 2007 to 0.59% in 2009, and then 0.51% in 2010; still quite lower than the target goal for 2010 set in the previous industrial policy PDP of 0.65%.

Whereas the rise in absolute terms in BERD appears to reflect the impact of public funding programmes aimed at leveraging greater private sector investments, such as the Economic Subsidy programme and the fiscal incentives provisions in the Positive Law, both launched in 2006; the 2010 decline as the share of GDP is partly due to the fact that 2009 GDP fell by 0.33%. Moreover, BERD as a share of GERD went fell slightly from 47.9% in 2007 to 47.3% in 2010, after a high 48.4% in 2009.

The Brazilian innovation survey PINTEC 2008 (latest available, covering period 2005-2008) shows that although in relation to the 2005 survey results (covering the period 2003-2005) the number of innovative firms increased from 30,377 to 38,299 in a universe of over 100,000); the share of industrial firms developing advanced technological innovation remained quite small albeit growing from 2.7% in 2003 to 4.1%. While the number of firms doing R&D fell from about 5,000 in both 2003 and 2005 to 4,300 in 2008, the number of those doing R&D internally, continuously grew from 2,400 in 2003 to 3,000 in 2008.

In 2011, FINEP registered a finance demand from innovative companies in the order of €2.71b (R$9.56b). In the face of this, FINEP committed its full budget and will contract €970b (R$2.5b) in innovation finance loans with enterprises, an increase of 52.6% compared to the prior year. The actual disbursement to enterprises will total €721m (R$1.86b) until the end of 2011, a growth of 52.7% compared to 2010. To meet the demand of the productive sector, FINEP has reduced by 58.8% the average time project analysis in 2011.

Overall, between 2006 and 2010 (although 2010 data for some programmes are not yet available and for others, the last call was in 2008) the government mobilised €5.58b for business innovations distributed as follows: economic subsidies (grants) and fiscal incentives (34.4%); financing, which includes a small share for FINEP and BNDES public venture capital programmes (61.1%) and structuring programmes (tech transfer, incubators and technological parks, etc.) (4.5%). Government innovation policy and its main programmes (in terms of resource allocation) – Finep's corporate grants (*Subvenção Econômica*), fiscal incentives (Positive Law provisions) and financing (Finep's Pro-Inova / Inova Brasil programme and BNDES multiple programmes.

The number of firms that made use of the Positive Law fiscal incentives reached 524 in 2009, a 317% growth compared to 2006. Their R&D investments over the same period grew from €814m (R$2.1b) to €3.22b (R$8.3b). Similarly, counterpart investments made by beneficiary ICT-producing firms of fiscal incentives under the Informatics Law increased considerably. In 2009, 519 firms benefited, a 147% growth over 2007. Over the period 2007-2009, their investments in R&D projects totalled €853 (R$2.2b). In October 2010, Finep launched two calls totalling €19.4m (R$40m

for parks + R$10m for incubators) call to expand and develop technological parks and support anchor-incubators of incubator networks, supported in to previous calls in 2006 and 2009, under the National Programme to Support Incubators and Technological Parks (*Programa Nacional de Apoio a Incubadoras e Parques Tecnológicos* PNI), which funded 12 projects of technological parks and 14 anchor incubators in April 2011.

The ENCTI, in order to meet the challenge 'Promotion of Innovation in Firms', has set the objective to 'Expand the business participation in the country's technological efforts, with a view to improving the competitiveness in national and international markets'.

The main strategic activities and orientations associated are: 1) give priority to the strengthening of partnership with SEBRAE, with a view to fostering RD&I in micro and small enterprises, which have great potential and require new tax incentives, funding and support, as well as technological extension; 2) improvement of the regulatory framework and incentives to innovate, expanding the reach of these policies and reinforcing the integration between the different instruments of support to innovation; 3) expansion of the use of government procurement power as powerful mechanism of strengthened demand for products of innovative companies, with the consequent acceleration of investment in technology; 4) attraction of R&D centres of transnational companies and review of the regulatory framework for foreign direct investment, in view of linking investment to the internalisation of R&D centres and to the increase of local content in the segments of medium and high technology, and to encourage the association with Brazilian companies 5) broadening of participation in risk pre-competitive phase; 6) expansion of current mechanisms for promotion of entrepreneurial capital investment funds; 7) support initiatives to raise awareness, consciousness building and mobilisation of entrepreneurs to innovation; 8) strengthening of new programmes and actions geared to the insertion of researchers and postgraduates in companies; 9) strengthening of programme RHAE (in-company researcher), with a view to inserting qualified human resources in R&D activities of the small and mid-sized companies; 10) stimulation of the training of researchers (masters and PhD) with focus on innovation and its joining enterprises; 11) award value to innovation and technological extension academic assessments; 12) strengthening of Sectorial Technological Entities (ETS) and stimulate cooperation among them; 13) consolidation of technology transfer units (Núcleos de Inovação Tecnológica NIT) for the management of innovation policy in S&T institutions; 14) stimulus for the protection of intellectual property rights and transfer of technology, including the strengthening of the National Institute of Industrial Property (INPI); 15) consolidation of networks of the centres of innovation, technological services and technological extension of SIBRATEC to support innovative efforts of companies; 16) expansion of links between universities, research centres and companies in the development of innovative technologies, with emphasis on the final phase of product development, mainly through the creation of an strategic institution oriented towards industrial innovation — Brazilian Research and Industrial Innovation Enterprise (EMBRAPII) – in partnership with CNI; and 17) strengthening of the national programme to support incubators and technological parks (PNI) with a view to stimulate the emergence of innovative companies.

Next, ENCTI in order to meet the challenge of establishing 'New pattern of public finance for the development of national scientific and technological innovation' has set the objective 'Expand the resources for the development of national scientific base

and for technological innovation', which will be met by the pursuit of the following strategic goals and activities: 1) transformation of FINEP into a "national bank of innovation" and strengthening of its capital base; 2) expansion of investment capacity in promoting research and training human resources by increasing budgetary resources available to the CNPq; 3) preservation of current revenue stream of the sectorial oil & natural gas fund CT-PETRO and its expansion to include other sources of receipts the oil pre-salt layer exploration; 4) establish an risk capital organisation 'FINEP-Par', as part of the creation of new mechanisms for direct investment in companies, directed to acquisition of securities and equity participations in high technological content ventures; 5) creation of new sectorial funds and streamlining of existing ones, among which stand out the proposals for the automotive, mining and civil construction and the financial system; 6) external fundraising to invest in R&D; 7) improvement of the legal framework of innovation, with special attention to RD&I incentives to micro, small and medium-sized enterprises; 8) deployment of resources respecting the regional diversity, with emphasis on partnerships for network formatting and decentralisation programmes.

## 2.4 KNOWLEDGE DEMAND

GBOARD evolved from €2,565.6m in 2005 to €5,826.6m in 2009 (latest available year). According to the author's estimates, defence accounts for 9.33% of GBAORD (Ministry of Defence R&D + MCT National Nuclear Development programme outlays). By default, civilian GBOARD represented 91.77% in that same year and its estimated breakdown was:

- Economic Development: 32.85% of total GBAORD;
- Health and Environment: 8.68% (Ministry of Health R&D + Ministry of Environment R&D + MCTI ST&I Applied to Natural Resources and Meteorology and Climatic Changes programmes);
- Exploration and Exploitation of Space: 2.83% (MCTI National Programme for Space Activities PNAE;
- Non-oriented Research: 4.39% (MCTI Promotion of Scientific and Technological Research programme);
- Research financed from General University Funds (GUF): 41.92% (Ministry of Education R&D=graduate education outlays).

According to the results of the latest innovation survey for the period 2006-2008 (Pintec 2008), the automotive sector accounts for about one-fourth of industrial R&D and has the highest innovation rate of 83.2% - higher than the overall (industry and selected services) innovation rate of 38.6% and that of the industrial sector of 38.1%. Following the automotive sector were high and medium-high technology categories: pharmaceutical and pharmaceutical-chemical products (63.7%), other optical and electronic products (63.5%), chemical products (58.1%), communications equipment (54,6%), peripherals and information technology equipment (53.8%), machinery and equipment (51.0%) and electronic components (49.0%). Below the industrial sector average, there is only one of the medium-high sectors with transportation equipment (36.1%). All other industries belong in the low technology sectors. Those with the lowest innovation rates are extractive industries (23.7%) and wood products (23.6%).
Another way to get a glimpse into this demand is to analyse the demand and goals of sectorial ministries over the PDP period. Overall, given that R&D by the oil and gas (O&G) state company Petrobrás (affiliated to the Ministry of Mining and Energy MME) accounts for roughly 20% of GBAORD for 2007-2010, and given the fact that

three main general R&D funding sources – MCTI, BNDES and MEC – jointly account for 68.1% of GBOARD and have about two-thirds of their funds directed to sectorial/thematic priorities, it is fair to state that the balance between generic and thematic/sectorial R&D policies tips toward the latter. Estimates from available data show that Brazil's GBOARD for the period of the PACTI 2007-2010 (2010 estimate) was €16.5b (R$41b). The three main generic funding sources were MCTI (43.3%), National Bank for Social and Economic Development BNDES, linked to the MDIC (13.2%) and MEC (11.6%).

The corresponding shares of sectorial ministries were: MME (19.4%), which includes its affiliated state companies – Petrobrás in the O&G sector with the largest budget and Eletrobrás, active in electric energy generation and transmission. These are followed with considerable distance by the Electric Energy Research Centre CEPEL; MAPA (3.5%) and MS (2.7%). The MME main research programme for energy and O&G, is under the responsibility of the public company Petrobrás; whereas CEPEL of Eletrobrás executes and coordinates RDI programmes.

In regard to health (GBAORD Health and Environment line), it should be noted in the context of PACTI's integrated planning framework, the MCT and MS are partners in building research networks to respond to the needs of Brazil's public health system SUS and in creating national toxicology centres. MS's S&T Secretariat makes public calls according to themes developed by the National Agenda of Health Research Priorities, in articulation with CNPq, Finep and Unesco; and coordinates all stages of funding from the definition of research themes to their monitoring and evaluation.

