European Commission

JRC SCIENCE FOR POLICY REPORT

RIO COUNTRY REPORT 2015: BRAZIL

Laura Maragna

2016

EUR 28337 EN

Joint Research Centre

Contact information
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

JRC Science Hub
https://ec.europa.eu/jrc

JRC104963

EUR 28337 EN

PDF ISBN 978-92-79-64590-7 ISSN 1831-9424 doi:10.2791/680135

How to cite: Laura Margna; RIO Country Report 2015: Brazil; EUR 28337 EN;
doi:10.2791/680135

Abstract
RIO R&I International Country Reports analyse and assess the research and innovation system, including the main challenges, framework conditions, regional R&I systems, and international co-operation.

Table of Contents

Foreword

The report offers an analysis of the R&I system in Brazil for 2015, including relevant policies and funding. The report identifies the main challenges of the Brazilian research and innovation system and assesses the policy response. It was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc.

Acknowledgments

The report has benefited from comments and suggestions of Jana Zifciakova and Liliana Pasecinic from DG JRC, European Commission.

The comments and suggestions of Paulo Egler (Brazilian Institute for Information in Science and Technology – IBICT), Antônio Galvão, Cristiano Cagnin and Antônio Oliveira (Centre of Strategic Studies and Management – CGEE) and of colleagues from the Division of Science and Technology of the Ministry of Foreign Affairs of Brazil (DCTEC/MRE) are also greatly acknowledged.

Author's affiliation:

Laura Maragna, Local Agent, Delegation of the European Union to Brazil, Brasilia, Brazil

Executive summary

The political and economic crisis in Brazil intensified in 2015 and the President Rousseff was impeached. However, the legitimacy of the impeachment process has been questioned which led to a high level of uncertainty. The International Monetary Fund (IMF) forecasted a recession of 3.5% in 2016 with a recovery predicted only for 2018. Besides, the unemployment rate has been going up, inflation rose up to 10,84% (well above the inflation target range of 2,5%-6,5%), consumer confidence is at its worst since 2005 and the currency has weakened significantly against the dollar. The adoption of the needed fiscal adjustment measures by the Congress has proven to be a very difficult exercise, including a Wellfare Reform.

From 2012 to 2016, four Science, Technology and Innovation Ministers were nominated as a reflection of the political instability. Additionally, on May 2016 the merger between the Ministry of Science, Technology and Innovation and the Ministry of Communications was announced, as part of the strategy to streamline the public administration, reducing the number of ministries from 32 to 23.

Between 2014 and 2015, the budget for the Ministry of Science and Technology was reduced by 25%. A subsequent adjustment at the end of May 2015 annouced a total cut of the ministry's budget of 37%. The ministry's portfolio count on approximately € 1.17 billion, and the National Fund for Scientific and Technological Development (FNDCT), the main tool to support research and development in Brazil was also adjusted significantly.

Nevertheless, in recent years, there were some significant advances in the R&I policy, which contributed to the institutional strengthening of the R&I System. Among them, the number and the qualification of human resources improved and the R&D infrastructure expanded with further decentralisation and reduction of regional asymmetries. Thus, actions aimed at establishing guidelines for a "national strategic framework" on the territorial dimension of the challenges and structural axes of the National Strategy for Science, Technology and Innovation are currently taking place in the country.

Brazil has clear national competitive advantages when it comes to social and biodiversity aspects and its potential for the production of commodities. The country is at the scientific and technological forefront in research and agricultural production in tropical regions as well as in the control, prevention and treatment of tropical and neglected diseases. In addition, the country has relative technological expertise in the aeronautical sector, oil and gas, and nuclear. It has bilateral agreements with several countries and multilateral agreements with numerous regions and international organizations that have contributed to improve the areas of expertise and develop other capabilities.

However, the country still has quite unsatisfactory indicators for innovation as shown in the Global Innovation Index 2015[1], despite the increase of the number of research and innovation driven programmes and funding instruments, as well as an improvement in the regulatory frameworks.

The productivity rates in Brazil are closely linked to technology and innovation, but also to a combination of systemic conditions which need improvement as infrastructure, education and the business environment. Over the last fifteen years, innovation policies have made a more significant contribution and designed a more favourable regulatory institutional framework to the innovative performance of Brazilian companies, but performance measurement has to be futher developed.

[1] https://www.globalinnovationindex.org/content/page/gii-full-report-2015/#pdfopener

R&I Fact sheet
Brazil

Table 1 - General Data

Indicator	Brazil	EU-28
Number of inhabitants (Million)	206.1 (2014)	*506.6*
GDP MEUR	2 103 900	*13 068 600*
GDP per head (index, EU28 = 100 EUR per capita)	15 590	*100* *26 600*
Real GDP growth rate (%)	0.1%	*0.1%*
Agriculture weight in the economy (%)	5.6 %	*1.7%* *5.1%*
Industry & construction weight in the economy (%)	23.4%	*24.8% (15.1%)* *22.4% (14.3%)*
Services weight in the economy (%)	71.0%	*73.6%* *72.4%*
Employment rate, aged 20-64 (% of population)	65.6%	*68.4%*
Unemployment rate (% of the active population)	7.6%	*10.9%*
Early leavers from education and training (% of population aged 18-24)	44.9%	*11.9%*
	Target 2020:	*Target 2020:10%*
Tertiary educational attainment (% of population aged 30-34)	16.32%	*37.1%*
	Target 2020:	*Target 2020: 40%*
Total government expenditure (MEUR % of GDP)		*6 412 328*
		49.1%
General government gross debt (% of GDP)	66.23%	*87.1%*
General government deficit (% of GDP)		*-3.3%*
Human Development Index (HDI), Source: UNDP	0.755 *(75th)*	*EU max (NL): 0.915* *EU min (BG): 0.777*
PISA Ranking, Source: OECD, 2013 (reading; mathematics; science)	410-391-405	--

Source: Eurostat data 2013 unless otherwise indicated

Table 2 - Institutional Structure of the Research and Innovation System

MINISTRIES RESPONSIBLE	Ministry of Science, Technology, Innovations and Communications (MCTIC) - www.mcti.gov.br
NAME OF THE MINISTER	**Gilberto Kassab** Minister for Science Technology and Innovations and Communications
FUNDING AGENCIES	Studies and Projects Financing Agency (FINEP) - www.finep.gov.br
	National Research Council (CNPq) – www.cnpq.br

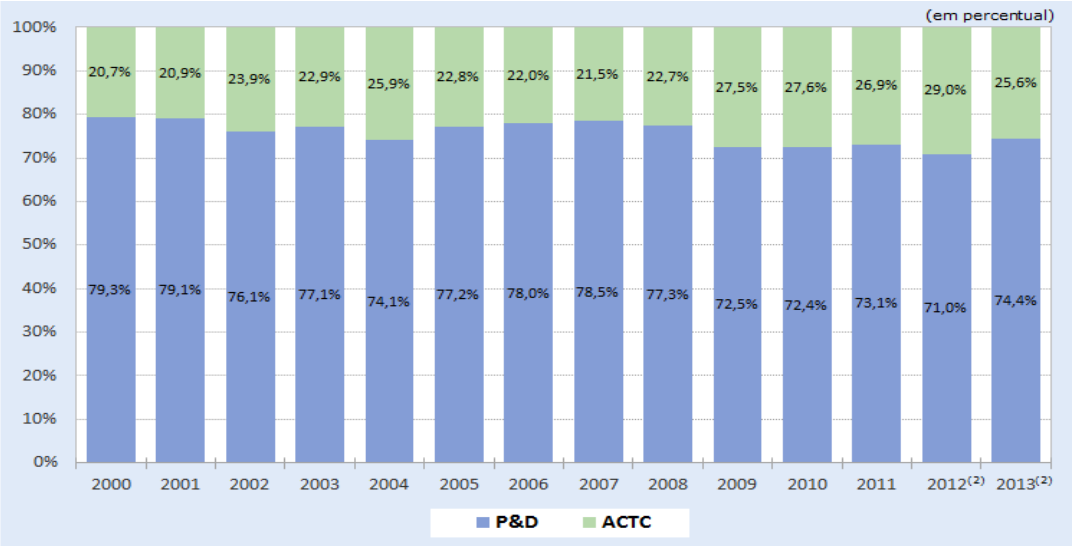
Investment & HR & Innovation

Gross domestic R&D expenditure (GERD)	€ 24,472.65 million; 1.66% of GDP;[2] TARGET 2020: 2.0%

Source: MCTI 2015

In Brazil there are two different cathegories of expenditures in Science and Technology. The first is the Scientific and Technical Related Activities (ACTC), which are activities related to research and development and contribute to the generation, dissemination and application of scientific and technical knowledge. Cover scientific and technological services are provided by libraries, archives, science museums, botanical gardens, zoos, surveying, geology, hydrology, prospecting and related activities. Research and Development (R&D) comprises creative work undertaken systematically, in order to increase the stock of knowledge of the institution or company, and to use this knowledge to create new applications. The R&D activity includes basic research, applied research and experimental development.

Figure 1 – Percentage of R&D and ACTC in the overall ST&I public expenditures



Source: Coordenação-Geral de Indicadores (CGIN) – Ministério da Ciência, Tecnologia e Inovação (MCTI, 2015)

[2] http://www.mct.gov.br/upd_blob/0237/237254.pdf

Table 3 - Sources of Funding and Expenditure in S&T

(million €)

		Research and Development (P&D)			Scientific and Technical Related Activities (ACTC)	
Year	TOTAL (P&D) and (ACTC)	TOTAL	Implemented budget	HEIs	Total	Implemented budget
2010	17,778.11	12,877,95	9,617,89	3,260,06	4,900,15	4,900,15
2011	19,484.	14,250,24	10,280,43	3,969,81	5,234,39	5,234,39
2012[(2)]	21,847.51	14,250,24	11,013,60	4,487,70	6,346,19	6,346,19
2013[(3)]	24,472.65	18,213,88	12,899,70	5,314,17	6,258,76	6,258,76

Notes: 1) Science and Technology (S&T) = Research and development (R&D) + Scientific and Technical Related Activities (ACTC); 2) considered graduate of spending as a proxy of expenditure on R&D in higher education institutions (HEIs); 3) preliminary data. Updated on: 26/10/2015

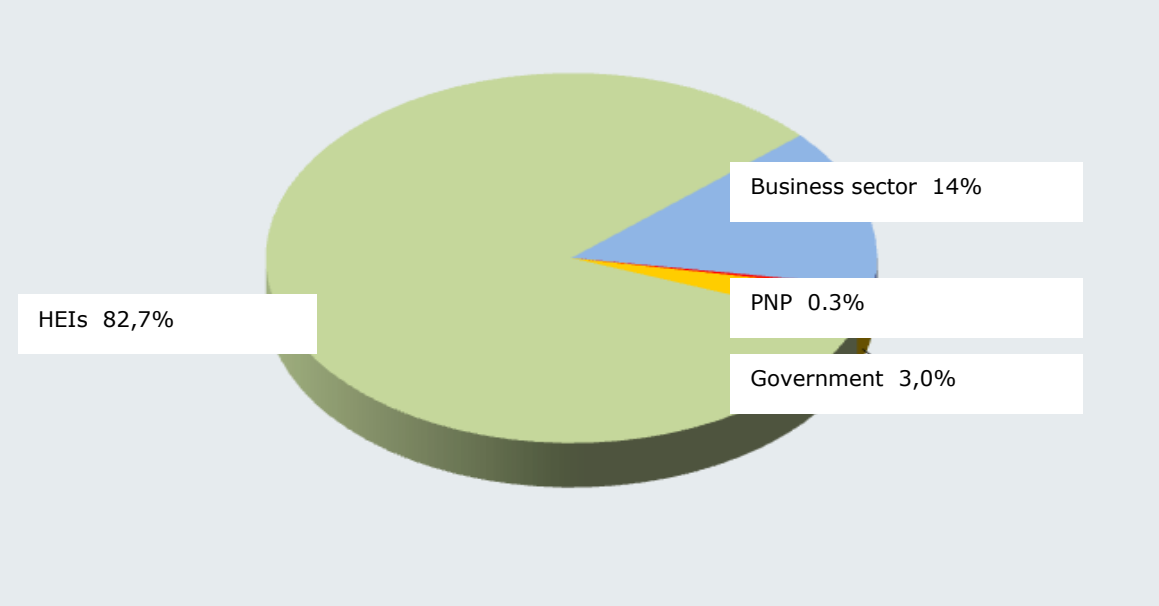
Sectors	**% of GDP**			
	2010	**2011**	**2012**	**2013**
Total	1,60	1,56	1,62	1,66
Public expenditure	0,84	0,81	0,85	0,93
Federal Expenditure	0,58	0,54	0,56	0,64
Brazilian State's Expenditure	0,26	0,27	0,29	0,29
Private Sector Expenditure	0,76	0,75	0,77	0,73

From the above data we can see that there was a slight increase in the expenditure of the public sector as percentage of GDP in S&T activities (P&D + ACTC) over the period 2010-2013. However, there was also a slight decrese in the private sector expenditure.

The public sector also plays a key role regarding the number of researches involved in P&D, since most of the Higher Education Institutios (HEIs) receive funding from the public sector.

It can be also perceived that the majority of ST&I performance indicators improved from 2000 to 2013. But as presented in the figure related to patent application, the evolution from 2013 is a reflection of the political and economic crisis that has downgraded most of the indicators in the country, e.g., unemployment rate, GDP growth, rising inflation etc. Therefore, in the "Patent applications at the Brazilian Institute of Industrial Property (INPI)" figure there is a clear decline in the number of applications from 2013 to 2015.

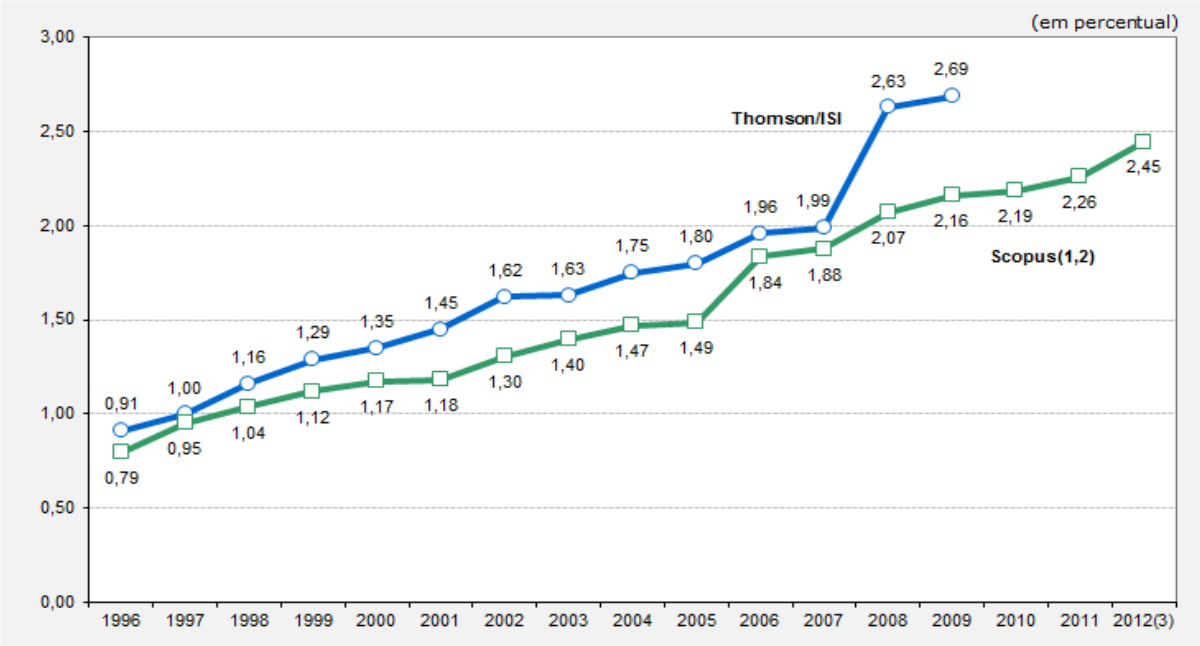
Figure 2 - Human Resources – researchers involved in P&D per institutional sector 2010:



Source: Coordenação-Geral de Indicadores (CGIN) - ASCAV/SEXEC - Ministério da Ciência, Tecnologia e Inovação (MCTI).

The figure above shows that 82,7% of researchers involved in R&D activities are based at Higher Education institutions (HEIs), while only 14,0% are based on the provate sector. [3]

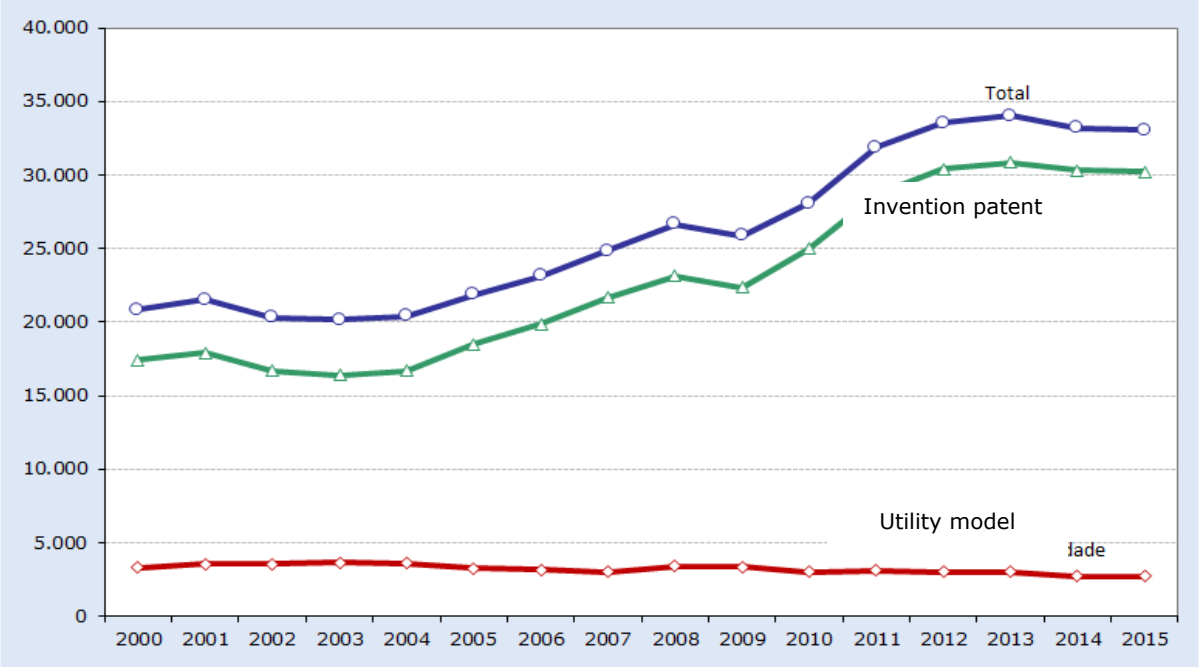
Figure 3 – Percentage of Brazilian articles published in indexed scientific journals by Thomson/ISI and Scorpus in comparison to the world (1996-2012)



Source: Coordenação-Geral de Indicadores (CGIN) - ASCAV/SEXEC - Ministério da Ciência, Tecnologia e Inovação (MCTI).

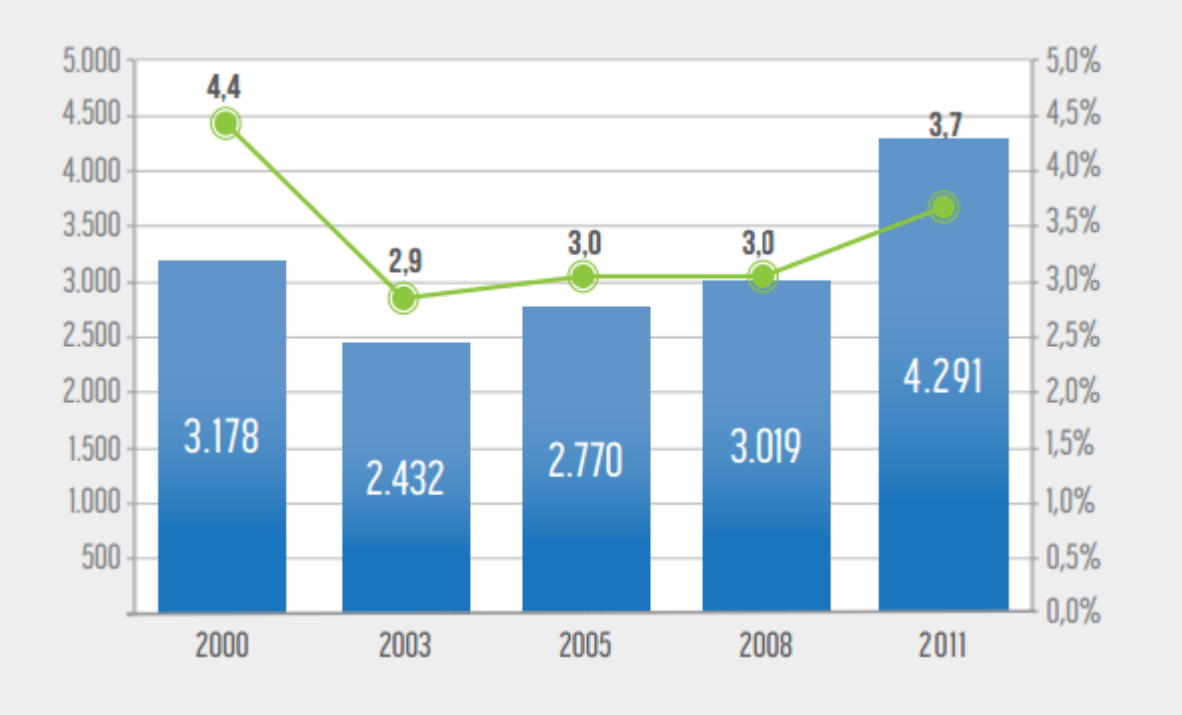
3 http://www.mct.gov.br/index.php/content/view/5859/Brasil_Percentual_de_pessoas_envolvidas_em_pesquisa_e_desenvolvimento_P_D_por_setor_institucional_2010.html

Figure 4 – Patent applications at the Brazilian Institute of Industrial Property (INPI)



Source: Coordenação-Geral de Indicadores (CGIN) - ASCAV/SEXEC - Ministério da Ciência, Tecnologia e Inovação (MCTI).

Figure 5 – Pecentage of industrial companies with continuous P&D performance



Source: Coordenação-Geral de Indicadores (CGIN) - ASCAV/SEXEC - Ministério da Ciência, Tecnologia e Inovação (MCTI).

1. Overview of the R&I system

1.1 Introduction

Brazil is Latin America's largest country with an area of 8.5 million km², which represents almost twice the size of the European Union. Brazil's 2015 (July est.) population was 204.2 million and its GDP in 2014 was € 2.078 trillion, the world's seventh largest according to the World Bank. At 47.3% Brazil's BERD/GERD is as the highest in Latin America, but is much lower than those of China (71.7% in 2009) and South Korea (72.9% 2008).

Brazil's innovation policy has moved from focusing mainly on the science base to a stronger support for business R&D (OECD, 2012). Several changes in the legal framework allow for an increase in incentives. For instance, The Greater Brazil Plan 2011-14, adopted in 2011, gives innovation a central role and includes proposals for significant changes. Moreover, the new National Strategy in Science, Technology and Innovation (ENCTI 2016-2019) was presented in May 2016. Brazil's STI policy governance has not recently undergone major changes despite the recent merger with the Ministry of Communications. Nevertheless, several measures aim to improve co-ordination between institutions at the federal level and between federal and state bodies.

Concerning the main indicators released by the Brazilian Ministry of Science, Technology and Innovation, whereas R&D intensity (GERD/GDP) was 1.24% (up from 1.15 % in the previous year). The main sources of investment in science and technology in Brazil are in R&D activities. In 2013, we invested € 15 billion. The federal and state governments are the main investors (57.7%)[4]. To encourage the private sector to invest in scientific and technological activities, the tax waiver from the federal government in 2013 was €1.5 billion.[5]

Table 4 - Main R&I indicators 2012-2014[6]

Indicator	2012	2013	2014	EU average
GDP per capita	EUR 5.565,36	EUR 6.035,9	EUR 6.406,22	27,300 EUR
GDP growth rate	0.9%	2.5%	0.1%	1.3%
Budget deficit as % of public budget	47,19%	42%	45,11%[7]	86.8
Government debt as % of GDP	58,8%	56,8%	58,91%[8]	-2.9

[4] http://www.mcti.gov.br/noticia/-/asset_publisher/epbV0pr6eIS0/content/aumenta-o-investimento-em-c-t-no-brasil;jsessionid=07736D8647F9CD2FDEF18BEBDB17D849

[5] Investment in STI in Brazil is the sum of the Technical and Scientific Related Activities (ACTC) and research and development (R&D). The ACTC are actions that contribute to the generation, dissemination and application of scientific knowledge, such as scientific and technological services provided by libraries, science museums, botanical gardens, zoos, among others. As for the research and development activities include basic and applied research and experimental development, that is the creative effort to raise awareness of the institution or company and create new applications.

6 http://www.ibge.gov.br/home/estatistica/pesquisas/indicadores.php

7 http://brasilemsintese.ibge.gov.br/contas-nacionais/pib-per-capita.html

8 http://pt.tradingeconomics.com/brazil/government-debt-to-gdp

Unemployment rate as percentage of the labour force	5,5%	4,3%	4,8%	10.2
GERD in €m	21,847.51	24,472.65[9]	N/A	N/A
GERD as % of[10] the GDP	1,15%	1,24%		N/A
GERD (EUR per capita)	N/A	N/A	N/A	
Employment in high- and medium-high-technology manufacturing sectors as share of total employment	N/A	N/A	N/A	5.6 (2013)
Employment in knowledge-intensive service sectors as share of total employment	N/A	N/A	N/A	39.2 (2013)
Turnover from innovation as % of total turnover	N/A	N/A	N/A	11.9 (2012)
Value added of manufacturing as share of total value added	N/A	N/A	N/A	N/A
Value added of high tech manufacturing as share of total value added	N/A	N/A	N/A	N/A

The Ministry of Science and Technology data shows that Brazil increased from 1.34% of Gross Domestic Product (GDP) in investment in science and technology (S&T) in 2002 to 1.66% of GDP in 2013 (more recent statistics available)[11]. In addition, IMD World Competitiveness Centre research with 60 countries shows that Brazil still occupies the 33rd position in expenditure on R&D. Besides, researchers point out that the country also needs to have a macroeconomic and most appropriate business environment, since most of the spending on science and technology in the country is still done by the public sector.

Brazil's innovation policy has moved from focusing mainly on the science base to stronger support for business R&D. Several changes in the legal framework allow for a stimulus: the Innovation Law (2004) permits direct funding of business through competitive grants. Additionally, The Goodwill Law (2005) introduced a wide range of fiscal incentives. Besides, the new Legal Framework for STI, approved in December 2015, includes proposals for further legal changes, such as the funding of private non-profit institutes and new fiscal incentives for investors.