In regard to agricultural production and technology (GBAORD Economic Development line), the Ministry of Agriculture and Husbandry Production (MAPA) is responsible for carrying out policies for developing agribusiness and coordinates the agribusiness action line of the PACTI in a planning partnership with MCTI. Its research execution arm is the Brazilian Agricultural Research Company EMBRAPA. Its main activities are to strengthen the national system of agricultural research, which includes the state organisations for Agricultural Research (OEPA), and to support the setting up of a new state company Embrapa Agro Energy.

In regard to defence GBAORD, the Ministry of Defence MD's National Defence Policy maintains research activities under the Industrial Defence Complex programme of PACTI, and has benefited from the consolidation of its partnership with MCTI in the PACTI framework, aimed at strengthening military research and training institutes and development of new products and process through import substitution.

The distribution of 14 SIBRATEC thematic network innovation centres also provides an idea about the knowledge demand. They are serving manufacture and capital goods; microelectronics; consumer electronics; wine culture and science; photovoltaic solar energy; plastics and rubber; advanced visualisation; bioethanol; odontology, hospital and medical equipment; human health inputs; digital ICT; nano-cosmetics; and electric vehicles.

## 2.5 KNOWLEDGE PRODUCTION

### 2.5.1 Quality and excellence of knowledge production

In 2010, the total number of scientists and researchers was about 234,797, of which a little over one-third held a doctorate and the majority worked in the public sector, the

near totality in higher education institutions. In 2009, they published 32,000 scientific articles, representing over half of Latin America production and 2.69% of the world's scientific papers (Thomson/ISI), up from 1.8% in 2005, ranking as the 15th largest producer of scientific literature (up from number 20 in 2000). In 2009, according to Thomson/ISI database, the top three scientific areas in Brazil with the highest share in world production were: agricultural sciences (9.89%); animal and plant science (7.04%), and pharmacology and toxicology (3.96%). In 2008, Brazilian scientific publications grew by 11.3%, 3.8 times the world average growth. According to the Scopus database, Brazil had a produced 39,881 accounting for 52.6% of Latin American production and 2.11% of world production. By 2011, its production reached 48,415 articles, corresponding to 54.6% of Latin America's and 2.39 of world's production.

According to the Unesco, between 2002 and 2007 the number of scientific publications grew from 12,573 to 26,482, an absolute growth of 110%. The area with the highest absolute number of publications is medicine (8,799 in 2008), whereas mathematics had the lowest with 708 in 2007, despite having had a considerable increase from 2002 with 398 papers.

Over 90% of Brazil's scientific production comes from the 4,099 graduate programmes. The country has roughly 85,500 Ph.D. holders, equalling 1.4 Ph.Ds. per thousand inhabitants, against 8.4 in the United States and 13.6 in Germany. Over 80% of the Ph.Ds. is working in universities. There are 253 universities employing 77.463 Ph.Ds. and 113 public and non-profit scientific and R&D centres employing 8,099 PhDs. Between 2007 and 2010, the number of students enrolled in doctoral programmes and of doctorates awarded, went from 49,667 to 71,387 and from 9,915 to 12,217, respectively. In 2007, the top three scientific areas in these categories were Human Sciences (8,949), Health Sciences (7,644) and Engineering (6,908), and Health Sciences (1,798), Human Sciences (1,698), and Agricultural Sciences (1,217), respectively. In 2012, the rankings were, again for both, Human Sciences (11,134), Health Sciences (10,247) and Engineering (8,722), and Health Sciences (2,132), Human Sciences (2,007), and Agricultural Sciences (1,468), respectively.

The number of Brazilian patents filled at the USPTO grew from 375 in 2007 to 568 in 2010 (Mexico 295 and India 3,789); and patents awarded from 118 to 219 (Mexico 115 and India 1,137). In 2008, Brazil had 0.2% of triadic patents (WIPO). The number of patents filed at the Brazilian intellectual property office (*Instituto Nacional de Propriedade Industrial* INPI) rose from 25,406 in 2006 to 28,052 in 2010. Non-residents accounted for 72.6% and 74.1%, respectively. PCT filings accounted for 63.7% and 64.4%, respectively, the near totality in both years by non-residents. Between 2006 and 2010, the number of patent filings by micro enterprises increased from 199 to 288, a 44% growth.

A research policy partnership between the MCTI and the states, the Regional Scientific Development programme established 519 agreements with FAPs for a total value of €33m (R$84m) to support projects in regional ROs with a lack of qualified researchers.

### 2.5.2 Policy aiming at improving the quality and excellence of knowledge production

Although there is yet no systematic effective monitoring and review system, making full use of output indicators, international benchmarking or ex-post evaluation tools,

some new institutional and network programmes are being selected on the basis of the quality of proposals and subject to external peer review. For example, the National Institutes for Science and Technology programme (INCT) funded 122 institutes spread out throughout the country in 2010, has been monitored and evaluated on the basis of internationally acknowledged criteria; projects were selected on the basis of the quality of proposals and subject to international external peer review.

ENCTI propose actions to reinforce postgraduate studies and research infrastructure in the North, Northeast and Centre-West regions, without compromising the excellence levels achieved by the Southeast and South regions. Among ENCTI's strategic activities to meet the objective of strengthening scientific and technological research, to face the challenge of reinforcing its infrastructure, are the increase in resources and the number of research projects supported by federal agencies, aiming at the strengthening of groups of excellence and emerging groups; evaluation, consolidation and expansion of INCTs; support for deploying multiuser national laboratories; and expansion and modernisation of R&D infrastructure of public and private research institutions.

In the ENCTI, part of the strategy to develop human resources with high excellence is signalled by FINEP's improvement of relationship with the representative entities of the National System of Science, Technology and Innovation (SNCTI): Consecti, Confap, States, CNI, Anpei, Anprotec, SBPC, ABC, among other relevant partners.

## 2.6 KNOWLEDGE CIRCULATION

### 2.6.1 Knowledge circulation between the universities, PROs and business sectors

Most policy measures to reinforce the cooperation between universities, research and business were launched after the passing of the 2005 innovation law and therefore it is too early to assess their effectiveness and impact. Recent research, however, has continued to show that Brazil has a low high tech share (PROTEC, 2012; IEDI, 2011) as well as a lowly developed business culture and a high reluctance of PROs to cooperate with the private sector.

The number and scope of policies designed to support innovation that have complementary impacts on researchers and research activities have increased over time particularly following the launch of the 2005 Innovation Law, which targeted efforts in some of these areas. One exception is support to incubators which dates back to the late 1980s. Since then the programme has grown and its scope was enlarged to comprise support to technological parks. In October 2010, Finep launched a call to fund the expansion and development of technological parks with an €16.1m (R$40m) budget. One year earlier, in March 2009, FINEP had made an €4.0m (R$10m) call to support Technological Innovation Nuclei (TTO in English or NIT in Portuguese) at public universities/research centres which funded eight projects involving 73 institutions. By the end of 2009 there were 80 of those Technological Innovation Nuclei, distributed in 64 public and 17 private institutions. Another activity in this area did not take place until March 2012, when Finep issued a public call for university-industry cooperatives projects in the development of assistive technologies of €7.8m (R$20m) (*CHAMADA PÚBLICA*

*MCTI/SECIS/FINEP/FNDCT – Cooperação Empresa-ICT – TECNOLOGIA ASSISTIVA – 01/2011*). Results will be announced in October 2012.

## 2.7 OVERALL ASSESSMENT

In 2010, the total number of scientists and researchers was about 234,797, of which a little over one-third held a doctorate and the majority worked in the public sector, the near totality in higher education institutions. In 2009, they published 32,000 scientific articles, representing over half of Latin America production and 2.69% of the world's scientific papers (Thomson/ISI), up from 1.8% in 2005, ranking as the 15th largest producer of scientific literature (up from number 20 in 2000).

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# 3 National policies for R&D&I

## *3.1* LABOUR MARKET FOR RESEARCHERS

### 3.1.1 Stocks of researchers

In 2010, the total number of scientists and researchers was 234,797 (versus 192,091 in 2007), of which 80% worked in higher education institutions (74% in 2007), 3.3% in government, 17.6% in business companies (23.6% in 2007) and the remainder in non-profit organisations. Of the 2010 total, 83,170 had a doctorate (or 35.4%, versus 33.3 in 2007), of which 79,180 worked in higher education institutions and 1,444 in business companies (versus 1,737 in 2007), according to MCTI. In the same year, of the 138,653 full-time equivalent researchers (0.72 per million inhabitants in 2010), 33.5% had a doctorate, 68% worked at higher education institutions and 16% in business companies.

### 3.1.2 Providing attractive employment and working conditions

As the country's economic growth continues, a shortage of engineering graduates has become obvious. Only 5% of higher education students in Brazil are trained in engineering. Brazil graduates 30-35.000 engineers per year, far below the actual and projected demands. Furthermore a large percentage of those graduates pursue careers in other areas. There is an even more serious shortage of technicians for growth industries ranging from construction to oil and gas. Whereas six million students are enrolled in higher education, only one million are enrolled in technical education programmes. In order to face this challenge, the government launched at the end of April 2010 a national technical education programme (*Programa Nacional de Acesso ao Ensino Técnico e ao Emprego* Pronatec). The programme will build 200 new technical schools by 2014 and had a 2011 budget of about €450m (R$1b) for scholarships (70%) and student loans (30%).

### 3.1.3 Open recruitment and portability of grants

In Brazil, federal and state university professors and researchers are civil servants. Non-nationals are eligible in competitions for permanent research and academic positions. However any candidate holder of foreign undergraduate and graduate diploma will be required to have it accredited by a federal institution of higher education with an established post-graduate programme in the area (which can be the same prospective employing institution or another) in order to gain employment at a federal university or research institute. Job openings (professors, post-docs etc.) are advertised in the institution's website and sometimes in specialised journals and online sites. In some universities and areas there's still considerable "inbreeding". Formal recruitment processes are generally open and transparent, but in some areas the process can be oriented towards pre-selected candidates.