9 http://www.mcti.gov.br/inicio?p_p_state=maximized&p_p_mode=view&saveLastPath=0&_58_struts_action=%2Flogin%2Flogin&p_p_id=58&p_p_lifecycle=0&_58_redirect=%2Frecursos-aplicados
10 http://www.mcti.gov.br/indicadores
11 http://www.mcti.gov.br/indicadores

Key recent developments include the merger of the Ministry of Science, Technology and Innovation with Communications now stading as MCTIC

The scientific community was at first sceptical with the merger. They argue that the two Minsitries had very different missions and agendas and expressed their concerns about the importance addressed to the Science, Technology and Innovation in the country. The positive aspect indicated by the scientific community is that according to the profile of the new Science, Technology, Innovation and Communications Minister, Gilberto Kassab, he will contribute to promote the dialogue between the scientific community with the business community.

1.2 National R&I strategy

The National STI Strategy is a milestone for the intertemporal coordination of sectoral and cross-cutting public policies and private sector initiatives related to scientific and technological development of the country. It continues and expands the efforts, proposing to progress on other equally important dimensions of the transformation process in Brazil.

The Ministry of Science, Technology and Innovation is responsible for implementing a new National Strategy for STI (ENCTI) for the period 2016-2019. The elaboration of this new Strategy is an exercise of continuity and improvement of earlier documents as ENCTI 2012-2015 and the Action Plan on Science and Technology (PACTI) 2007-2010.

The final text of the National Strategy for Science, Technology and Innovation 2016-2019 was presented in May 2016. The document[12] pursues to update and consolidate existing guidelines, such as the previous ENCTI; the Greater Brazil Plan (Plano Brasil Maior), and the directives of the Ministry of Development, Industry and Foreign Trade (MDIC); as well as contributions from the National STI Conference (CNCTIS), the Business Mobilization for Innovation (MEI) and the World Science Forum (FMC).

The Strategy is a joint work of the secretariats of the Ministry of Science with the National Research Council (CNPq/MCTIC) and the Studies and Projects Financing Agency (Finep/MCTIC). Additionally it comprises the outcomes of the discussions with the Brazilian Academy of Sciences (ABC), the Brazilian Society for the Progress of Science (SBPC), the National Confederation of Industry (CNI) and other stakeholders.

The priority areas identified in the 2016-2019 STI Strategy are based on the trends for STI policies around the world, Brazilian strengthens and potential and the OECD Science, Technology and Indrustry Outlook 2014[13]: defence, climate change, reduction of the impact of natural disasters, oceans and Antartica, sustainable urban systems, tackling gender inequality in research, ageing of the population, althernative methods to animal testing, new production processes, information society and digital economy, energy, technological convergence, enabling technologies.

The new ENCTI points out the necessity to invest heavily in increasing productivity through innovation in order to ensure the competitiveness of the economy. The bias of innovation developed in the country is still concentrated in the production chain. Thus, the reduction of risks in scaling-up activities to encourage commitment to RD&I products and services with high added value, providing the replacement of technological imports and the country's assimilation into new supply chains is a challenge to be faced.

The Strategy also highlights the urgency to improve the institutional environment for innovative business by creating forums for the negotiation and establishment of rules of conflict on the intellectual property resulting from the activities developed in partnerships between research institutions and companies. Additionally, it mentions the

[12] http://www.mcti.gov.br/documents/10179/1712401/Estrat%C3%A9gia+Nacional+de+Ci%C3%AAncia,%20Tecnologia+e+Inova%C3%A7%C3%A3o+2016-2019/0cfb61e1-1b84-4323-b136-8c3a5f2a4bb7

[13] OECD Science, Technology and Industry Outlook 2014. http://www.oecd.org/sti/oecd-science-technology-and-industry-outlook-19991428.htm

challenges of reducing the regional inequalities in production and access to STI; innovative solutions to social inclusion and promoting sustainable development.

The challenges identified in the Strategy will be addressed by the mobilization of resources, actors and instruments aiming at strenghtening the STI System. The centrality of this system demands an approach that considers three dimensions that enhance structuring the Axis of the ENCTI 2016-219: expansion, consolidation and integration.

It is expected to advance in these dimensions from the fundamental pillars that make up the National STI System as: research, infrastructure, financing, human resources and innovation.

With respect to global challenges the National STI Strategy foresees:

- Ensuring water security, food and energy of the Brazilian population;
- The cyber security defense and consolidation of the country in digital economy and society;
- Maintaining the Brazilian leadership in energy and renewable fuels in the economy;
- The exploration and oil and gas production in deep waters;
- Increse the knowledge and sustainable use of the oceans;
- Mitigation and adaptation to climate change;
- The reduction of imports of pharmaceuticals and hospital products and supplies for the chemical industry;
- The preservation and sustainable use of Brazilian biodiversity;
- Increasing competitiveness of the national bio-economy;
- Promoting science and technology in critical areas to business innovation and national competitiveness;
- The development of social technologies for socio-productive inclusion to reduce regional disparities in production and access to science, technology and innovation.

The investment goal in Science, Technology and Innovation until the end of 2015 was to reach 2% of GDP, which was not achieved.

1.3 R&I policy initiatives, monitoring, evaluations, consultations, foresight exercises

In December 2015, the Brazilian Congress approved a new Legal Framework for STI (Law 13.243/2016), known as "Marco Legal". The framework suffered numerous adjustments over four years to meet the concerns of the scientific and technological community, business, and academia. It was initially born of the Brazilian Constitutional Amendment No 85 with which innovation became part of the Constitution in several provisions, giving greater state commitment to the subject, either by supporting different territorial arrangements that make innovation ecosystems, either by encouraging strategies of interaction between companies and Science, Technology and Innovation Intitutions (ICTs).

Another important advance Amendment was the institutionalization of STI System under the regime of collaboration among federal agencies.

The new Legal Framework will bring significant changes to simplify and stimulate the STI capacity of Brazil by reducing the bureaucracy. For instance, it allows teachers of public universities in exclusive dedication engaged in research activity also in the private sector, with compensation; allows universities and research institutes share the use of their laboratories and teams with companies, for research purposes as well as

simplifying procedures and reduction of taxes for import of research material. Therefore, this new Legal Framework also made several changes in the Innovation Law (Law 10.973/2004), among others, by normalizing relations between researchers, research institutions and entrepreneurs, in order to establish parameters that minimize conflicts of interest.

Another recent legal instrument that modifies the national scientific and technological production is the new Biodiversity Law (Law 13,123/2015). The device defines access to genetic resources and associated traditional knowledge and regulates the sharing of benefits. It has as main objective reducing the bureaucracy and stimulating sustainable development and scientific research in the country associated with biodiversity. As noted in Law 13,243, regulation through specific Decree of the new Biodiversity Law should represent advances for the realization of productive activities and research in Brazil.

In addition, the number of evaluations and assessments of public policies on STI has increased significantly in recent years, at the initiative of MCTIC itself and its related bodies, such as the Centre of Strategic Studies and Management (CGEE) and other institutions such as the Institute of Applied Economic Research (IPEA).

The CGEE has as one of its lines of action precisely the conduction of studies, analyses and evaluations on public policies related to the area of STI and has produced several studies in order to analyse and monitor public policies, as well as roadmaps and a mapping of technological innovations within selected production chains aiming to asset business opportunities in specific sectors and locations.[14]

Furthermore, the MCTIC established in 2012, the Monitoring and Evaluation Policy (PMA), which main objective is to analyse, monitor and evaluate policies, programmes and actions undertaken or funded by the Ministry, seeking continuous improvement and the achievement of its objectives. The implementation of the PMA is the responsibility of the Standing Committee for Monitoring and Evaluation, expressed in the Annual Monitoring and Evaluation Plan[15].

The PMA is structured in three main groups indicators[16]:

a) basic indicators of monitoring, which are those indicators related to physical and financial implementation of the actions of the Ministry. These indicators seek to answer whether the policy is effectively running the satisfactorily and not whether it is having the desired effect.

b) indicators on resources invested and public supported, which are more comprehensive indicators on the type of investment and the beneficiaires' profile achieved by the policies. The focus of this type of information is the allocation of public resources. Therefore, this indicators will inform if the policy is reaching the target audience that should effectively achieve.

c) result indicators, which are those relating to the results actually achieved by the beneficiaries of STI public policy.

Table 5 - Group of indicators of the Monitoring and Evaluation Policy (PMA)

Group of indicators	Type of information	Main information sources*	Focus
basic indicators	physical and financial	SigMCT(1)	implementation/execution

[14] Studies and others produced by CGEE are available at: http://www.cgee.org.br/index.html
[15] Available at: http://www.mct.gov.br/upd_blob/0223/223949.pdf

	execution/constraints (barriers)		
resources indicators	investment type, number and profile of beneficiaries (sector, size etc.)	RAIS[17] IBGE	allocation of resources
results indicators		INPI[18] IBGE RAIS Plataforma LATTES[19]	policy results

Source: National Monitoring and Evaluation Policy report (2012).

The Monitoring of the implementation of the National Strategy for STI will be conducted by means of indicators that help the decision makers on the necessary adjustments in programmes and strategies outlined in the document.

These indicators are presented below and make up a complex picture that should be noted from the specificity of each dimension of STI it seeks to address.

Thus, the analysis of the weeknesses and strenghtens of each sector can be identified within a certain period. It also highlights the need to implement an effective monitoring and evaluation system to be managed by Science Ministry, which subsidizes decisions on possible adjustments needed to achieve the results indicated the Strategy.

Table 6 - Indicators to monitoring the implementation of the ENCTI 2016-2019

Indicators		**Last official data**	**2019**	**Source**
1	National R&D expenditure (%GDP) - GERD	1,24% (2013)	2,00%	MCTIC
2	Private R&D expenditure (%GDP) - BERD	0,52% (2013)	0,90%	MCTIC
3	Government R&D expenditure (%GDP) - GvERD	0,71% (2013)	1,10%	MCTIC
4	Federal government expenditure (%GDP)	0,50% (2013)	0,80%	MCTIC
5	Enterprises innovation rate	35,7% (2011)	48,6%	PINTEC
6	Number of enterprises with continuous R&D	5.600 (2011)	10.000	PINTEC
7	% of enterprises using gov. instruments to innovation	34,2% (2011)	40,0%	PINTEC
8	No. of technicians and researchers doing R&D	103.290 (2011)	120.000	PINTEC

[17]The Annual Social Information (RAIS) is a report on socio-economic information requested annually by the Brazilian Ministry of Labour and Employment to corporations and other employers.
[18] National Institute of Industrial Property: http://www.inpi.gov.br/.
[19] Plataforma Lattes is a integrated database with curriculums,r esearch groups and institutions of the Brazilian research Council (CNPq): http://lattes.cnpq.br/.

9	Percentage of graduates in engineering in relation to overall graduates	7,2% (2013)	12,0%	INEP
10	Number of researchers per million inhabitants	709 (2010)	2.100	MCTIC

Source: National Strategy of STI 2016-2019

Although there is no systematic and effective monitoring and review system already taking place in Brazil, as well as ex-post evaluation tools, some institutional programmes are selected on the basis of the quality of proposals and subject to external peer review. Such cases can happen within the State Foundations (FAPs) and also through the National Institutes for Science, Technology and Innovation (INCTs) from the Ministry of Science and Technology.

The Institute for Applied and Economic Research (IPEA) also plays an important role in the publication of studies and data for the evaluation of public policies in the country. As a state agency not directly linked to specific sector or area of the government, IPEA incorporates different areas and dimensions of analysis for a more qualified understanding of the complex and intricate problems of the public policy processes.

The Ministry of Science, Technology and Innovation also has its Brazilian Institute for Information in Science and Technology (IBICT). The information technology transfer is one of the actions that consolidated IBICT as a reference in the area in Brazil and abroad. Their staffs perform the absorption and customization of new technologies, transferring them to other entities interested in the capture, distribution and preservation of scientific and technological intellectual production.

Since 2015, the IBICT is involved in a cooperation project with the Joint Research Centre (JRC) of European Commission. IBICT aims to establish a Research and Innovation Observatory in Brazil to monitor all the public policies and data related to the STI system in the country. The cooperation should allow IBICT to learn from the experience of the JRC in building its own Research and Innovation Observatory (JRC RIO).[20]

The Brazilian government is looking forward to adopting a more systematic Monitoring and Evaluation frameworks, which in addition to measuring the achievement of goals and the efficiency of programmes, would permit adjustments in implementation base. Apart from a few limited empirical assessments of R&D programmes, there have been few efforts to systematically evaluate policy programmes, especially in the exercise of adopting a National Strategy for STI.

1.4 Structure of the national research and innovation system and its governance

1.4.1 Main features of the R&I system

The Brazilian STI system is quite complex and fragmented: it counts approximately thirty STI funding agencies, besides other governmental entities able to launch Calls for Proposals such as ministries, public enterprises, technical organisations.

The Consitutional amendment (EC) 85/2015, in force since 26 February 2015, provides that the State should encourage the development and strengthening of innovation in enterprises, as well as in other public or private entities, the creation and maintenance of technology parks and other innovation friendly environments. The amendment has added the world innovation throughout the Constitution's articles that were referring or mentioning science and technology.

[20] The JRC RIO is a new initiative of the European Commission to monitor and analyse research and innovation developments at country and EU levels to support better policy making in Europe.

In addition, the EC 85 allowed the Union, the states, the Federal District and the municipalities to establish instruments of cooperation with public bodies and entities and private entities, including the sharing of specialized human resources and installed capacity, through financial or non-financial contribution assumed by the beneficiary entity.

The National System of Science, Technology and Innovation (SNCTI), which is organized in collaboration between public and private entities, in order to promote scientific and technological development and innovation in a more institutionalized arrangement is also a reflect of the ammendments of EC85/2015.

At the federal government level, the coordination of the research policy is under the responsibility of Ministry for Science, Technology, Innovations and Communications (MCTIC), the centre body of the federal STI system. In terms of definition and execution of the research budget, there is an involvement of other ministries: education, agriculture, health, communications, energy, planning and development, industry and foreign trade.