At the undergraduate level, in 2009 there were 2,700 foreign students studying at 89 participating higher education institutions – federal, state and private. Most were in in the framework of the PEC-G programme for students from developing countries with which Brazil has education, and cultural and S&T agreements. Most foreign students are enrolled in medicine, engineering, business administration and international relations.

### 3.1.4 Enhancing the training, skills and experience of researchers

In 2011 there were postgraduate programmes in Brazil: 1,554 both master and doctorate (top 5 areas: Health sciences, 25.2%; Human sciences, 14.8%; Agrarian sciences, 12.7%; Biological sciences, 12.1%; and Engineering, 9.7%), 1,161 masters (top 5 areas: Human sciences, 16.2%; Applied social sciences, 15.6%; Multidisciplinary, 13.2%; Engineering, 12.1% and Health sciences, 11.4%) , 52 doctorate (16 in Health sciences and 15 Multidisciplinary) and 329 professional master.

In 2011, the doctoral student enrolment (71,387) distribution in the top 5 areas was: Human sciences, 11,800; Health sciences, 11,469; Engineering, 9,462 (6,908 in 2007); Agrarian sciences, 8,318; and Biological sciences, 7,438. The distribution of degrees awarded was: Health sciences, 2,379; Human sciences, 2,089; Agrarian sciences, 1,493; Engineering, 1,346 (1,184 in 2007); and Biological sciences, 1,293.

Between 2006 and 2009 (last year available), the two federal agencies awarding undergraduate and postgraduate scholarships and postdoctoral fellowships (CNPq/MCTI and Capes/MEC) increased the number of national scholarships-year from 48,217 to 66,824 and of foreign scholarships-year from 3,578 to 3,777. However, the distribution of types of scholarship changed over the period. Over the same period, in national scholarships-year, the number of postdoctoral fellowships-year grew 154% (3,144 in 2009), doctoral scholarships-year 30% (to 26,359 in 2009) and master scholarships-year 40.8% (37,321 in 2009). Similarly, in regard to foreign awards, postdoctoral fellowships grew 17% (1,067 in 2009); doctoral scholarships fell 33% (783 in 2009); doctoral sandwich scholarships (*Bolsas Sanduíche*), which fund doctoral students abroad for a period of 12 to 18 months, awarded by both CNPq and CAPES, grew by 18% (1,910 in 2009); and master scholarships 143% (17 in 2009).

For comparison, in 2009, the state of São Paulo research support foundation Fapesp awarded almost 2,000 domestic doctorate (about 1,500 in 2005) and 1,000 post-doctoral scholarships (about the same in 2005). However, only 171 scholarships were awarded for research abroad, less than in 2005.

On 26 July 2011, the federal government launched the programme Science without Frontiers (*Programa Ciência sem Fronteiras* CsF) which aims to promote the consolidation, expansion and internationalisation of science and technology, innovation and Brazilian competitiveness by awarding foreign scholarships and fellowships to postgraduate and undergraduate students and to promote international mobility by awarding foreign postdoctoral and research fellowships. CsF goal is to award up to 75 thousand scholarships in four years (2011-2104), complemented by an additional 26 thousand awards by business companies to reach a total of 101 thousand foreign awards. Students and researchers are to enrol in universities and research institutes selected by the government as recognised centres on international excellence.

The initiative is a joint effort by MCTI and MEC through their respective funding agencies CNPq and Capes, and MEC's Departments of Higher Education and Technological/Vocational Education. Over the period, the target distribution by type of the programme awards is: 3,900 postdoctoral foreign fellowships, 7,850 full-time doctorate foreign scholarships, 13,900 sandwich doctoral foreign scholarships; 11,600 undergraduate sandwich foreign scholarships, 2,000 senior research internship foreign fellowships, 490 national fellowships to attract young talent from abroad

(*Bolsa Atração de Jovens Talentos* BJT), preferably Brazilians working abroad, and 290 special visiting senior researcher national fellowships (*Pesquisador Visitante especial* PVE). CsF objective is to promote a fast technological development and stimulate the innovation processes in Brazil through international student (vocational, undergraduate and postgraduate), professor and researcher mobility, stimulating the integration of research performed in Brazilian institutions to the best international research experiences. CsF is addressed to priority areas for the development of the country: engineering and other technology areas; exact and earth sciences: physics, chemistry, biology and geosciences; biomedical sciences and health; computing and information technology; aerospace technology; pharmaceuticals; sustainable agricultural production; oil, gas and coal; renewable energies; mineral technology; biotechnology; nanotechnology and new materials; technology for prevention and mitigation of natural disasters; biodiversity and bio-prospecting; marine sciences; creative industry; new technologies of construction engineering; and training of technologists.

In addition, there are in CsF public calls targeted to priority areas. For example, the late 2011 competitive public call for 'sandwich doctoral scholarship and postdoctoral fellowships (CNPq/GSC nº 29/2011) was aimed at the development of theses and research at the University of Toronto (Canada) and Oxford (United Kingdom), in the priority areas of CsF and in research areas of the Structural Genomics Consortium laboratories. The duration of the fellowships is up to 12 months for sandwich doctoral, and up to 24 months for doctoral and post-doctoral. Results were announced in late April 2012. A novelty in CsF is award of scholarship for undergraduate studies. Enrolled undergraduate students who have completed at least 40% of his/her course in a Brazilian higher education institution can apply for a ''sandwich' undergraduate scholarship (*Graduação Sanduíche no Exterior* SWG) to spend 6 to 12 months abroad, at least 6 doing coursework and an activity plan comprising research or innovation/technology in a company, research centre or laboratory. CsF has agreements and partnerships with various educational institutions, exchange programmes and research institutes around the world. Another is the granting of scholarships to students from mid-level technical courses: 3,000 awards over three years. These will benefit both students of technical courses, and of professional education courses. There will be 15,000 scholarships distributed as follows: 6,000 for top courses, 3,000 for technology to bachelor's degree in mathematics, physics, chemistry and biology, 3,000 for technological baccalaureate and 3,000 for middle-level students. As of May 5, 2012, according to the its website (http://www.cienciasemfronteiras.gov.br/web/csf/paises;jsessionid=0C264A9259CBBA798C0BF8E0224CDF40), the programme's official partner countries were: Australia, Belgium, Canada, Germany, The Netherlands, South Korea, Spain and Portugal. With all but Germany the partnership comprised the categories of undergraduate, doctoral and postdoctoral studies. The German partnership is based on agreements with the German organisations Frauenhofer and DAAD.

As part of its continuing search for excellence in international cooperation, MCTI has sought to establish partnerships with the best research universities and institutions worldwide. As part of this effort, CNPq issued in August 2011 a call to fund joint research projects with the Massachusetts Institute of Technology (MIT) (*Chamada de Projetos nº 18/2011 Programa de Cooperação CNPq/MIT*).

Among ENCTI's strategic activities to meet the objective of strengthening scientific and technological research, to face the challenge of reinforcing its infrastructure, are

the increase in resources and the number of research projects supported by federal agencies, aiming at the strengthening of groups of excellence and emerging groups; evaluation, consolidation and expansion of INCTs; support for deploying multiuser national laboratories; and expansion and modernisation of R&D infrastructure of public and private research institutions.

## 3.2 RESEARCH INFRASTRUCTURES

In the horizontal axis "Strengthening the Sustainability Base of the S&T&I Policy" of the ENCTI 2012-2015, a main action line is "Strengthening Research and Scientific and Technological Infrastructure," particularly in the North, Northeast and Midwest regions, without compromising the level of excellence achieved in the Southeast and South regions.

The main policy mechanism is the horizontal research fund CT-INFRA, under the budgetary envelope fund FNDCT. The objective of CT-INFRA is the modernisation and expansion of infrastructure and research support services developed in public institutions of higher education and research in Brazil. Its key instrument is the grant programme for research infrastructure and equipment Programme to Support Research Infrastructure (CT-INFRA call PROINFRA), which accounted for over 80% of the CT-INFRA expenditures in 2010. The next two target areas in that year were new campuses and private universities, object of a call for the first time. The fund also supports special infrastructure projects for new university campuses, which had calls in 2006 and 2007, such as the public call of May 2006 oriented to fund research infrastructure in the 40 new campuses of federal public universities (CT-INFRA call Proinfra – New Campuses NOVOS CAMPI), under the Ministry of Education's Programme for Expansion of the Federal System of Higher Education. Finally, public state universities and research institutes get support for infrastructure from the regional programme (CT-INFRA 2009 and 2010 calls). In 2011, there were two public calls in the framework of FNDCT/CT-INFRA. First, the late implementation of the PROINFRA 2010 call (*Chamada Pública PROINFRA 02/2010*), which granted €140m (R$361m) to 118 projects. At the end of December 2011, Finep launched the PROINFRA 2011 public call of €155m (R$400m) (*CHAMADA PÚBLICA MCTI/FINEP/CT-INFRA - PROINFRA – 01/2011*), which will start to be implemented from August 2012.

Since 2004, Proinfra had a significant expansion of resources. It invested €519m (R$743.9m) between 2004-2009, with a significant growth rate for 2008 and 2009, when public calls totalled €144.8m (R$360m). In 2011, CT-INFRA executed investments of €114m (R$294m), 96% of its approved budget, including contracting and payment of resources of projects approved in three previous public calls in 2010, as well as transfers to CNPq, MCTI and Finep, the latter to cover operation costs and administration fees. Further, between 2007 and 2011, revenues of CT-INFRA almost doubled, going from €155m (R$399.6m) to €297m (R$765.5m), the second largest revenue behind the oil & gas sectorial fund (CT-PETRO) with €513m (R$1,321.7m).

Another recent important funding source for research infrastructure is the main research programmes of MME under the responsibility of the government controlled oil and gas company, Petrobrás. From 2007 to 2009, Petrobrás invested approximately €2.2b (R$5.8b) in R&D, including €531m (R$1.37b) to expand the infrastructure of academic and research institutions.

In his inauguration speech on 24 January 2012, the new MCTI minister Marco Antonio Raupp confirmed his goal to strengthen the science and technology infrastructure and to bring together universities and research institutes to develop strategic projects. Further, in order to stimulate the participation of private capital in innovation, Raupp promised to increase public-private partnerships such as the development of the new Industrial Research (Embrapii) programme, created by the previous minister Mercadante in partnership with the National Confederation of Industry (CNI). The programme aims to make available to industrial companies the infrastructure of public laboratories and skills, such as those of the Technological Research Institute (*Instituto de Pesquisas Tecnológicas* IPT), connected to the University of São Paulo (USP), the National Institute of Metrology, Standardisation and Industrial Quality (Inmetro), linked to MDIC and high-performance centres of National Service of Industrial Learning (Senai).

## 3.3 STRENGTHENING RESEARCH INSTITUTIONS

### 3.3.1 Quality of National Higher Education System

In 2010, last year available, there were 2,377 higher education institutions (universities, university centres and faculties) (*instituições de ensino superior* IES), of which only 180 were universities (253 federal, state, municipal and private). In 2000 there were 1,180 IES. Private IES account for 74% of undergraduate enrolment of 6,379,299, double that in 2000. They were enrolled 29,507 courses, 15% in the modality of distance learning, and the majority attended universities (54%), although their enrolment was in decline in relation to university centres and faculties. However, from 2009 to 2010 there was an increase of 11.8% in the number of enrolments in the federal IES (*Instituições Federais de Ensino Superior* IFES), almost double the increase of the private IES. The goal of the national education plan (PNE), is to reach 10 million enrolments by 2020.

In 2010, there were 59 public federal universities operating more than 230 campuses. The majority of the research is executed at universities, which employ 57% of the researchers and 93% of doctorate holders. In 2008, the number of tertiary-level students (5,080,056) as a share of the population (189,613,000) was 2.68%. The preferred studies were: Social Sciences, Business and Law (42.6%), Education (16.2%), Health and Social Services (15.5%), Engineering, Industrial Engineering and Civil Engineering (9.2%) and Science, Mathematics and Computer Science (8.5%).

The majority of higher education students are enrolled in private institutions of higher education, including 131 universities. The majority of these institutions are devoted mainly to teaching.

Institutional funding for public federal universities is provided by the Ministry of Education budget. Funding for graduate study programmes in public (federal and state universities), which account for over 80% of courses, and in private universities are provided mainly by MEC's agency CAPES through both competitive and block funds. The latter is distributed according to evaluations made every three years of the more than 4,000 graduate courses (master and doctorate level) in terms of mission, faculty, student body, social insertion, dissertations, thesis and intellectual production.

In 2010, HERD as a share of GDP was 0.18% in 2010. In 2010, it reached €2,631m, 16% of GERD, distributed as follows: 53% public federal institutions, 40% public state

institutions 7% private institutions. Altogether universities account for 50-60% of total R&D performance in Brazil and they are mainly publicly funded. Private sector funding has been growing in recent years, albeit from a relatively small volume and financial base. Business expenditures on post- graduate education in 2010 were €192 (R$495m).

Research is predominantly performed at public universities. Well known examples are the University of São Paulo USP and the University of Campinas UNICAMP, both in the state of São Paulo; the UFRGS in Rio Grande do Sul, the UFSC in Santa Catarina, and the UFMG in Minas Gerais and the University of Brasilia UnB in the Federal District. Research is conducted among a few private universities, in particular in confessional ones. The Pontifical Catholic University of Rio de Janeiro (PUC Rio) is the country's most important private research university.

Very few of the research universities have embraced the third way, that is to become more entrepreneurial and geared to innovation. In some universities some department and areas have developed stronger linkages with industry, as for example in the case of oil and gas exploration, where the leading state company Petrobrás has developed strong ties with both the federal university UFRJ, (particularly with its engineering graduate programme COPPE in ocean and platform engineering), as well as with PUC Rio (particularly in the area of computer graphics). Over the last few years, due to government university-industry research promotion programmes, the expansion of Petrobrás university cooperative programme as well as the entry of several other large, national and multinational, firms (Vale, CSN, Braskem, Oxiteno and Natura among others) and government incentives for universities to become more innovation-oriented, the number of research universities actively involved in science and technology transfer has increased.

There are no Brazilian universities in the 2010 Shanghai top 100 HE index. The first Brazilian university to appear in the 101-150 ranking is the University of São Paulo. It is also the only one to appear in the Times Higher Education 2012 World Reputation Rankings, in the 61-70 bands. Further, in 2011, the University of Sao Paulo was the first Ibero-American institution in the Times Higher Education World University Ranking's top-200 (Position 178 in the World).

### 3.3.2 Academic autonomy

Public universities have full autonomy in research, including the capacity to autonomously design research agendas and topics of research specialisation. In regard to management of research budgets and on hiring personnel, public universities depend on the relevant authority in the federal government (Ministry of Education, MEC) or in the state government. Generally the governing model adopted by universities is the University Council.

Members of the governing body of the public universities are selected from within the university. Private universities may have an additional governing body that sets out broad strategic orientations with members external to the institution (from business, government and private non-profit sectors). Rectors/Deans in public universities must be elected by peers and top ranked names are submitted to the relevant authority, i.e. the Minister of Education, who usually validates electoral top choice, for nomination.

### 3.3.3 Academic funding

Public universities are funded through budgetary appropriations, mainly for payment of professors' salaries. Along with a handful of private research universities, they also receive block funding for graduate and undergraduate scholarships on the basis of performance assessments (mainly based on bibliometric indicators diplomas/graduate degrees granted). Public competitive funding is available for infrastructures and research projects at the institutional as well as at the research unit level. Universities – by and large - make decisions for allocating resources autonomously in line with their research units' priorities and financial capacity obtained through competitive grants. Due to a high level of variability from one university to the other in terms of the amounts of academic block funding and competitive grants and their annual change, it is difficult to calculate shares for each of the funding modes. Official data, in this respect, is not available.

## *3.4* KNOWLEDGE TRANSFER

### 3.4.1 Intellectual Property (IP) Policies

Compared to North America, the average university in Brazil generates far fewer inventions and patents. This is largely due to a less systematic and professional management of knowledge and intellectual property (IP) by them. Additionally, the efficient knowledge transfer in Brazilian-European research institutions is hindered by a range of factors, including: cultural differences between the business and science communities, lack of adequate incentives, legal barriers as well as underdeveloped and fragmented markets for knowledge and technology.

At most public federal universities which have established sharing rules on revenues of IP ownership of research results and associated IP rights, the inventors receive 1/3 and the university 2/3. The latter is split half in order to finance the IP processing and administrative costs and the other half will be allocated to the department of the inventing research unit.

The 2005 Innovation Law and subsequent modifications supported the creation of Knowledge Transfer Office (KTO) at universities (*Núcleo de Transferência de Tecnologia* NIT) and created the possibility for federal public academic researchers to establish a start-up firm without losing institutional tie and public employee retirement benefits. In 2006, MCTI supported the creation of the National Forum of KTO Managers (*Fórum Nacional de Gestores de Inovação e Transferência de Tecnologia* FORTEC). Then, MCTI established the Working Group on IP (*Grupo de Assessoramento Interno de Propriedade Intelectual* GTA-PI) to promote a uniform institutional IP culture in articulation with the Inter-Ministerial IP Group (*Grupo Interministerial de Propriedade Intelectual* GIPI) and the Inter-Ministerial Commission on the Innovation Law Framework. Further, the PACTI Pro-Inova programme reinforced the commitment to the expansion and strengthening of KTOs.
Monitoring and reporting of Knowledge Transfer activities is carried out by the MCTI. Public research institutions with KTOs have the legal obligation to provide information to the MCTI on their patenting and licensing activities annually. For the few private ones which receive support this is voluntary. In 2008, of the 101 institutions that provided patenting information (82 public and 19 private) to MCTI, 67 had filed for patents (1,021 patents filled in Brazil (INPI) – versus 767 in 2007- and 112 patents filed abroad (not specified where) – versus 93 in 2007) and 31 had been granted patents (146 in Brazil – versus 122 in 2007 - and 21 abroad – versus 10 in 2007).

In March 2009, FINEP made a €4.0m (R$10m) call to support Technological Innovation Nuclei (ILO/TTO or NIT in Portuguese) at public universities/research centres which funded 8 projects involving 73 institutions. In 2008, a €4.0m(R$10m) call for the implementation, structuring and consolidation of regional and state-level NITs approved 8 projects involving 64 institutions. In that year there were 81 NITs, distributed in 64 public and 17 private institutions (institutions that provided information to MCTI in 2009). However, estimates point to the existence of 140 NITs. In general, the support system for facilitating knowledge transfer has improved over the past few years due to the creation and evolution of KTOs which, however, are still poorly staffed.

### 3.4.2 Other policy measures aiming to promote public-private knowledge transfer

**Spinoffs**

A trend is the increase in the number and scope of innovation policy instruments for firms with a grants for pre-incubation and in incubation (First Innovative Firm Programme PRIME); venture capital funds covering more stages of a technology-based firm growth trajectory (seed and regular VC); and reduced interest loan programmes which can reach close to zero for innovative MSEs at incubation and seed stages (Zero Interest Rate Programme JURO ZERO), as well as more flexible university-industry cooperative mechanisms and decentralised grant programmes (PAPPE Subvenção).

Since 2009, the First Enterprise programme (PRIME) – which provides start-ups, in a first phase grants from the Economic Subsidy Programme, and in a second phase, subsidised loans from the JURO ZERO programme – has supported the creation of university spinoffs. It awards locally competitive milestone-based small grants of up to €96,552 (R$200 thousand) to start-ups. It is implemented in a decentralised manner by anchor incubators that were selected through a competitive call; this leads to a local network of agents. The PRIME programme benefited 1,381 start-ups up to 2010. Each was awarded €48.3 thousand (R$ 120 thousand), from the Economic Subsidy Programme, for a total of €66.8m (R$166m). Programme expenditures for the 2010 call were €80.5m (R$200m). This was the last call. A reformed edition of the programme has been announced several times over the last half of 2011 and first half of 2012, but a new one has not been issued. Zero Interest Rate Programme finances projects and business plans of innovative MSEs for up to 18 month. Since 2007, 60 projects were financed for a total of €13.3m (R$33.1m).