Increasingly, the federal government and the regions (state governments) identify joint priorities and set the share of resources that each will contribute in the field of innovation. In practice, this implies more opportunities for cooperation (including with the EU) at grassroots level, while inevitably it increases the complexity of the decision-making and implementation mechanism for research and innovation.

In the context, the intensification process of State functions in STI area has set at the National Science, Technology and Innovation System characteristics of an effective systemic model. Due to this process, new institutional actors - state and municipal governments, besides the private sector institutions - are incorporated into the System in an interactive way, which has proved to be relevant in the scientific and technological development process of Brazilian society.

The federal government is the main source of funding for universities and other research organizations. In other words most of the spending on science and technology in the country is still done by the public sector (57.7%)[21]. Over the past decade, State level research foundations have increased their funding of research. In general, funding comes majorly from the three main federal agencies: CNPq, CAPES and FINEP and the 25 State Foundations. Over the past years, many of the calls which have been launched had features of international openness, meaning that foreign participation was encouraged.

Among the main R&D programmes in Brazil, in the field of research and training of human resources for science, technology and innovation the Science without Borders programme is highlighted. The programme is a joint effort with the Ministry of Education (MEC), with the objective to send 101,000 Brazilian students to the most prestigious universities in the world. Together, the National Research Council (CNPq) and the Coordination for the Improvement of Higher Education Personnel (Capes), have granted over thousands of scholarships to about 30 countries, especially the United States, United Kingdom, France and Canada. Engineering and other technological areas are the priorities.

Among the development programmes of research, the National Institutes of Science and Technology Programme (INCT)[22] is highlighted. The Institutes supported 125 projects in the period of 2009-2014 across the country; the results have a strong impact on scientific and technological development and productive modernization of the country.

[21] http://www.mct.gov.br/index.php/content/view/336709/Distribuicao_percentual_dos_dispendios_nacionais_em_pesquisa_e_desenvolvimento_P_D_segundo_setor_de_financiamento_sup_1_sup__paises_selecionados.html

[22] http://inct.cnpq.br/

Regarding Research Infrastructures, CT-Infra is a funding programme from the Finep[23], created to facilitate the modernization and expansion of infrastructure and research support services developed in public Brazilian institutions of higher education and research through the creation and renovation of laboratories and purchase of equipment, for example, among other actions.

Still with regard to the constant modernization of the infrastructure for research, initiatives were on two fronts: the construction of large national research infrastructure and decentralized support to the laboratories of Institutions of Science and Technology (ICT). Regarding the infrastructure of ICT, the PROINFRA programme – to support the development, expansion and acquisition of equipment for universities and other research institutions laboratories - contributed more than € 275 million in resources over the past four years.

1.4.2 Governance

The Brazilian National STI System is composed by various actors. Some have a more significant performance and other with a more operative role in the System. The decision-making power of these actors is results of representative democracy (the Executive and Legislative) as well as of the choices made in the context of sectoral representation entities (entrepreneurs, workers and researchers). The executing agencies are responsible by the instruments that will enable the decisions taken by political actors, to implement activities planned in the STI System.

Research budgets (S&T) are annual, but are part of a multi-year budgetary planning tool, coordinated by the Ministry of Planning, Budget and Administration. This is called Plano Plurianual (PPA)[24].The PPA, effective for four years, serves to establish the guidelines, objectives and medium-term goals of public administration. National development planning is seen as an effective tool of economic development, and in Brazil, the 1988 Constitution includes the PPA together with the Budgetary Guidelines Law (LDO) and the Annual Budget Law (LOA), as part of a set of legal instruments for fiscal, and public expenditure management. Its main role is to provide the government with strategic guidelines for the allocation of public resources and to improve efficiency through a results-oriented strategy.

The PPA 2016-2019 presents four strategic axis: quality education for social and economic development; social includion and reduction of inequalities; raise of productivity and competitiveness of the economy; strengthening of public institutions with social participation and control. The third axis aiming at raiding productivity has the scientific and technical exchange as a key element. Also, one of the strategic directives is to promote science, technology and innovation aiming at productive raise as well as competitiveness and sustainability of the enconomy. [25]

The MCTIC exercises the Coordinator function of the STI System considering its legal powers, the domain of many essential resources and the historical role played by the institution in the sector. Created in 1985 from the strong mobilization of researchers and politicians, the MCTIC was a key actor for many achievements in the field, such as the Innovation Act, the creation of the Sectorial Funds and the consolidation of the National Institutes of Science and Technology.

The centrality of MCTIC is also illustrated by the performance of its governance to the National Science and Technology Development Fund (FNDCT), beyond the responsibility of the Ministry in the formulation of national policies for the sector. Under the

[23] Finep is a funding agency linked to the Ministry of Science and Technology that plays a major role in creating a favorable environment to innovation in Brazil. With advances in public policies in science, technology and innovation (ST&I), the agency has expanded its portfolio of funding programs for technological innovation.
[24] The Brazilian budget model is defined in the 1988 Federal Constitution of Brazil. It consists of three instruments: the Multi-Year Plan - PPA, the Budgetary Guidelines Law - LDO and Annual Budget Law - LOA.
[25] PPA 2016-2019. Available at: http://www.planejamento.gov.br/secretarias/upload/arquivo/spi-1/ppa-2016-2019/ppa-2016-2019-ascom-3.pdf.

responsibility of the Ministry are two of the main implementing agencies of the system, FINEP and CNPq, and several research institutes. Considering these elements is that it is up to the MCTIC the leading role in initiatives aimed at expansion, consolidation and integration of STI System.

Other Ministries have significant activity in the STI System. Some of them have specific agencies to take care of STI theme, and others have linked units operating in the sector. In addition, other relatively new actors in SNCTI, the regulatory agencies, have actively contributed to the strengthening of the System. The explanation relies on the legal obligation that these agencies have to work in STI activities and regulated sectors, counting both with features of the so called R&D clauses. These clauses are legal obligations of private investment in R&D defined by regulations issued by the Regulatory Agency competent to exercise the power of supervision and control of the resources provided.

Under the Executive Branch should also be highlighted the performance of the State Secretariats of STI. There are two instances of regional representation that should be highlighted: the National Council of State Secretariats for Science, Technology (Consecti) and the National Council of State Research Foundations (Confap). These two instances are presented as forums for coordination of the policies of the Brazilian States governments aimed at scientific and technological development. Several joint initiatives have been undertaken involving federal and State actors, verifying the continued evolution of these relations in favour of improving the National STI System.

Research Support Foundations (FAPs) stand out as SNCTI Development Agencies. As a reference for the creation of other existing FAPs in the country, the Research Foundation of São Paulo (FAPESP) was established in 1960 and has the binding 1% of state revenues to fund their activities. Several states have adopted similar strategies to São Paulo, which strongly contributed to the expansion of the Regional Systems of STI. Most of the FAPs was created in the 90s and gradually they expanded holdings in SNCTI initiatives, especially through programmes coordinated by the Federal Government that require regional counterparts.

The Legislative power is responsible for establishing rules that regulate and facilitate the full development of STI activities. Several legal documents that enable the functioning of National STI System are subject to the consideration and approval of the National Congress at the federal level, and the Brazilian State's Assemblies. Instruments of tax incentives, budgetary laws, and researcher's careers rules are examples of topics that require the arbitration of the representatives.

It is also under the Legislative competence to supervise and control the government policies. Among the most recent initiatives of the National Congress that should be highlighted is the inclusion of the National System of STI in the Brazilian Constitution through Constitutional Amendment No. 85. As a result of this initiative will be up to Congress to regulate the system by promoting new debates and interactions between the STI actors.

The Chamber of Representatives and the Federal Senate have both a Standing Committee on Science and Technology, Communication and Informatics (CCTCI) in order to discuss and vote on the proposals of laws.

A significant part of the developments under the STI System occurs in coordination with public actors, aimed at improving the legal instruments or performing a specific programme, for example. Within the Academic representation the Brazilian Academy of Sciences (ABC) and the Brazilian Society for the Advancement of Science (SBPC) stand out for their historical performance in favour of the scientific and technological development of Brazil. The National Confederation of Industry (CNI), as an entity, and the Business Mobilization for Innovation (MEI), as a forum, are two relevant instances of business activity in the STI scope. Additionally, the Trade Unions are relevant actors, in

terms of political forces that also contribute to dialogue from the workers' vision for building up initiatives within the System.

Furthermore that are also the Executing Agencies linked to the Ministries and other local governments that have a central role. These agencies participate actively in the formulation of the policies that guide the System. Besides, in the present setting of the STI System, the executing agencies allocate public resources through different supporting instruments to the R&D activities that will hence concretize the directives agreed at the political level by means of programmes and projects that are implemented by STI players.

Four Executing Agencies stand out at the Federal Government. The first is the National Research Council (CNPq), linked to the Ministry of Science, Technology and Innovation and that has has decades of experience in fostering research particularly through: scholarships for the national researchers; encouraging the establishment and consolidation of research groups; the articulation research networks of excellence in the country. In addition, there is the Coordination for the Improvement of Higher Education Personnel (CAPES), which is under the Ministry of Education and plays a fundamental role in the expansion and consolidation of post-graduate studies, responsible for most of Brazilian research. Both the CNPq and CAPES's main target group is the National Science and Technology Institutes (ICT).

The other two Executing Agencies are the Studies and Projects Financing Agency (FINEP) and the National Bank for Economic and Social Development (BNDES). These two entities are different from the two others presented above for more focused actions oriented to promote business innovation. FINEP is linked to Ministry of Science and Technology and acts as the Executive Secretariat of National Science and Technology Development Fund (FNDCT) and operates in granting reimbursable and non-reimbursable funds. BNDES is connected to the Ministry of Industry and Development, and has instruments similar to FINEP, but differs from it by operating larger resources and more broadly in the national economy.

In addition to the federal entities, Brazilian States Research Foundation (FAPs) stands out as the Executing Agencies National STI System. Reference to the creation of existing FAPs in the country, FAPESP (São Paulo) was established in 1960 and has the binding 1% of state revenues to fund their activities. Several states have adopted similar strategies to São Paulo, which strongly contributed to the expansion of Regional Systems of STI. Most of the FAPs were created in the 1990s and gradually they expanded their holdings in STI System initiatives, especially through programmes coordinated by the federal government that require regional counterparts.

1.4.3 Research performers

Several institutional arrangements are identified with the main research performers in Brazil, being the most relevant to the STI System the Postgraduate courses installed in Public Universities. It is within these Public Universities that most of the national scientific production occurs. These Universities can also be taken as Science and Technology Institutes (ICT).

There are also the Research Institutes of Ministry of Science, Technology and Innovation (INCTs); the Federal Institutes of Education, Science and Technology; the Brazilian States Institutes of STI. The INCTs are 122 research centres. The purpose of these centres is to develop research and create patents for the country. The programme is led by the Ministry of Science, Technology,Innovation and COmmunications (MCTIC), National Research Council (CNPq), in partnership with the Coordination for the Improvement of Higher Education Personnel (CAPES), the National Development Bank (BNDES) and several Brazilian State's Research Foundation (FAPs). Each INCT is responsible to produce an Activity Report annually.

The shares of actual R&D performed by HEIs, PRO and Business Enterprise sectors (% of GERD) are not available at the time of publication. As previously mentioned, the majority of research is carried out at universities, followed far by public research institutes, among which is worth mentioning the Brazilian Agricultural Research Agency (EMBRAPA), which is linked to the Ministry of Agriculture and Supply (MAPA). It maintains research centres spread around the country. Another major centre is the Oswaldo Cruz Foundation (Fiocruz), which is linked to the Ministry of Health (MS) and headquartered in the city of Rio de Janeiro.

Another group of research performers is related to the technological development of processes and business innovation. These performers can compose innovation ecosystems territorially circumscribed, along the lines of technological poles or high-tech clusters. In these environments, beyond the territorial proximity institutions can count on the support of universities, as reflected in technology parks and business incubators. Entities can also compose other innovation ecosystems, with varying intensities of relationship between start-ups and innovative companies already consolidated in the market. These private actors use various instruments available in STI System, following international trends to support innovation, presenting as a continuous challenge to the intensification of interaction between universities and companies.

For instance, business incubators in Brazil have recent history. They are an initiative of the National Research Council (CNPq), in the 1980s, as the establishment of the first Technology Parks programme in the country. Several incubators also become the embryo of technology parks in recent years, when the Brazilian environment has become more sensitive to innovation.

Initially, the incubators were focused only on intensive sectors of scientific and technological knowledge, such as information technology, biotechnology and industrial automation. Commonly known as incubators of technology-based or technology incubators, they were intended, thus creating potential with companies to bring to market new ideas and technology trends. Currently, in addition to the original purpose, they are intended to contribute to local and sectoral development.

In this sense, it was implemented a Monitoring System of Technology and Business Incubators Parks (SAPI) - Project conducted by the Federal Association of Incubated Businesses and Technological Parks (Anprotec), in partnership with the Ministry of Science, Technology, Innovation and Communications (MCTIC), Studies and Projects Financing Agency (FINEP), National Research Council (CNPq) and other partners. According to this mapping in 2011 there were 384 incubators in the country, with 2,640 incubated companies and more than 2,500 graduate business, the two categories adding up to over €1 billion. Besides, almost 70% of the incubated companies have a technology focus with almost 80% of the affiliated entities as universities or research institutions.[26]

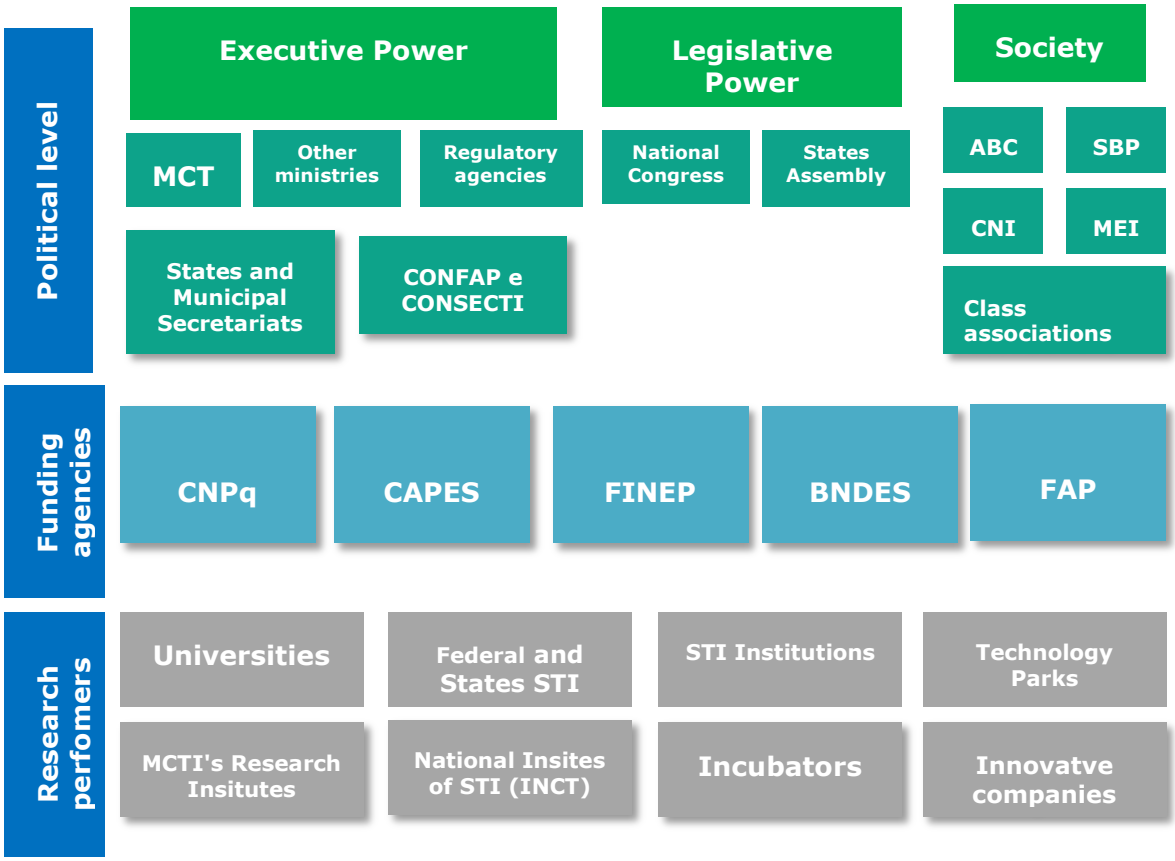
The Ministry of Education (MEC) also has an important role in the STI scenario in Brazil through the financing of scholarships and fellowships offered by its agency, the Coordination for the Improvement of Higher Education Personnel (CAPES).

Other Ministries, such as the Ministry of Health (MS), the Ministry of Defence (MD), Ministry of Development, Industry and Commerce (MDIC), Ministry of Mines and Energy (MME), Ministry of Agriculture, Livestock and Supply (MAPA) also contribute to funding research and innovative projects. These Ministries usually sign an agreement with a funding agency (CNPq, FINEP, CAPES or even with EMBRAPA) and implement financial resources for the development of research in their fields of interest[27].

[26] Technical Report of Federal Association of Incubated Businesses and Technological Parks: (Antropec): http://www.anprotec.org.br/ArquivosDin/Estudo_de_Incubadoras_Resumo_web_22-06_FINAL_pdf_59.pdf.
[27] Annex I: List of Brazilian funding institutions.

In addition, the Brazilian STI system counts on the State level funding instruments supporting Research and Innovation the State Foundations for Research (FAPs). Their financial resources come essentially from a percentage of the State resources defined in its constitution.

Figure 6 - Overview of Brazil's Research System Governance structure



Source: ENCTI 2016-2019

1.5 Quality of the science base

Table 7 - Performance of the R&D System in Brazil and the EU

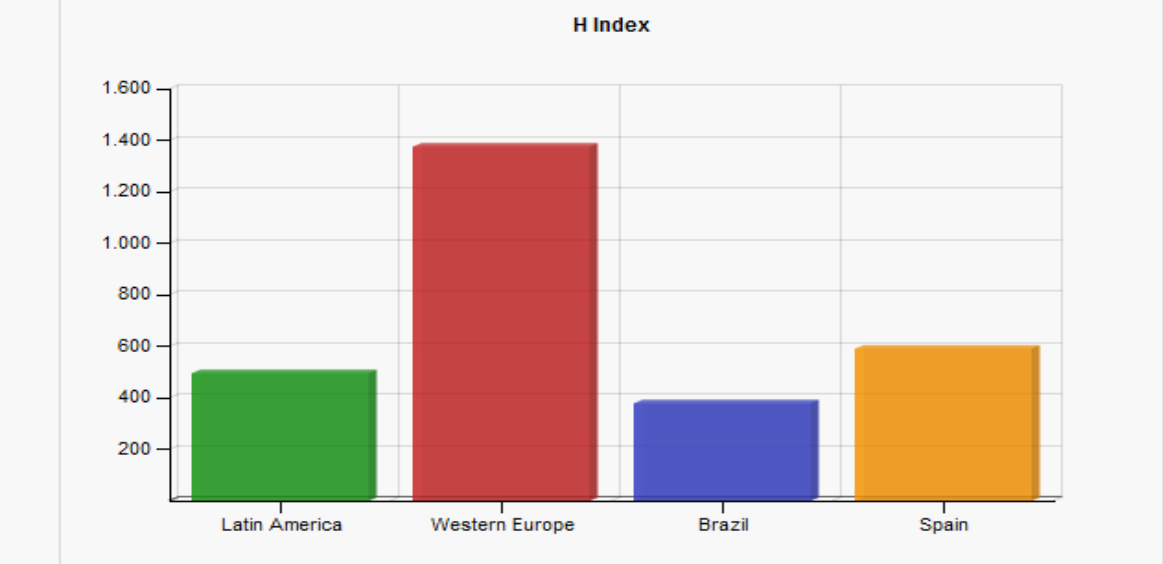
Indicator	Year	EU average
Number of publications per thousand of population	0,29 (2013)	1.43
Share of international co-publications	25,3% (2013)	36.4%
Number of international publications per thousand of population	0,07	0.52
Percentage of publications in the top 10% most cited publications	6,11 (2000-2013)	10.55
Share of public-private co-publications	1,0% (2011-2013)	1.8%

Source: Scimago Journal & Country Ranking

The Brazilian research had a significant quantitative progress in recent years. However, the qualitative progress has been less impressive, with a reduced impact globally. Although the growth of scientific production in Brazil has been growing, the number of

citations of articles is still lower than the world average. Compared with Spain, for example, the growth of scientific production in both countries was similar between 1981 and 2010, but the impact of the Spanish articles is above the world average, unlike Brazil. China already has a scientific production growth much higher than Brazil, but shows problem similar to that of Brazil regarding the level of impact.

Figure 7 - Index comparing Western Europe with Latin America, Brazil and Spain



Source: SC Imago Research Group, 2016.

According to 2013 Higher Education Census results [28], the number of education institutions in the country totalled 2,391. Public institutions are 301, of which 106 federal, 119 state and 76 municipal. Private institutions totalled 2,090. Another interesting finding of the 2013 Census is that in 2012, the percentage of people attending higher education represents almost 30% of the population aged 18 to 24 years. Also in the period 2012-2013, enrolment increased by 3.8%. Private HEIs have a stake of 74.0% in total undergraduate enrolment.

The technological area also stands out in Higher Education Census. In the period 2003-2013, enrolment in technological courses increased 24.1% on average annually with a total of 995,746 students enrolled. The private network corresponds to 85.6% of the technological level of enrolment. In 2003, this percentage was 2.9% with 114,770 students. The census shows that 85.6% of enrolments are in the private network. The fact of the larger percentage of enrolments in private institutions in the technological field can be related to the investment of private institutions in infrastructure.

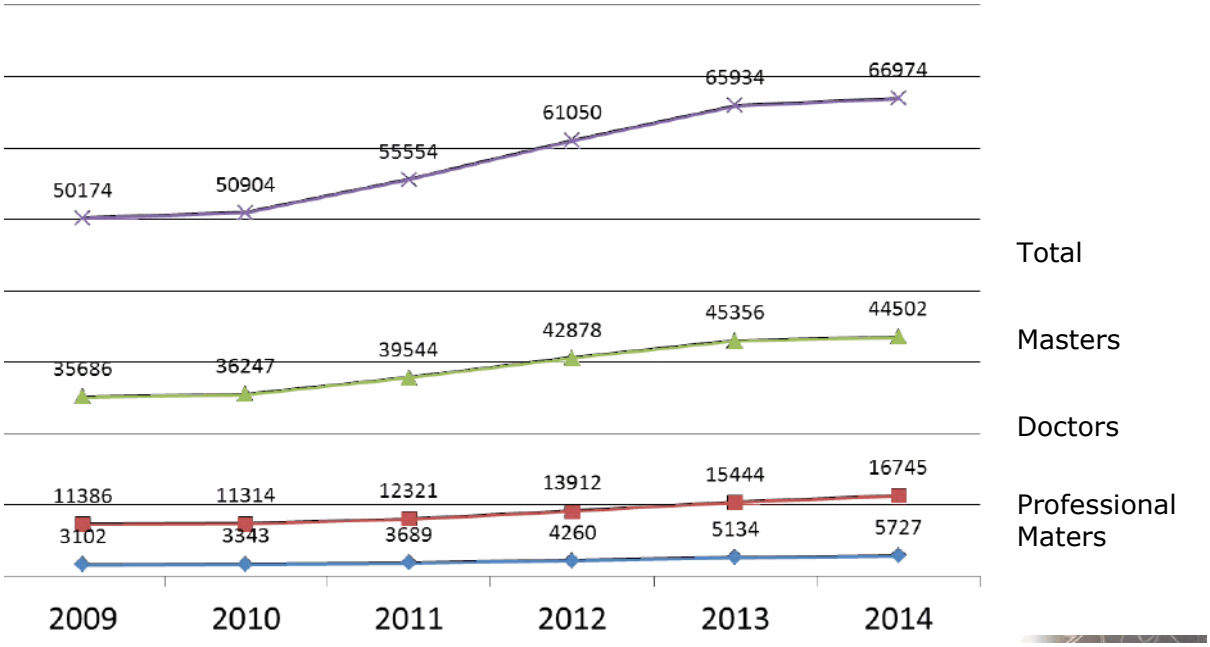
There is also the Federal Network of Professional, Scientific and Technological Education, linked to the Ministry of Education and that mission is to train professionals for the various sectors of the Brazilian economy, conduct research and develop new processes, products and services in collaboration with the productive sector.

The Ministry of Education has invested more than €800m between the years 2011 and 2014, for the expansion of the Network. There are 38 Federal Institutes present in all Brazilian states, offering training courses, integrated high school, and higher education and technology degrees. This network is still formed by institutions that did not adhere to the Federal Institutes, but also offer vocational education at all levels. There are two

[28] http://portal.mec.gov.br/index.php?option=com_docman&view=download&alias=17199-cne-forum-educacao-superior-2015-apresentacao-10-jose-soares&Itemid=30192

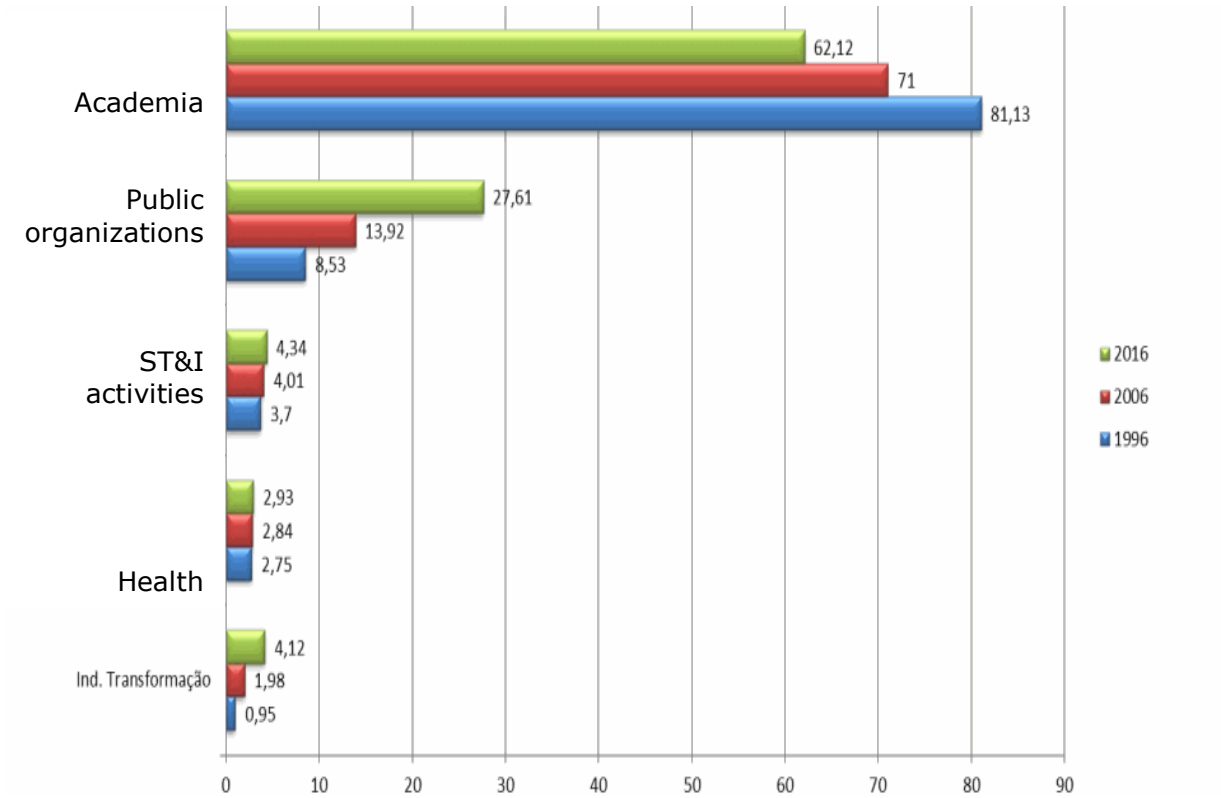
federal Centres for Professional Education and Technology (CEFETs). 25 schools linked to universities and a Technological University.