The PAPPE Subsidy (PAPPE Subvenção) programme uses resources from the Economic Subsidy Programme to co-fund innovative projects by MSEs selected through state-level public calls managed by FAPs and other local organisations employing criteria that responds to local needs and objectives. It funds firms with annual revenue up to €4.2m (R$10.5m) with grants in the € 80.5-161 thousand (R$ 200 - 400 thousand) range. Up to the end of 2010, 414 MSEs were awarded grants by the programme in 13 units of the federation. Total investment reached €106.6m (R$265m), of which €46.3m (R$115m) in counterpart funds from FAPs, local SEBRAE units and state industrial federations. Taking into account the 1,600 proposals received in the calls of the twelve federation units the project average value is €100.6 thousand (R$ 250 thousand). A programme similar in nature to it directed specifically to the North, Northeast and Centre-West regions called PAPPE

Integration (*Pappe Integração*) was launched in 2010 with €35.4 m (R$88m) call to partners in 18 federation units of these regions.

Private support systems for the early development of university spin-offs in form of early-stage venture capital and business angels are still widely lacking. FINEP's regionally-based seed capital programme (*Inovar Semente*) allows the participation of business angels as minority partner investments in the fund and provides them with guarantees on lost investment. However, there is no public support for the creation and development of business angel networks. In June 2012, there were only three formal angel groups in operation and two existing public seed capital funds, however the latter had investment floor target well above the financial needs of university spin-offs and other technology-based start-ups.

Support for incubators and more recently for technological parks, has continued to increase.

**Inter-sectorial mobility**

In terms of inter-sectorial mobility, this is generally low. While public researchers cannot move easily between the public and private sectors, many professors provide consulting to business firms, mostly large ones.

**Involvement of private sector in the governance bodies of HEIs and PROs**

An involvement of the business sector in the governance of universities and PROs is non-existent in the public sector. There are a few exceptions in private research universities, where representatives from the private sector can join the university boards.

**Promoting research institutions - SME interactions**

The interaction between research institutions and SMEs is aimed to improving with Sibratec programme. The Sibratec umbrella programme launched in 2007 aims to support business technological development through promotion of research and development activities for innovation and supply of metrology and technological extension, assistance and transfer services. Its operation is through different networks of local agents catering to local productive requirements. Between 2007 and 2009, with resources from FNDCT / Sectorial Funds, Sibratec invested €122.3m (R$304m) in the implementation of eight technological extension state networks, six thematic innovation centres and 18 technological services networks involving 54 institutions and 527 laboratories. Sibratec is made of three types of network.

1) Innovation Centres, composed of universities and research institutes with experience in business interactions. Its objective is to transform knowledge into commercially feasible prototypes for the creation of new technology-based firms or incremental innovation in existing firms.
2) Technological Services Institutes for the provision of metrology, norms, calibration, conformity analysis and essays through the articulation and modernisation of existing entities and networks.
3) Technological Extension network to stimulate demand for specialised innovation assistance through consultants to make business diagnostics, propose solutions and prepare research projects for submission to research institutes.

**Regional Development policy**

In the last few years there has been an effort on the part of the federal government to decentralise research policy by transferring researches to state agencies which run the programme locally. The first was CNPq's First Research Programme (PPP) to fund

young researchers' projects. Next, was Finep's Programme for Supporting Research in Enterprises (PAPPE) that gives research grants to individual researchers to work with a university to assist in technological development. PAPPE is co-funded with FAPs. It operates in 20 states, funding 599 projects in 540 firms and its last edition 2006 budget was of €8.4m (R$21m). Finally there was, the still on-going, PAPPE Subvenção programme aimed at decentralising the flagship direct innovation subsidies for innovation programme for provision of (grants) to firms. The programme is implemented in seventeen states and has a total budget of €100.6m (R$250m).

State research agencies research expenditures are made through competitive calls and are generally distributed as follows (percentages for Fapesp in 2009): scholarships (36%) (São Paulo grants 45% of all doctorates); research projects, including thematic (42%); special programmes for strategic areas (11%) and support to technological innovation (11%).

As far as research and innovation policies are concerned the federal government and increasingly the regions (state governments) identify joint priorities and set the share of resources that each will contribute. This process happens through the implementation of programmes and operational activities related to STI. The creation of sector funds brought a new perspective of funding to the national and regional scientific and innovation systems. The governance structure was reinforced by the implementation of Science & Technology Secretariats Council CONSECTI with the representation of all the states. The Council debates and defines regional and state priorities linked with the national ones, and tries to establish a budget level, or at least, identify finance sources at the public and private sectors.

These efforts have generated at another level an integration of the "territorial reality" in their national scientific strategies. In practice, that implies that the regional authorities and PROs are increasingly developing innovation network activities. This shared policy implementation and the relative flexibility it allows to state partners is one of the products of the negotiation between the Federal Government research and innovation policy makers with CONFAP and research support foundations - FAPs. Another prominent example of this emerging research policy partnership trend between the MCTI and the states is the Regional Scientific Development programme, which has established 519 agreements with FAPs for a total value of €33m (R$84m) to support projects in regional ROs with a lack of qualified researchers.

### 3.5 ASSESSMENT

In 2010, the total number of scientists and researchers was about 234,797, of which a little over one-third held a doctorate and the majority worked in the public sector, the near totality in higher education institutions. In 2009, they published 32,000 scientific articles, representing over half of Latin America production and 2.69% of the world's scientific papers (Thomson/ISI), up from 1.8% in 2005, ranking as the 15th largest producer of scientific literature (up from number 20 in 2000).

The number of Brazilian patents filled at the USPTO grew from 375 in 2007 to 568 in 2010 (Mexico 295 and India 3,789); and patents awarded from 118 to 219 (Mexico 115 and India 1,137). In 2008, Brazil had 0.2% of triadic patents (WIPO). The number of patents filed at the Brazilian intellectual property office (Instituto Nacional de Propriedade Industrial INPI) rose from 25,406 in 2006 to 28,052 in 2010.

The Brazilian innovation survey PINTEC 2008 (latest available, covering period 2005-2008) shows that although in relation to the 2005 survey results (covering the period 2003-2005) the number of innovative firms increased from 30,377 to 38,299 in a universe of over 100,000); the share of industrial firms developing advanced technological innovation remained quite small albeit growing from 2.7% in 2003 to 4.1%. While the number of firms doing R&D fell from about 5,000 in both 2003 and 2005 to 4,300 in 2008, the number of those doing R&D internally, continuously grew from 2,400 in 2003 to 3,000 in 2008.

# 4 International R&D&I Cooperation

## 4.1 MAIN FEATURES OF INTERNATIONAL COOPERATION POLICY

Several new inter-regional cooperation arrangements have been developed: South-South, particularly with Mercosul, and other Latin-American countries; between South America and Arab and African countries, particularly with Portuguese-speaking countries. They aim at human resources' training and infrastructure building. A forum with India and South Africa is in the process of expanding its working agenda. In recent years, cooperation with China has expanded to include new areas beyond the successful joint space programme. Joint work strengthened also with developed nations, particularly Germany, France, United States, United Kingdom, Finland and Switzerland, and the European Union as a whole. Brazil now has a segmented international R&D&I cooperation policy strategy, as shown in Tables 4.1.1.a. and b. below, a synthetic overview of this policy landscape.

In terms of purpose, Brazil's international cooperation is divided into four main categories: South-South Cooperation, Regional Integration, Traditional Partners and Opportunities. These are further sub-divided into major geographic areas.

South-South Cooperation comprises cooperation programmes aimed at Asia-IBAS, China and India; and at Africa-PROAFRICA. The Regional Integration has both Multilateral programmes for the Mercosul area and South America- Mercosul, Prosul, SEGYB, Unasul, ECLA, ZOPACAS); as well as Bilateral programmes with Argentine, Cuba, Uruguay and Venezuela). The Traditional Partners category includes bilateral programmes with countries and regional unions in North America-Canada and United States; Europe-European Union, France, Germany, Portugal, Switzerland and United Kingdom; and Asia-Japan and South Korea). Finally, the Opportunities category has bilateral programmes with countries in Europe-Belgium, Russia, Spain, Sweden, The Netherlands and Ukraine). The topics /areas of most cooperation (multilateral and bilateral) are ICT (11), Nanotechnology (10), Life Sciences (8, most Biotechnology-related), and Energy (7). Europe is the region with most cooperation (excluding the new programme Science without Frontiers CsF, which is still being implemented), led by European Union (5 topics / areas) and Germany (3). There are six cooperation agreements in the Innovation area: SEGIB, Uruguay, Germany, Spain, Sweden and United Kingdom.

There is an expanding awareness in the Brazilian government about the need to improve the strategic and regulatory frameworks of international cooperation in order to make it more clearly defined, dynamic and efficient. A decree proposal being discussed in the Presidency aims to facilitate visa conditions for scientists, professors

and researchers as well as professionals involved in STI, and to simplify entry of foreign professionals involved in scientific and technological cooperation. An initial outcome of this concern was the launching in August 2011 of CsF, discussed below in 4.6.