Figure 8 - Masters and Doctors in Brazil from 2009 to 2014



Source: CAPES, 2015

Figure 9 - Concentration of Brazilian masters and doctors in the Academia, Industry and governmental institutions



Source: CAPES, 2015

Brazilian research has just started shifting from theoretical to more practical and innovation-oriented fields. This is illustrated by an incipient absorption of researchers in the private sector as the graphic above shows. In Brazil almost 60% of researchers are working in universities while in other countries as Germany 65% and in the US 75% of researchers work in the private sector.

Another topic worth highlighting is the concentration of research by regions. Research strength in Latin America tends to be much more geographically concentrated than in other regions. Brazil, for example, has four institutions in the region's top 10, and three University of São Paulo (USP), São Paulo State University (Unesp) and the State University of Campinas (Unicamp) — are in São Paulo State; another top-10 institution in Brazil is the Federal University of Rio de Janeiro (UFRJ). About half of Brazil's science output comes from São Paulo.

Still with reference to scientific concentration in Brazil, the Southeast and South regions, whose relative share in GDP reached about three quarters, represents more than 73% of doctors, accounting for almost 90% of technical-scientific work-force and more than 80% of the number of innovative companies, although reaching less than 60% of the population of the country. When analysing the less developed regions, the picture obviously is reversed. Thus, the Northeast region - whose population represents 28% of the total of the country and holds 13% of the GDP - is about 5% of technical-scientific workforce and less than 10% of innovative companies.

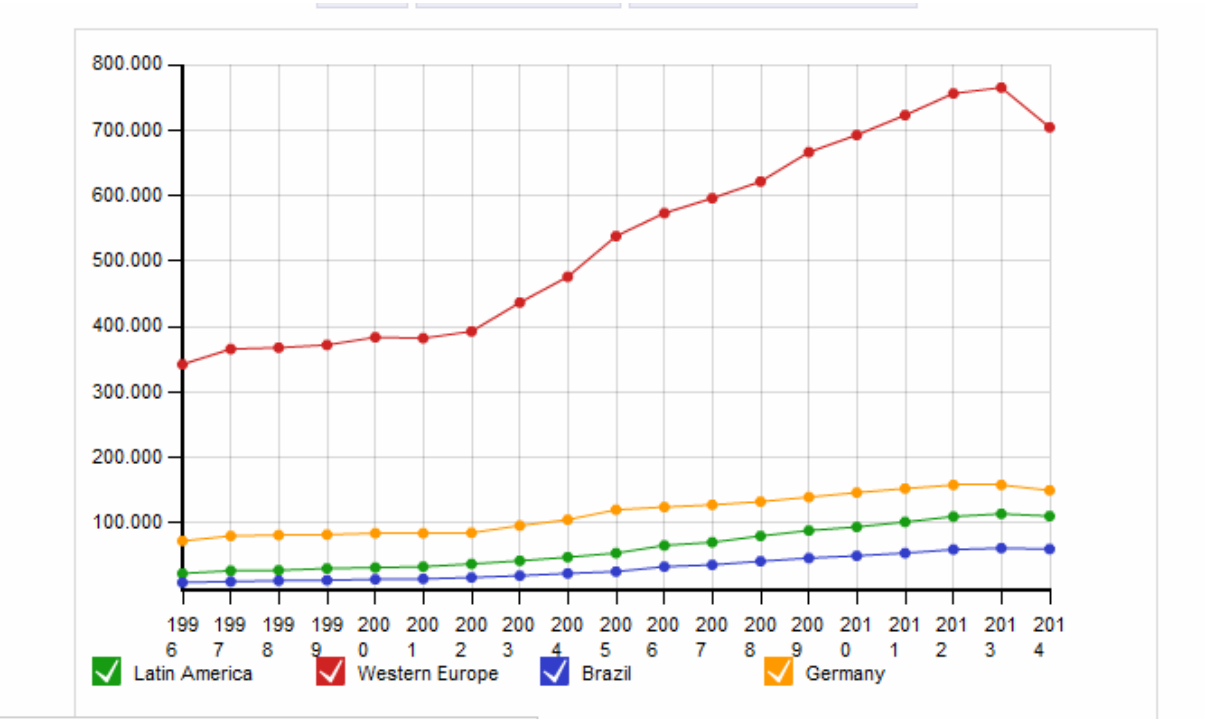
In respect to patents in force, Brazil had its peak in 2009 being ranked at 19 (WIPO, 2014). In 2014 Brazil summed up 24.976 patents in force being ranked at 30. In Brazil, the National Institute of Industrial Property (INPI) is responsible for receiving applications, examine and grant or not the patent. Between 2003 and 2013, 34,189 patents were granted. On average, 3,108 per year. In addition to the volume which is low in relation to other countries, the average waiting time for an INPI response almost doubled in the period. In 2003, the delay was just over six years. In 2008, it increased to nine years. In 2013, it has reached eleven years.

In 2014, the Director of the Patent Board of the Brazilian Patent Office (INPImade a presentation to patent agents and attorneys to discuss the measures that INPI is implementing to reduce the patent application backlog. The backlog, as highlighted in his presentation is currently the biggest issue plaguing INPI. According to an article published in 2014[29], in 2012, there were 225 professionals to assess 166,181 patent applications. There were 738 applications per examiner. Last year, the number of examiners fell and the requests increased: there were 192 examiners for 184,224 requests. The proportion rose to 980 patent applications per examiner.

Also according to its Director, INPI will soon launch a programme called "Promoted Withdraw". This program will allow an Applicant to abandon an "old" pending patent application and refile it as a new application which would be placed much higher in the queue for examination. Furthermore, INPI is planning to hire an additional 400 examiners until 2018. This measure aims to speed up the processing and examination of applications, thus contributing to the reduction in the backlog.

[29] http://www.portaldaindustria.com.br/cni/imprensa/2014/04/1,35905/brasil-ocupa-penultima-posicao-em-ranking-de-patentes-validas.html

Figure 10 - Scientific production in Latin America, Western Europe, Brazil and Germany from 1999 to 2014



Source: SC Imago Research Group, 2016

According to a Background Paper for the Workshop on Innovation for Productivity Growth in Brazil in July 2015 in Brasilia, prepared jointly by IPEA, World Bank and OECD[30], several additional factors have stuck the contribution of public S&T and R&D to economy-wide innovation and productivity. They include a disconnect between S&T investments from business needs and demands; a too slow shift by researchers from theoretical to more practical applications; regulatory and governance deficiencies that constrain business collaboration, and a continued scarcity of engineering and technology specialists.

The majority of the S&T production remains basic research in nature, and incentives in university departments foster isolation rather than interactions with business. Second, as previously mentioned, the concentration of researcher is on the Academia sector. Third, despite the advances with the new Legal Framework for STI, the public research sector is still characterized by regulatory deficiencies that discourage scientists (and institutions) from engaging in technology transfer and collaboration with the private sector. Last but not least, a major obstacle to firm innovation continues to be the lack of specialists in engineering and technology.

[30] https://www.innovationpolicyplatform.org/system/files/CONDITIONS%20FOR%20INNOVATION%20IN%20BRAZIL_Background%20Paper_Website_2_0.docx

1.6 Main policy changes in the last five years

Table 8 - Timeline of policy changes related to STI (2011 - 2015)

Main Changes in 2011

In 2011, discussions on entrepreneurship and innovation increased in the country because of the perceived need by the institutions to develop increasingly innovative projects that bring solutions to various areas of the economy. In 2010, the Ministry itself, which was called the Ministry of Science and Technology, had its name changed to Ministry of Science, Technology and Innovation, aiming to focus on this goal of improving the innovation in the country.

July 2011, the federal government announced the **Science without Borders** programme aimed to promote exchange and mobility through scholarships and fellowships to postgraduate and undergraduate students.

August 2011 the industrial policy **Greater Brazil Plan 2011-2014 (Plano Brasil Maior)** was launched. The plan reaffirmed the government commitment to innovation with its slogan: 'Innovate to compete. Compete to grow."

December 2011: the **National ST&I Strategy 2012-2015 (ENCTI)** was launched. The overarching strategic goal is to achieve sustainable development with S&TI as its main driver. The strategy addressed some challenges through main drivers as promotion of innovation, human resources training and capacity-building, and strengthening of ST&I research and infrastructure.

December 2011: Brazilian National Centre for Monitoring and Early Warning of Natural Disasters (CEMADEN) became operational.

Main changes in 2012

In 2012 it was published the first Brazilian National Strategy in Science, Technology and Innovation (ENCTI) for the period of 2012-2015.

In January 2012, a **new Minister of Science, Technology and Innovation**, Marco Antonio Raupp replaced Aluízio Mercadante, who became Minister of Education.

Brazil host **Rio+20 Conference** in Rio de Janeiro. The outcomes include: commitment by States to eradicate extreme poverty; the launch of intergovernmental process for the creation of the Sustainable Development Goals (SDGs); the creation of the Political Forum of the High Level Panel on Sustainable Development and encouraging the strengthening of the United Nations Environment Programme (UNEP).

Main changes in 2013

From January 21 to 25, Director-General of the Joint Research Centre, Mr. Dominique Ristori visited Brazil (São Paulo and Brasilia). In São Paulo, he visited the Brazilian Centre for Prevention of Natural Disasters (CEMADEN).Also, the Director signed the **Cooperation Arrangement between the Joint Research Centre (JRC) of the European Commission and the Ministry of Science, Technology and Innovation (MCTI)** for scientific and cooperative activities in fields of common interest, signed during the VI EU-Brazil Summit.

Minister Raupp continued the previous programmes and policies and strengthens some initiatives such as the calls launched by the national Research Council (CNPq), the Finep performance and the Inova Empresa Plan (€12 billion to support innovation in enterprises), from Finep and BNDES.

August 2013, it was created the **Brazilian Nanotechnology Initiative (IBN)**, which aims to encourage actions on nanoscience and nanotechnology area. It is a public policy programme that consists of numerous strategies for nanotechnology to become the Brazilian industry more innovative. The Nanotechnologies Laboratory System (SisNano) was one of the main actions of this programme.

Main Changes in 2014

Clelio Campolina Diniz, previously rector of the University of Minas Gerais was appointed as the new STI Minister. Campolina advocated that education, science, technology and development should be designed in an integrated manner, to combine economic growth with social justice,

reducing regional inequalities and improve our ability to compete in an increasingly globalized market

Also in 2014, the **Knowledge Platforms Programme** was conceived although still up to date not implemented. The idea was to set up 20 platforms including agriculture, health, energy, ICTs, defence, Amazon amongst others. The aim was to use since to boost production through the articulation of governmental agencies with private and research institutions.

Main Changes in 2015

2015 was a year of important changes in terms of STI in Brazil. Since the economic and political scenario was aggravated by a weak economy and corruption scandals, some changes affected the Ministry of Science, Technology and Innovation in terms of budget but also with the nomination of two Ministers. Aldo Rebelo was pointed in 2015 and months latter replaced by Celso Pansera.

In December 2016, the **Legal Framework for Science, Technology and Innovation** was sanctioned. The new legislation facilitates the interactions and collaboration between the public and private sectors that form the STI system, thus making it more agile, flexible and less bureaucratic.

On 12 May 2016 Gilberto Kassab, a new Minister for Science, Technology Innovations and Communications took office at the ceremony where 23 ministers were sworn in by the interim president Michel Temer. Gilberto Kassab, 55 years, is a Brazilian political member of the Social Democratic Party (PSD). Degrees in civil engineering and economics, both from the University of São Paulo (USP), Gilberto Kassab is mainly known for having been mayor of São Paulo twice between 2006 and 2012. In the House of Representatives, Kassab chaired the Committee on Science and Technology, Communication and Information (CCTCI) in 2004. In 2008 he was re-elected for another term. During his term it was announced the Information Technology Law aiming to improve the competitiveness of enterprises in the innovation field. Furthermore, from January 2015 to April 2016, Kassab held the position of Minister of Cities in the last Dilma Rousseff government.

2. Public and private funding of R&I and expenditure

2.1 Introduction

Public expenditures are, in most cases, higher than the business in respect to STI funding in Brazil. However, state-owned enterprises have a great weight in spending STI, as is the case of Petrobras and Embrapa, that both play an important role in R&D activities. Considering this characterisctics of the Brazilian funding scenario, public spending, by the federal government or at the Brazilian States level, are the main source of funds for STI in the country.

Table 9 - Basic indicators for R&D investments

Indicator	2011	2012	2013	2014	2015*	EU average in 2013
GERD (as % of GDP)	1.14	1.15	1.24	N/A	N/A	2.03p(2014) 2.03 (2013)
GERD (PPP$)	33.904,37	35.462,18	39.704,47	N/A	N/A	558.4p (2014) 542 (2013)
GBOARD (PPP$)	17.934,25	19.479,92	22.909,98	N/A	N/A	92,828.145 (2014)
GBAORD as %of GDP						0.67 (2014)
R&D funded by GOV and HEIs (% of GDP)	0,60	0,63	0,71	N/A	N/A	0.68
R&D funded by PNP (% of GDP)	0,52	0,50	0,50	N/A	N/A	0.03
R&D funded by BES (% of GDP)	0,75	0,77	0,73	N/A	N/A	1.12
R&D funded from abroad (% of GDP)						0.2
R&D performed by HEIs (% of GDP)	0,16	0,17	0,19	N/A	N/A	0.48
R&D performed by GOV (% of GDP)	0,41	0,42	0,50	N/A	N/A	0.25
R&D performed by BES (% of GDP)						1.29

Source: Indicadores Selecionados de Ciência, Tencologia e Inovação – MCTIC 2015.