Table 4.1.1a.: Brazil Science, Technology and Innovation International Cooperation-Multilateral Programmes

| *Programme* | *Nature / Purpose* | *Geographic Scope* | *Topics / Areas* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *S&T Policy* | *Innovation* | *CyTED* | *Energy* | *Life sciences* | *Health* | *Physical and natural sciences* | *ICT* | *Nano-technology* | *Social Sciences* | *Space* |
| *IBAS* | South-South Cooperation: Asia | Brazil, India, South Africa | | | | Alternative & renewable energy | Biotechnology | Aids; malaria; tuberculosis | Oceanography | | X | | IBAS Satellite |
| *Mercosul* | Mercosul & South America | Argentine, Brazil, Paraguay, Uruguay | | | | | Biotechnology (*Biotec Sur*) | | | Information Society (*Mercosul Digital*) | | | |
| *Prosul* | Regional Integration: Mercosul & South America | South America | | | | | | | | | | | |
| *SEGIB* | Regional Integration: Mercosul & South America | South America | | X | X | | | | | | | | |
| *Unasul* | Regional Integration: Mercosul & South America | South America | | | | | | | | | | | |
| *United Nations ECLAC* | Regional Integration: Mercosul & South America | Latin America | X | | | | | | | | | | |
| *ZOPACAS* | Regional Integration: Mercosul & South America | South America | | | | | | | | | | | |
| PROAFRICA | South-South Cooperation: Africa | Africa | | | | | | | | | | | |
| Portuguese Speaking Nations Community CPLP | South-South Cooperation: Africa | Africa | | | | | | | | | | X | |

Table 4.1.1b.: Brazil Science, Technology and Innovation International Cooperation-Bilateral Programmes

| *Regions* | *Category* | *Topics / Areas* | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Innovation* | *Bilateral (outside ENCTI)* | *Antartic* | *Energy* | *Life sciences* | *Environment* | *Health* | *Physical and natural sciences* | *ICT* | *Micro-electronics* | *Natural Resources* | *Nano-technology* | *Nuclear* | *Social sciences* | *Space* |
| *Latin America* | | | | | | | | | | | | | | | | |
| Argentine | Regional Integration | | CNPq/CONICET | X | | Biotechnology | | | High Energy Physics | X | | | X | X | | X |
| Costa Rica | Not classified | | CNPq/CONICIT | | | | | | | | | | | | | |
| Cuba | Regional Integration | | | | Biofuels | | | | | X | | | X | | | |
| Uruguay | Regional Integration | X | | | | Biotechnology | X | | | X | | | | | | |
| Venezuela | Regional Integration | | | | | Biotechnology | | | | | | | | | | |
| Mexico | Not classified | | | | | | | | | | | | X (CNPq) | | | |
| *North America* | | | | | | | | | | | | | | | | |
| Canada | Traditional Partners: North America | | | | Green technologies | X | | | | X | | | X | | | |
| United States | Traditional Partners: North America | | | | Biofuels | | | | Women in Science | IBM | | | | | | |
| *Europe* | | | | | | | | | | | | | | | | |
| Belgium | Opportunities: Europe | | CNPq/FNRS andCNPq /FWO (Call 09/2011) | | | | | | | | X | | | X | | |
| European Union | Traditional Partners: Europe | | | | Biofuels | Biotech Sur | Natural disasters (JRC) | | | X | | | | | Social technologies | |
| France | Traditional Partners: Europe | | CNPq/ANR (Call 03/2011); CNPq/CNRS-INRIA-INSERM-IRD (Call INCT-08/2011); CNPq/IRD (2012) | | | | | | | Super computer | | | X | | | |
| Germany | Traditional Partners: Europe | Fraunhofer/MCTI-CNI (Embrapii); Industrial techn(BRAGECRIM) | | | | | Innovate and OTAA | | Physiscs (LNLS /DESY) | CeBIT | | | | | | |
| Italy | Not classified | | CNPq/CNR (Call 09/2011) | | | | | | | | | | | | | |
| Portugal | Traditional Partners: Europe | | | | | | | | | Grid computing | | | | | | |
| Russia | Opportunities: Europe | | | | | | | | | | | | X | | | X |
| Slovenia | Not classified | | CNPq/MHEST (Call 09/2011) | | | | | | | | | | | | | |
| Spain | Opportunities: Europe | X | CNPq/CSIC (Call 09/2011) | | | | | | | | | | X | | | |
| Switzerland | Traditional Partners: Europe | | CNPq (Call 01/2011) | | | | | X | | | | | Nano-sciences | | | |
| Sweden | Opportunities: Europe | X | | | | | | | | | | | | | | |
| The Netherlands | Opportunities: Europe | | CNPq/Dutch Polimers Instit - Eindhoven Techical U | | | | | | | | | | Nanotech & pollymeric materials | | | |
| Ukraine | Opportunities: Europe | | | | | | | | | | | | | | | X |
| United Kingdom | Traditional Partners: Europe | Civil construction, oil & gas | CNPq/BBSRC (call 10/2011) | | | | | | | | | | | | | |
| *East Asia* | | | | | | | | | | | | | | | | |
| Japan | Traditional Partners: Asia | | | | Oil & Gas; Renewable Energy | Biotech; Biomass and Agric | Oceans | | | | | Mining and Geology | | | | Space and Satellite Data Uses |
| South Korea | Traditional Partners: Asia | | | | Bioenergy | | | | | X | (Semi-conductors) | | X | | | |
| *Southeast Asia* | | | | | | | | | | | | | | | | |
| China | South-South Cooperation: Asia | | | | | | Climate change | | | | | | X | | | China-Brazil Earth Resources Satellite CBERS |
| India | South-South Cooperation: Asia | | | | | | | Aids/Malaria | | X | | | | | | |

However, no explicit national R&D&I policy measure has had a specific eye toward strengthening the international cooperation in S&T. International cooperation in form of multilateral and bilateral agreements have grown in recent years partly due to Brazil's growing domestic market and role on key global issues as environment and renewable energy. Although increase in international S&T co-operation is not an individual priority goal of ENCTI, several programmes call for it. In order to meet one of the strategy's five challenges, 'Expansion and consolidation of Brazilian leadership in the natural knowledge economy', ENCTI calls for the encouragement of international scientific-technical cooperation and public-private partnership in niche opportunities for local manufacturing of high-tech products with intensive use of rare earth compounds. Another challenge 'Consolidation of new pattern of international insertion of Brazil' sees science and technology contributing in an important way in various aspects of the development of the country's international relations, including foreign trade, defence of national strategic interests and international cooperation, among others. Further, it argues that S&T&I is established as a decisive element in strategic partnerships between developing countries and, therefore, has contributed to the strengthening of the identity of the BRICS and IBAS. Equally important is their role in the process of deepening of Mercosul and of the Union of South American Nations (Unasul) and of support to the African countries of the Community of Portuguese Language Countries (CPLP). It also emphasises collaborations with countries of the Amazon region and with countries that maintain oceanic research programs and in Antarctica. In order to meet this challenge, ENCTI proposes actions to promote the internationalisation of Brazilian science and scientists and the strengthening of scientific and technological cooperation with other countries and regions, as well as support for the internationalisation of Brazilian companies and the acquisition of technology assets abroad, the attraction of multinational enterprise R&D centres and encouragement of technology transfer processes. Finally, international scientific cooperation is given a role in the ENCTI priority programmes for future-building sectors such as space (China CBERS-3 and -4 satellite development, launch of Cyclone-4 rocket in partnership with Ukraine and development of scientific satellite with South Africa in the framework of IBAS), biotechnology, energy and nanotechnology (for example, the Brazil-China Centre in Nanotechnology).

Thematic cooperation in strategic areas has been established with the United States and the European Union on biofuels; with Canada on renewable energy; and with China, France, the United Kingdom and Ukraine in space technology.

## 4.2 NATIONAL PARTICIPATION IN INTERGOVERNMENTAL ORGANISATIONS AND SCHEMES

Brazil participates in six intergovernmental organisations and schemes.

The Dialogue Forum Brazil-South Africa-India (*Fórum de Diálogo India-Brasil-África do Sul* IBAS) was established in 2003 and comprises three pillars: political coordination, sectorial coordination and the IBAS fund for Hunger and Poverty Alleviation[3]. One of the 16 working groups of the second pillar deals with science and technology.

[3] http://www.itamaraty.gov.br/temas/mecanismos-inter-regionais/forum-ibas.

Cooperation in the framework of the Mercosul regional integration (Argentine, Brazil, Paraguay and Uruguay) scheme takes place in the areas of Life Sciences/Biotechnology – Biotec Sur and ICT/Information Society-Mercosul Digital. The former main instrument is the Biotec Sur biotechnology platform, a spinoff of the project BIOTECH – Mercosul-UE created in November 2005, aimed at developing and promoting usage of technologies developed in the region towards the increase in value added and competitiveness of its products (http://www.biotecsur.org/). Since 2008, it links through five regional cooperative projects the private academic and public sectors of the four countries, funded by a €3m subsidy. MERCOSUR Digital project was born with the objective of reducing the legal and technological asymmetries and promote common policies and strategies in the area of the information society in the region. The project is an initiative of international cooperation between the European Union and Mercosul aimed at promoting technological training in specialised ICT resources and creating the conditions that can develop an effective e-commerce, strengthening digital economy and working for a structural symmetry between the countries. Mercosul Digital is included in the document of the regional strategy of the European Commission, which provides for cooperation with the Mercosul for the period 2007-2013, having as beneficiaries of the four full members of the common market group of the Mercosul (Common Market Group GMC): Argentina, Brazil, Paraguay and Uruguay. The Brazilian institution National Research Network (*Rede Nacional de Pesquisa* RNP), delegated by the GMC, is the project executive secretary. The programme is part of the 2007-2013 Mercosul cooperation regional strategy of the European Commission and calls for a total investment of €9.6m (the majority provided by the European Commission).

The South American programme of Support to the activities of cooperation in science and technology (*Programa Sul-Americano de Apoio às Atividades de Cooperação em Ciência e Tecnologia* Prosul) was established in August 2000, in the context of the generation of an integrated South American area in the area of science, technology and innovation. Prosul provides new resources for the region, in order to broaden cooperation among countries of South America for its scientific and technological capacity-building. It does so through mechanisms such as intensification of cooperative efforts of scientific and technological research and increase in coordination between the multilateral agencies and the cooperation projects that it will eventually support. It aims to provide the system of science and technology of South American with instrument enabling the formulation of an own regional strategy in the area. CNPq under the MCTI is responsible for the programme (http://www.cnpq.br/programasespeciais/coopint/prosul.htm).

The Ibero-American General Secretariat (*Secretaria Geral Ibero-americana* SEGIB) international organisation is the permanent body of institutional and technical support of the Ibero-American Summit, which emerges in the first Ibero-American Summit of Heads of State and Government, held in Guadalajara (Mexico, 1991), constituted by States of America and Europe of Spanish and Portuguese languages. The realisation of annual Summits and other meetings in different areas allows people of Ibero-American cooperation in political, economic, social and cultural realms. Its first programme is the Ibero-American Innovation Programme (*Programa Ibero-Americano de Inovação*), which includes Argentine, Bolivia, Brazil, El Salvador, Spain, Mexico, Nicaragua, Panama, Paraguay, Peru, Portugal and Uruguay, was launched in the 20th Ibero-American Summit of Heads of State and Government special meeting of national coordinators and cooperation (Madrid, 28-

29 October 2010) and has as objectives: increase the Ibero-American, in particular SMEs, competitiveness in a new post-crisis economic scenario and contribute to a model of economic and social appropriation of more balanced knowledge in the field of Latin American societies[4].

The Ibero-American Science and Technology for Development Programme (*Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo* CYTED), which includes Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Chile, Dominican Republic, Ecuador, El Salvador, Spain, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Portugal, Uruguay and Venezuela was approved in the V Iberoamerican Summit of Heads of State and Government (San Carlos de Bariloche, 16 and 17 October 1995). Its predecessor programme CYTED, a program created in 1984 through an international framework agreement signed by 19 countries of Latin America, Spain and Portugal, is defined as an international programme for scientific and technological cooperation multilateral, with horizontal and Iberian scope. Since 1993 the CYTED program has been organising every year and in conjunction with the signatory agency of the host country, the preparatory Scientific Conference of the Ibero-American summits of Heads of State and Government. In 1995 the programme is incorporated as a programme of cooperation of the summits. Its objectives are: to promote cooperation in the field of applied scientific research and technological development through the transfer of knowledge and the mobility of scientists and experts, and to facilitate the modernisation of production equipment and improve the quality of life of Ibero-American societies.

The Union of South American Nations (*União de Nações Sul-Americanas* Unasul) is formed by twelve South American countries. Its constitutive treaty was approved during the extraordinary meeting of Heads of State and Government in May 23, 2008 and after ratification by ten countries (Argentina, Brazil, Bolivia, Chile, Ecuador, Guyana, Peru, Suriname, Uruguay and Venezuela) the Treaty entered into force on March 11, 2011. Unasul aims to build participatory and consensual manner, a joint space within cultural, social, economic and political among his people. Unasul has today eight Ministerial Councils, including one for education, culture, science, technology and innovation[5].

Brazil has equally stepped up its participation in international forums: the UNESCO Commission on S&T; Third World Academy of Sciences TWAS, World Science Forum of UNCTAD, Economic Commission for Latin America; and OECD Science and Technology Policy Committee, in which Brazil was admitted as observing member in 2007.

## 4.3 COOPERATION WITH THE EU

### 4.3.1 Participation in EU Framework Programmes

In FP7, there were 1,142 Brazilian proposals of which 277 were main listed (24%) for a total budget of €555m. The largest demands was in the funding scheme category 'Collaborative project' (659), about three times larger than each of the next two: 'Support for training and career development of researchers (Marie Curie)' (229) and 'Coordination and support action' (207). The lowest were for 'CIP-Thematic Network'

[4]http://segib.org/programas/2010/12/20/programa-ibero-americano-de-inovacao/?lang=pt-pt.
[5]http://www.unasursg.org/.

(1) and 'Network of Excellence' (2). The category with the highest success rates were ' Combination of Collaborative Project & Coordination and support action' (55%), followed by 'Support for training and career development of researchers (Marie Curie)' (40%) and 'Coordination and support action'(25%). Three categories did not have any project funded: 'CIP-Thematic Network,' 'Network of Excellence,' and 'Support for frontier research (ERC).' The categories withy the largest share of funded projects were 'Collaborative project' (42%), 'Support for training and career development of researchers (Marie Curie)' (36%) and 'Coordination and support action' (19%). The FP7 programmes with the highest share of demand were: PEOPLE (229), ICT (165), SSH (133) and ENV (128); and those (identified) with the lowest: REGIONS and GA (1 each), SME (7) and SEC (8). Those with the highest success rates were PEOPLE (49%); IFRA and TPT (40%), and KBBE (35%). The programmes with the largest number of projects main listed were: PEOPLE (100) and KBBE (46).

B.Bice is a project oriented to the enhancement of the international cooperation activities in science, technology and innovation between Brazil and the European Union (EU). It aims to improve the Brazilian participation in the EU's 7th Framework Programme. Its mission is to disseminate information, to identify financial support mechanisms and to assist in the search of Brazilian and European partners for setting up project proposals. In March 2011, B.Bice launched a project to map the scientific and technological competencies of Brazilian universities (*Mapa da Competência Nacional em P&D*) in order to support the goal of increasing Brazilian participation in the Framework Programme.

### 4.3.2 Bi- and multilateral agreements with EU countries

In 2011 and up to mid-2012, Brazil has evolved and strengthened multiple bilateral cooperation agreements in STI with EU countries. Over the period, there were 9 CNPq public calls under bilateral agreements with seven EU countries (3 with different French groups of agencies (1-ANR;2-CNRS/INRIA/IRD/INSERM and 3-, including a joint tripartite one with IRD and a pan African cooperation agency APGMV; and one each with Belgium, Italy, Slovenia, Spain, Switzerland and the United Kingdom).

Current CNPq international bilateral cooperation comprises 42 joint projects with 24 countries, among those several EU countries. They comprise, for example, bioenergy with Finland, biofuels with the European Union; and several projects with France's International Associated Laboratories (i.e., CNRS: engineering, materials, nanotechnology, and chemistry; with INSERM: biomedical and health sciences).

Brazil and Germany cooperation is based on a 1969 general agreement which established as priority areas environmental research and technology, materials research, information and communication technologies, marine research, biotechnology, geological sciences and space research. In 2000 genomics and nanotechnology were added. Nowadays, MCTI and its agencies provide €14m (R$ 20m) in funds for these cooperation programmes, the majority for the Amazon High Tower Observatory (*Observatório da Torre Alta da Amazônia* OTAA). Other Brazilian thematic research projects with Germany participation are in manufacturing technology (BRAGECRIM), marine sciences and water resource mitigation in the North-east (Bramar), support for the mobility of researchers by means of joint calls CNPq and German agencies, and grants for PhD scholarships in Germany under an agreement with the CNPq and CAPES (DAAD/ CAPES/CNPq), among others.

Further, among Brazil's several multilateral STI cooperation programmes there are a few with the involvement of EU countries: CERN Switzerland; European Union and Pierre Auger Observatory (Argentina); and thematic programmes on Atlantic Forest (Germany) and Marine Sciences.

## 4.4 COOPERATION WITH NON EU COUNTRIES OR REGIONS

### 4.4.1 Main Countries

CNPq maintains collaborative research mobility programmes with the United States (Bilateral Call nº 15/2009, CNPq/National Science Foundation) in several natural sciences, life sciences and engineering and Argentina (Call nº 10/2008 with 12 projects approved in nanotechnology, engineering and health).

Between 2006 and 2010, in the framework of the Biotechnology Competitiveness Programme, the Brazil-Argentina Biotechnology Centre (CBAB) funded 133 courses for 1,730 Brazilian, Argentinean and other Latin-American students and 29 joint projects with Brazilian and Argentinean research institutions.

### 4.4.2 Main instruments

The main instruments are scholarships and fellowships, as well as travel grants for short research stays in the development of joint research projects.

## 4.5 OPENING UP OF NATIONAL R&D PROGRAMMES

Current national programmes are not open for third country researchers. However, there is a noticeable increase in the number of calls on national thematic network-based research programmes which either require or strongly encourage the participation of third country researchers.

## 4.6 RESEARCHER MOBILITY

### 4.6.1 Mobility schemes for researchers from abroad

The main comprehensive national mobility scheme for researchers from abroad is the Science without Frontiers programme (CsF). Launched in August 2011, it has the overall objective of promoting accelerated technological development and stimulates the innovation processes in Brazil by training Brazilian students and researchers, especially in the postgraduate levels, in areas deemed strategic and priority to the development of the country. In addition, it has a research mobility component aimed at promoting technical and scientific cooperation between Brazilian researchers and researchers with internationally recognised scientific leadership through bilateral programmes; and a sub-programme within CsF for promoting recurrent short-term research stays in Brazil, either in the form of visiting researchers or permanent researchers (the latter centred mainly on returning Brazilian researchers living abroad) and for identifying foreign centres and leaderships of priority or strategic interest to Brazil, in selected sectors and areas for establishing cooperation and training.

In December 2011, this CsF component had a first public call 'Attraction of Young Talent' (*Chamada de Projetos MEC/MCTI/Capes/CNPq/Faps Nº 60/2011*) of €48.9m (R$149m), to be implemented between April 2012 and March 2013 in three rounds. It will fund 440 fellowships (and research stipend besides travel costs) up to

three years for young talent from abroad to carry out research in Brazil, preferably Brazilians residing abroad. Individual FAPs can complement these resources. Next, this component had a second call 'Special Visiting Researcher PVE' also in December (*Chamada de Projetos MEC/MCTI/Capes/CNPq/Faps Nº 61/2011*) of about €43m (R$111m), to be implemented between April 2012 and March 2013 in three rounds. The visiting researcher has to carry out research in Brazil for 2-3 months per year during 2-3 years tenure and receives a scholarship of about €5.5 thousand/month, an annual research stipend of about €20 thousand. In addition, the researcher can request scholarships for one-year doctorate (the so-called 'sandwich doctorate' scholarship) and for a post-doctoral researcher to work in his/her laboratory of origin.

The CNPq-Third World Academy of Sciences (TWAS) Fellowships Programme allows scientists from other developing countries to study or to do research in natural sciences in Brazil and then to return home to continue their careers. The March 2011 public call awarded 38 Full-Time Postgraduate/Sandwich Postgraduate Fellowships and 6 postdoctoral fellowships. Next, the Postgraduate Agreements programme (*Convênio de Pós-Graduação* PEC-PG), administered by MCTI-CNPq/MEC-CAPES/Ministry of Foreign Relations (MRE), enables citizens from developing countries (60 with which Brazil has an educational, cultural or S&T agreement) to pursue postgraduate studies, at masters and doctoral level, in higher education institution, in view of providing the training required for the students to contribute to the development of their country of origin. Its 2011 edition May call awarded 76 fellowships. Finally, as an example of thematic calls which often have a mobility component, the April 2011 call the physics scholarship programme for Latin American students of CNPq/Latin American Physics Centre (CLAF) awarded 17 doctoral and postdoctoral scholarships.