2.2 Funding flows

2.2.1 Research funders

The MCTIC main funding agency for technological development and innovation is the Studies and Projects Financing Agency (FINEP), charged with the administration of the National Fund for Science and Technology (FNDCT). These sectorial funds are the main source for funding instruments to support research projects and innovation in Brazil.

Currently, there are 16 Sectorial Funds, and 14 related to specific thematic areas. One of these two broader funds is focused on the promotion of university-industry interaction (CT-FVA - Green-Yellow Fund). Below there is a list of all the Sectorial Funds of the FNDCT.

Table 10 - Sectorial Funds of the FNDCT

Name of the Sectorial Fund	**Abbreviation**
Aeronautical Sectorial Fund	CT-Aeronáutico
Agribusiness Sectorial Fund	CT-Agronegócio
Amazon Sectorial Fund	CT-Amazônia
Fund for the transportation Sector, waterway and shipbuilding	CT-Aquaviário
Biotechnology Sectorial Fund	CT-Biotecnologia
Energy Sectorial Fund	CT-Energ
Space Sectorial Fund	CT-Espacial
Sectorial Fund for Water Resources	CT-Hidro
ICT Sectorial Fund	CT-Info
Fund for infrastructure	CT-Infra
Mineral Sectorial Fund	CT-Mineral
Sectorial Fund for oil and gas	CT-Petro
Health Sectorial Fund	CT-Saúde
Sectorial Fund for Land Transport	CT-Transportes
Green-Yellow Fund	CT-FVA
Technological Fund for the Development of Telecommunications	Funttel

Source: author's compilation

The resources for the FNDCT sectorial funds stem from contributions of the exploitation of natural resources, from taxes on Industrialized Products as well as from Contribution for Intervention in the Economic Domain (CIDE) collected from the values of the use or acquisition of technology and technology transfer from abroad. These resources are

allocated at the National Fund for Science and Technology (FNDCT) and managed by FINEP.

The National Research Council (CNPq), is a Ministry of Science, Technology, Innovation and Communications (MCTIC) agency and its main duties are to promote scientific and technological research and encourage the improvement of Brazilian researchers. The CNPq provides grants for training in the field of scientific and technological research in universities, research institutes, technological centres and vocational training, both in Brazil and abroad. In addition to promoting the training of human resources in strategic areas for national development, CNPq financially contributes for the implementation of projects, programmes and R&D networks, directly or in partnership with the States of the Federation.

CNPq also invests in promoting science and technology activities with financial support for editing and publication of periodicals, the promotion of scientific events and the participation of students and researchers in major congresses and national and international events in the field of science and technology.

The Ministry of Education (MEC) also has an important role in this scenario through the funding of scholarships and fellowships offered by its agency, the Coordination for the Improvement of Higher Education Personnel (CAPES). Other Ministries, such as the Ministry of Health (MS), the Ministry of Defence (MD), Ministry of Development, Industry and Commerce (MDIC), Ministry of Mines and Energy (MME), Ministry of Agriculture, Livestock and Supply (MAPA) also contribute to funding research and innovative projects. These Ministries usually sign an agreement with a funding agency (CNPq, FINEP, CAPES or even with EMBRAPA) and implement financial resources for the development of research in their fields of interest.

Founded in 1952, the National Bank for Economic and Social Development (BNDES) is one of the world's largest development banks and, today, the main instrument of the Federal Government for the long-term financing and investment in all segments of the Brazilian economy.

As a public company and not a commercial bank, BNDES evaluates the granting of support focusing on social, environmental and economic impact in Brazil. Its financial support instruments include financing; granting of non-reimbursable funds to social, cultural and technological projects; for example. For this purpose, the BNDES has several sources of funding as the National Treasury, but also raises funds from abroad, from multilateral organizations and with external market security issuances.

The Brazilian S&T system counts with 25 Research Support Foundations (FAPs), which are located in each federal state and in the Federal District of Brasília. These research support foundations aim to assist the research and innovation community of their respective state. While all FAPs financially support research and innovation activities, the individual budgets of the FAPs vary greatly.

The actions of the FAPs include a broad range of funding instruments in support of research, innovation and teaching. The São Paulo Research Support Foundation (FAPESP) is the largest and most effective FAP. FAPESP receives 1% of São Paulo State's tax revenues; and has a total expenditure in different types of research that equals approximately €500 million in 2013.

2.2.2 Funding sources and funding flows

From the perspective of Governing Bodies, it is possible to identify four types of sources:

- Budgets of the Direct Federal Administration;
- Resources Federal Executing Agencies;
- Budgets of the Federation Units;
- Resources managed by the Regulatory Agencies.

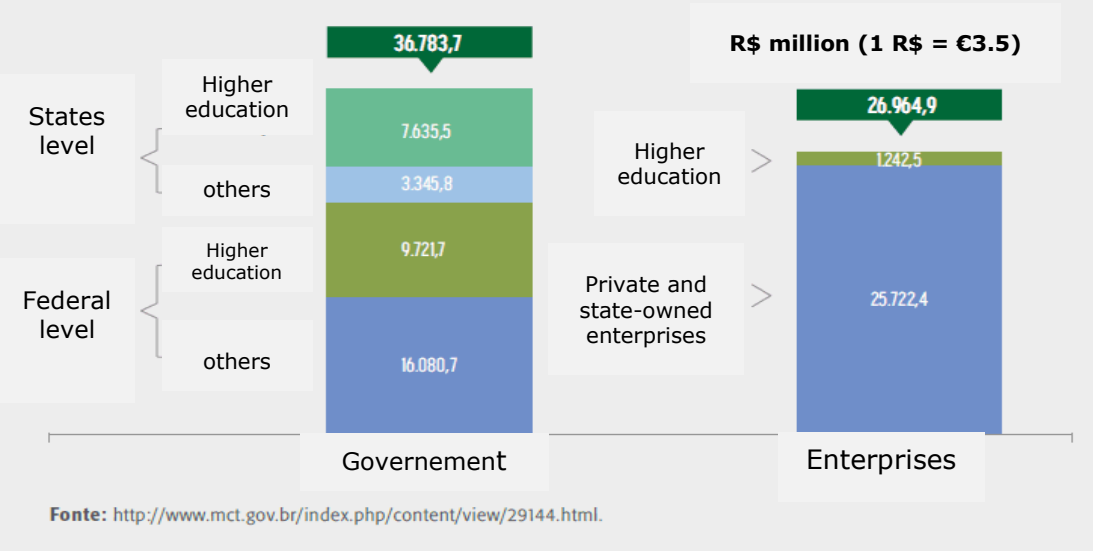
For expenses incurred in the 2012-2015 period, it took into account the activities of STI conducted with federal funds, federal state enterprises and Brazilian States Research Foundations (FAPs), in the framework of the support axes and of high-priority programmes of the National STI Strategy (ENCTI) as well as in the framework of the supplementary programmes. Thus, the resources for the period 2012-2015 amounted to €18.5 billion, €7.5 billion of MCTIC, €5.25 billion of other ministries, €3.25 billion of federal enterprises (BNDES, Petrobras and Eletrobras) and €2.25 billion of state funds operated by the Research Support Foundations (FAPs).

The allocation of R&I resources occurs through various instruments. Such instruments have formats and implementers with appropriate characteristics to the results outlined by sector planning. In general, are the Executing Agencies that controls these instruments, which can benefit researchers, science and technology institutions, businesses or arrangements that combine science and technology institutions and businesses. The instruments are more diversified in business support than the science and technology institutions and researchers.

The main instruments are:

- Scholarships Grant
- Research Subsides
- Economic Grant
- Loans
- Corporate Interest
- Investment and Participation Funds
- State purchase with Local Preference Margin
- Technological Order
- Tax Incentives

Figure 11 - Total expenditure in R&D by sector in 2013

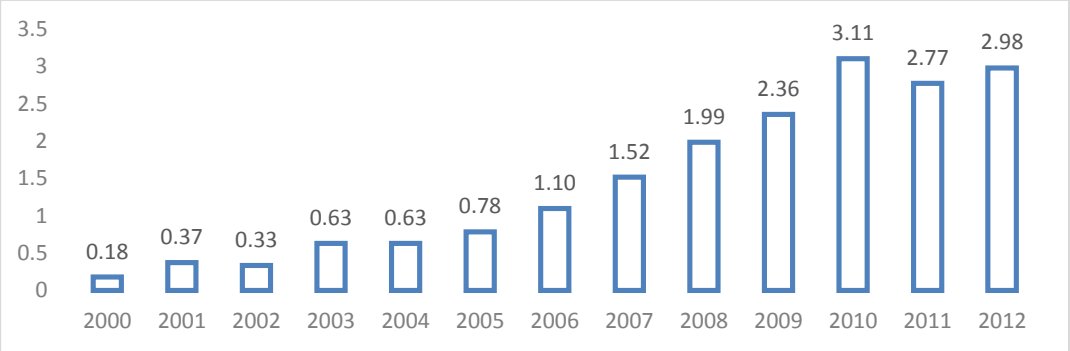


Source: MCTIC, 2015

Brazilian S&T investments are not "mission oriented", in the sense that most of these investments are not linked to Ministries with a specific mission as in other countries. The Ministry of Science, Technology and Innovation is responsible for 28,8% of the overall Ministries' investment in STI activities. Since the Ministry of Science, Technology and Innovation is responsible for the most diversified part of the Federal S&T investments and as the main implementing body of the STI Strategy, it is relevant to detail the Ministry's spending. The most important source of funding to S&T in Brazil, the National Fund for Scientific and Technological Development (FNDCT) that is intended to provide expanded and more stable financing to scientific and technological development and

promote constant investment in innovation and associations between science and industry. Figure 12 shows the evolution of FNDCT's budget execution since the creation of the Sectoral Funds until 2012.

Figure 12 - FNDCT's total budget execution: 2000 to 2012 (R$ bi)



Source: MCTIC www.mct.gov.br/indicadores

As regard of European Union Framework Programmes, the Seventh Framework Programme (FP7) has promoted research and innovation initiatives during the timeframe 2007-2013, with a total budget of €53 billion. The programme was open to international collaboration and Brazil at that time was eligible for automatic funding. Therefore, Brazilian entities participated 222 times in 170 FP7 signed grant agreements, receiving a total EU contribution of €32,24 million for such participants for the respective projects. Brazil was ranked 6th in number of participations and in budget share (according to final statistics of FP7).

However, under the new Framework Programme for research and innovation Horizon 2020, Brazil no longer receives funding since it is expected that it will finance its own participation like other major economies. Due to the difficult budgetary situation, at federal level, The European Union Delegation to Brazil, through the Research and Innovation Sector has started to strengthen the Dialogue with the National Council of State Research Foundations (Confap) and the Research Foundations itself, to finance their researchers under Horizon 2020 approved proposals. Until now, seven Research Foundations have published guidelines for financing local researchers under Horizon 2020 programme as from the States of São Paulo (FAPESP), Minas Gerais (FAPEMIG), Goiás (FAPEG), Federal District (FAP-DF), Santa Catarina (FAPESC), Espirito Santo (ES) and Paraná (Fundação Auraucaria).

Additionally, the EU has set aside important funds to support students and higher education institutions to participate in Erasmus+ and Jean Monnet actions.

2.3 Public funding for public R&I

Public research has been strengthened in Brazil based on interdisciplinary approaches focused on solutions to major challenges such as climate change, aging societies and development. In the field of research funding, are being strengthened mechanisms for competitive access to resources from the performance evaluation of institutions and new contractual arrangements.

Regarding state spending on R&I, in 2013 Brazil invested €3,75 billion, almost half of the funds invested by the federal government in the same year. São Paulo stands out as protagonist in these contributions, accounting for 58.6% of the sum of state expenditures. As is the case in federal scale, the growth rate of investment in R&I by State Governments is high, and also worth mentioning the growing participation of the northern states, the Northeast and Midwest. In 2013 the sum of investments in R&I of the federal and state governments was €12 billion. On the other hand, business

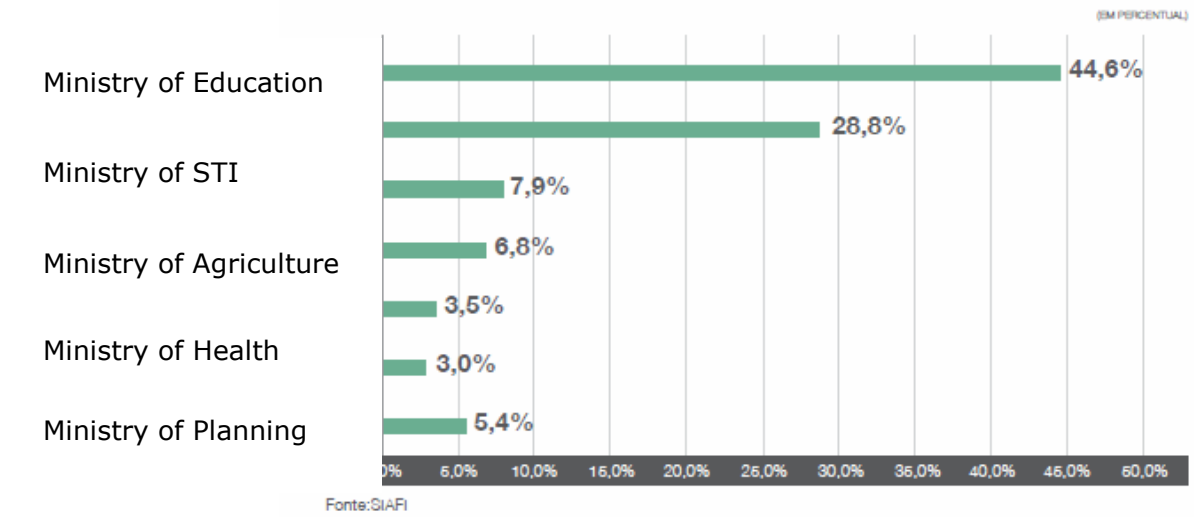
investments in S&T totalled €9,5 billion in 2013, verifying that this total amount of €310 million corresponds to expenditures for the Graduate.