### 4.6.2 Mobility schemes for national researches

Several individual national bilateral and multilateral and thematic programmes, as well as regional ones administered by FAPs have research mobility components for national researchers.

In the framework of CsF, by the end of 2011, 3,700 scholarships for undergraduate and postgraduate (full time and one year tenure, as well as postdoctoral) study abroad had been awarded and by April 2012, 10,300 were made and by June yet another 6,000. The cumulative goal for the end of 2012 is 20,000 student awards. In the first half of 2012, several firms awarded research fellowships and scholarships in their laboratories or affiliated universities: GlaxoSmithKline (GSK) Trust in Science project (sandwich postdoctoral scholarship and postdoctoral research fellowship) in its laboratories in the United Kingdom, United States and Spain; Varian Medical System (unspecified agreement); Natura, a Brazilian cosmetics and beauty-products multinational (100 unspecified scholarships); Hyundai Motor Company, South Korea (unspecified agreement); and SAAB AB, Sweden (100 scholarships) with partner Swedish and other foreign universities and research labs.

# 5 CONCLUSIONS

Brazil's R&D&I institutional framework and political environment underwent significant changes from mid-2011 to mid-2012. On the institutional side, first, in

August 2011, the ministry of science and technology added innovation to its name becoming the Ministry of Science, Technology and Innovation. Next, at about the same time, the Federal Government launched an ambitious policy for researcher training and mobility, which represented a major shift in the country's international cooperation strategy for the area so far, the Science without Frontiers (CsF) programme. It also signalled the government's efforts to rationalise and streamline the institutional policy framework, as responsibilities for implementation are shared by the two main grants funding agencies from different ministries: MCTI-CNPq and MEC-Capes. Finally, at the end of December 2011, MCTI issued a national strategy for the area for 2011-2014. On the political side, in August President Dilma Roussef issued a new industrial policy blueprint, the Great Brazil plan, which firmly put innovation as a goal for the country's social and economic development. Next, in January 2012, the MCTI minister Aloizio Mercadante moved to become minister of MEC and, Marco Antonio Raupp, then a director of Brazil's space agency AEB (as well as former director of two other MCTI research institutes LNCC -scientific computing- and INPE-space research) under MCTI, become the new minister of MCTI. The economic crisis finally caught up with the area in spite of its new political strength and stature. MCTI and sectorial fund-financed FNDCT suffered significant budget cuts for 2012.

Research, development and innovation experienced different evolutionary trajectories during this period. Research support – in particular infrastructure development and researcher training and mobility – received significant support, mainly through the PROINFRA and CsF programmes. The horizontal policy mechanism Sibratec, a technological development oriented programme based on locally-based research competence networks was reinforced with the launch of the decentralised industrial research state company Embrapii. Embrapii is patterned after the German Fraunhofer model but makes use of existing research institutes, federal and state. Technological development was also focused and strengthened on strategic great project areas such as pre-salt oil and gas exploration, health complex, defence complex, microelectronics and renewable energy among others. Innovation financing resources expanded, as MDIC-BNDES continued to increase the number and the resource volume of its business innovation financing programmes and MCTI-Finep increased significantly the volume of its innovation financing, through creative financial sourcing, to the detriment of its flagship economic subsidy for corporate innovation grants programme, which did not have a new public call since late 2010. SME and start-up innovation grant funding and loan financing were also put on a standstill during the period.

FINEP's presidency itself recently called attention in a news article to the fact that Brazil fell 37 positions in the Global Innovation Index (Arbix et alli, 2012). It states that although Brazil has good instruments and mechanisms, innovation financing (in light of the fact that FINEP demand is growing almost exponentially) and the volume and quality of investment are still lacking. Next, it points out that although there are over 800 firms with own R&D departments and full-time researchers with master and doctoral degrees, 90% of the funding comes from their own resources. The challenges ahead, the article concludes, are to increase R&D&I investments 5X faster than the GDP in order to reach a GERD of 1.80% of GDP by 2015, which will in turn require additional investments by public and private sector of the order of €222.2b (R$26b), each.

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# 7 List of Abbreviations

| | |
|---|---|
| ABDI | Brazilian Industrial Development Agency (*Agência Brasileira para o Desenvolvimento Industrial*) |
| ACS | Alcântara Cyclone Space Brazil - Ukraine Bi-national Corporation |
| AEB | Brazilian Space Agency (MCTI) |
| ANEEL | National Electric Energy Regulatory Agency |
| AEB | Brazilian Space Agency (MCT) |
| ANEEL | National Electric Energy Regulatory Agency |
| B.Bice | Brazilian Bureau for Enhancing the International Cooperation with the European Union" |
| BASis | National Higher Education Evaluation System Database (INEP/MEC) |
| BNDES | National Bank for Economic and Social Development (MDIC) |
| BRICs | Group of large, fast growth, middle income countries: Brazil, Russia, India, and China |
| CAPES | Foundation for Support of Higher Education (MEC) |
| CEA | Alcântara Space Centre (MCTI) |
| CEPEL | Electric Energy Research Centre (MME) |
| CIDE | Contribution for Intervention in the Economic Domain |
| CLAF | Latin American Physics Centre |
| CNEN | National Nuclear Energy Commission (MCTI) |
| CNI | National Industrial Confederation (*Confederação Nacional da Indústria*) |
| CONAES | Commission of Higher Education Evaluation (INEP/MEC) |
| CNPq | National Council for Scientific and Technological Development |
| CONSECTI | *Conselho Nacional de Secretários Estaduais para Assuntos de C,T&I* |
| CONFAP | *Conselho Nacional das Fundações de Amparo à Pesquisa* |
| CPLP | Community of Portuguese Language Countries |
| CsF | Science without Frontiers (*Ciência sem Fronteiras*) |
| CT-Infra | Infra-structure sectorial fund |
| CYTED | Ibero-American Science and Technology for Development Programme (*Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo*) |
| EMBRAPA | Brazilian Enterprise of Agricultural and Husbandry Research (MAPA) |
| EMBRAPII | Brazilian Industrial Research and Innovation (*Empresa Brasileira de Pesquisa e Inovação Industrial*) |
| ENCTI | National Strategy for Science, Technology and Innovation, 2012-2015 |
| ERP Fund | European Recovery Programme Fund |
| FAPs | State Research Support foundations |
| FAPESP | São Paulo state Research Support Foundation |
| FINEP | Studies and Projects Financing Agency (MCTI) |
| FIOCRUZ | Oswaldo Cruz Foundation (MS) |
| FNDCT | National Fund for Science and Technology Development |
| FP | European Framework Programme for Research and Technology Development |
| FSA | Audio-visual sectorial fund |
| FUNTTEL | Fund for the technological development of telecommunications |

| | |
|---|---|
| GDP | Gross Development Product |
| HEI | Higher education institutions |
| HES | Higher education sector |
| IBAS | Dialogue Forum Brazil-South Africa-India (*Fórum de Diálogo India-Brasil-África do Sul*) |
| IBGE | Brazil Geographic and Statistical Institute (*Instituto Brasileiro de Geografia e Estatística*) |
| IES | Higher Education Institutions |
| INCT | National Science and Technology Institutes |
| INEP | National Institute of Pedagogical Studies Anísio Teixeira (MEC) |
| INPI | Brazilian intellectual property office (*Instituto Nacional de Propriedade Industrial*) |
| IPI | Industrialized products tax |
| LOA | Congressional Annual Budget Proposal law (*Lei de Orçamento Anual*) |
| MAPA | Ministry of Agriculture, Husbandry and Supply |
| MCTI | Ministry of Science, Technology, and Innovation |
| MD | Ministry of Defence |
| MDIC | Ministry of Development, Industry and Foreign Trade |
| Mercosul | Southern Common Market (*Mercado Comum do Sul*): Argentine, Brazil, Paraguay and Uruguay |
| MME | Ministry of Mining and Energy |
| MEC | Ministry of Education |
| MINICOM | Ministry of Communications |
| MPOG | Ministry of Planning, Budget and Management |
| MS | Ministry of Health |
| OEPA | State Organisation for Agricultural Research |
| OTAA | Amazon High Tower Observatory (*Observatório da Torre Alta da Amazônia*) |
| PAC | Programme of Growth Acceleration |
| PACTI | Action Plan in Science, Technology and Innovation for National Development , 2008-2010 |
| PAPPE | Programme for Support of Research in Enterprises |
| PDA | Plano de Desenvolvimento da Agropecuária |
| PDE | Plano de Desenvolvimento da Educação |
| PDP | Productive Development Policy |
| PRIME | First Innovative Firm Programme (FINEP) |
| PROs | Public Research Organisation |
| Proinfra | S&T Institutes Modernization programme (CT-Infra) |
| Pronatec | Programa Nacional de Acesso ao Ensino Técnico e ao Emprego |
| Prosul | South American programme of Support to the activities of cooperation in science and technology (*Programa Sul-Americano de Apoio às Atividades de Cooperação em Ciência e Tecnologia*) |
| R&D | Research and Development |
| R&D&I | Research, Development, and Innovation |
| RHAE | Strategic Activities Human Resources Training (CNPq) |
| RNP | National Research Network / Rede Nacional de Pesquisa |
| S&T | Science and technology |
| SEGIB | The Ibero-American General Secretariat (*Secretaria Geral Ibero-americana*) |
| SIBRATEC | Brazilian System of Technology |
| SINAES | National Higher Education Evaluation System (INEP) |

| | |
|---|---|
| SNPG | National Graduate Education programme (CAPES) |
| SNCTI | National Science, Technology and Innovation System |
| SNPG | National Graduate Education Programme (CAPES) |
| STI | Science, Technology and Innovation |
| TTO | Technology transfer office |
| UNICAMP | State University of Campinas (São Paulo) |
| UFRJ | Federal University of Rio de Janeiro |
| Unasul | South American Nations Union (*União de Nações Sul-Americanas*) |
| USP | University of São Paulo |
| USPTO | United States Patent and Trademark Office |