About half of total public S&T investments of €10 billion in 2012 were directed at post-graduate university education. The Brazilian public sector (federal and local governments combined) spent around R$40 billion on science and technology in 2012. Around 40% of this S&T public investment was targeted at maintaining post-graduate university courses and institutions (at both the federal and state levels).

Therefore, the main instruments of public funding for public R&I, as previously presented in topic "2.3.2 Funding sources and funding flows" are the Scholarship Grants and the Research Subsides. The Scholarship Grants are the main source of direct support to researchers, and takes place through various modalities as mid-level and graduation, as well as Masters and PhDs. The main agencies working in the granting of scholarships are National Research Council (CNPq), Coordination for the Improvement of Higher Education Personnel (CAPES) and the State's Research Foundations (FAPs). The Research Subsides occurs through financial support to the strengthening of research projects; the publication of national periodicals; the participation of researchers in events; congresses; maintenance projects, upgrading and modernization of scientific and technological institution and research infrastructure.

The Ministry of Science, Technology and Innovation is responsible for the biggest share (36%) of the total public spending in R&I. Besides, there is also the Ministry of Education (MEC), which main agency responsible for theinvestments in S&T is the Coordination for the Improvement of Higher Education Personnel (CAPES), which means that most of its budget is attached to post-graduation scholarships in Brazilian and foreign universities. The flagship programme **Science without Borders** (*Ciência sem fronteiras*) is included in CAPES budget but also in the National Research Council's (CNPq) budget.

Figure 13: Percentage of expenditures of the Federal Government in Science, Technology and Innovation (STI), for organ in 2013:



Source: ENCTI 2016-2019

Other public funding for research and towards more oriented research institutions came from the Ministry of Agriculture (MAPA) and the Ministry of Health (MS). MAPA invested around €600 million in R&I in 2012, that is around 13% of total federal R&I investments. The main agency responsible for almost all of MAPA's investments in R&I is the Brazilian Agricultural Research Corporation (EMBRAPA) that is also considered a Brazilian success case in terms of technology and innovation.

Another important mission-oriented research institution in the Brazilian innovation system is the Oswaldo Cruz Foundation (Fiocruz), under the supervision of the Ministry

of Health (MS). Almost all MS budget for R&I is attached to Fiocruz. The institution has a broad scope, acting in education and in basic and applied research, especially on public health and related subjects.

In the Ministry of Industry, the S&T budget goes to the Brazilian Patents Office (INPI) and to the National Institute of Metrology, Quality and Technology (INMETRO). Finally, under the Ministry of Planning is the Brazilian Institute of Statistics (IBGE) that responds for most of the S&T budget of this Ministry.

2.4 Public funding for private R&I

2.4.1 Direct funding for private R&I

Public support for business innovation has increased steadily over the years, both through direct support measures and through R&D tax credits. Brazil provides a wide range of direct support measures, most of which is channelled through the dedicated Studies and Projects Financing Agency (FINEP), which offers direct R&D subsidies through tenders, provides low-interest loans for R&D projects and funds partnerships between business and universities. In addition, the National Development Bank (BNDES) provides additional innovation funding amounting to around a third of FINEPs resources in 2010.FINEP and BNDES also provide support to seed and venture capital funds that support start-up companies.

One of the main programmes financed by BNDES is the *Plano Inova Empresa*, by which the Federal Government improved how to foster innovation, integrating the support tools available (credit, economic subsidies, investments, equity and non-reimbursable funds). The expansion of the investment level set out in Plan, reaching the total amount of €8 billion for the period 2013-2017, favours the strengthening of relations between business and scientific and technological institutions (STIs) in the public sector. The funds are intended for companies of all sizes, aimed at direct investments in research, development and innovation (RD&I) economic subsidies to enterprises, partnership projects between research institutions and companies, shareholding interest in technology-based companies and credit for companies.

With similar goals and a more decentralized operations, the Brazilian Technology System (SIBRATEC), ran by FINEP has the aims to support the technological development of Brazilian companies, as well as improve the quality of products on the domestic and foreign markets, providing conditions for increasing the innovation performance and raise competitiveness.

SIBRATEC already assisted 57,000 businesses through more than 400 ICT distributed in 53 operational networks, 13 Innovation Centres, 18 of Technological Services and 22 of Technological Extension and had investments totalling €46 million of public funds and the return of more than €5 million of state funds and companies.

It should also be highlighted policies to support innovation executed in a decentralized manner through Inovacred and Tecnova programmes of FINEP. The Inovacred that decentralizes credit actions to innovative companies already has a partnership with 16 regional credit institutions that cater to 21 units of the federation. The Tecnova applying the same logic to resources for economic subsidies for innovation projects is now also operating in 21 Brazilian states, through partnerships with research support foundations.

The creation of the Brazilian Association for Research and Industrial Innovation (EMBRAPII), social organization whose mission is to support business projects that are innovation based through university-industry collaboration is also worth highlighting. The EMBRAPII's pilot project was completed in 2013 with the signing of 66 cooperative projects with companies involving financial resources of €65 million, shared equally by MCTIC/Finep, scientific and research institutions and businesses. The pilot project results provided valuable subsidies for qualifying EMBRAPII as a social organization, which

accredited in 2014, 13 scientific and research institutions (STIs) for the development of collaborative projects with companies.

According to the information agency of MCTIC, in 2015, EMBRAPII ensures the execution of €29 million in 62 industrial innovation projects signed with various companies. Since 2014, when the organization began operating, 71 agreements were signed worth a total of €31.25 million. The majority (74%) is project to develop new products.

In addition to direct fostering to innovative companies, should be highlighted the expansion and consolidation of conducive environments to innovation in the country, through the National Programme for Support of Technological Parks and Incubators (NIP) and the support policy for Centres Of Technological Innovation (NIT) of the of Science and Technology Institutions. Total investment in these programmes in the 2011 to 2014 were more than €50 million, and recent studies indicate that for every €1.0 invested by the Federal Government other € 3.6 were leveraged by state and municipal governments and the private sector. The more than 900 companies already established in the 30 operation Parks are generating 32,000 jobs and an annual turnover of almost €1 billion per year. The 400 deployed incubators have graduated 2,500 companies, which generate an annual turnover of €1 billion.

The direct support system has been criticised for excessive bureaucracy, which keeps some innovating firms from accessing the available support channels, and tends to be too slow for firms that need to make urgent investment decisions. From an organisational perspective, there may also be scope for raising the efficiency of support programmes by addressing overlapping responsibilities among institutions, a lack of clear mandates, and the lack of systematic cost-benefit analysis. In the future, all available direct support measures should subjected to systematic and regular evaluations, and the authorities should assess the scope for making the application process easier and faster, while continuing to ensure the quality of the supported projects.

2.4.2 Indirect financial support for private R&I

In addition to direct support measures, Brazil also uses tax benefits to support R&D indirectly, and these benefits more than doubled in real terms since the Good Law (Lei do Bem) came into effect in 2005. Many R&D expenditures can be deducted from corporate tax liabilities at 160% of the CIT rate – with additional benefits to reward employing researchers or obtaining a patent. Moreover, capital goods used for R&D can be fully depreciated for corporate taxes purposes in the first year of investment.

The Law of Innovation (Lei de Inovação), enacted in October 2005, was based on the idea that the government should stimulate and expand the support for universityindustry partnerships, thus promoting the participation of universities and research centers in the innovation process and stimulating the transfer of knowledge from universities to enterprises. In addition, this Law included mechanisms to support the innovative activities of private companies through the transference of non-reimbursable public resources. This law provided for the availability of an economic subsidy to the enterprises, through non reimbursable financing with funds from the public budget9.

As of 2006, FINEP started to implement the Economic Subsidy Programme whose resources were originated from FNDCT. This instrument was pointed by some analysts of the Brazilian innovation system as one of the main pillars of the national innovation policy and represented a step forward by allowing non reimbursable funds to be granted to Brazilian enterprises.

The other act that supports innovation was the "Lei do Bem", enacted in 2007, which provides for tax incentives for technological innovation, as well as other incentives such as exemption from income tax, accelerated depreciation and accelerated repayment, the reduction of tax on purchase of machinery and equipment for R&D; accelerated amortization of intangible assets; reduction of income tax withholding resulting

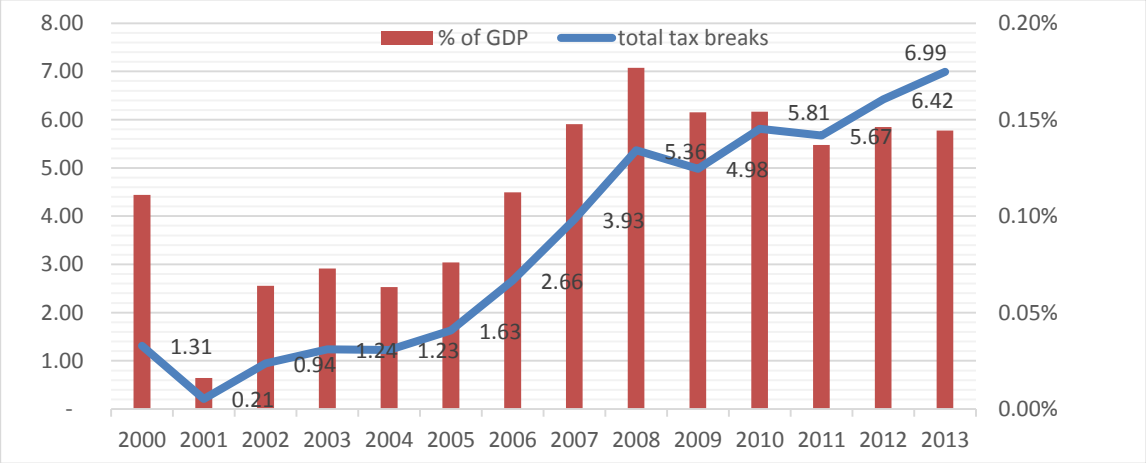
registration of technology transfer contracts and maintenance of trademarks, patents and cultivars; grants to researchers, masters and PhDs.

Furthermore, the "Lei do Bem" has bound economic subsidies to the resources from sectorial funds and to the funding for projects involving cooperation between companies and scientific and technological institutions (Koeller, 2009).[31]

The Innovation Law and other 9 legal devices were modified in January 2016, by law No. 13.243, known as the Legal Framework for STI. This law law establishes measures to encourage innovation and scientific and technological research in the productive environment, with a view to technological training, technological autonomy and development of the national and regional productive system of the country. The Legal Framewrok stablishes that the financial instruments to stimulate innovation in companies are: economic subsidy; financing; partner participation; technological bonuses; technological order; tax breaks; scholarships; use the state's purchasing power; investment funds; equity funds; financial securities, encouraged or not; investment forecast research and development in public service concession contracts or sectoral regulations.

The total tax incentives in Brazil reached around €1.5 billion in 2012 and MCTIC estimated €1.8 billion of tax breaks in 2014. According to estimates by OECD, the amount of fiscal incentives for R&D represented 0.05% of the Brazilian GDP in 2013 while direct incentives (funding of BERD) represented 0.10 percent (OECD, 2015). In these indicators, Brazil stands high far away from several OECD and other developing countries reported.

Figure 14 - Total tax incentives in Brazil (R$ Billion and percentage of GDP): 2000-2013



Source: MCTIC (www.mct.gov.br/indicadores) and IBGE

2.5 Assessment

Brazil does not allow refunds of R&D tax credits or losses to be carried forward. In this setting, unsuccessful firms do not benefit from R&D tax credits and starters are likely to face significant disadvantages in relation to incumbents, particularly in a context of scarce and expensive credit. In addition, these tax credits are only available for those firms filing tax return under one specific tax regime ("lucro real"), which is typically only chosen by large and established companies. Brazil should allow refunds of R&D tax credits or alternatively introduce long carry-forward periods, and make these benefits available regardless of the tax regime under which firms file tax returns.

[31] Doctoral thesis presented at the Economics Institute of the Federal University of Rio de Janeiro, Available at: http://www.ie.ufrj.br/images/pesquisa/publicacoes/teses/2009/Tese%20de%20Doutorado%20Priscila%20Koeller.pdf.

The Sectoral Funds, created during the second government of President Fernando Henrique Cardoso, represented a substantial change in the Brazilian innovation policy, since they allowed a significant increase in resources aimed at fostering innovation in Brazil, and provided greater sustainability to the volume of resources earmarked for innovation policy. During the ten years period under (2003 to 2013), the sectorial funds enabled a significant increase in funding for innovation, both in terms of reimbursable and of non reimbursable financing.

The Brazil now has several tax and financing mechanisms to encourage innovative activity, a considerable step forward for the country. However, there are obstacles related to the implementation of these instruments, since according to anaylists the country needs no more incentives for innovation, but a more efficient application of the instruments and resources available. Performance based funding could therefore be a important approach to incentives that are actually more demand based.

The main criticism of the tax incentives laws is in fact the benefits are restricted to companies that perform the calculation of net income, generally large companies that already have better financing conditions. Thus, the companies that need the incentives are small and medium, which usually choose for deemed income statement. According to Weisz 2006[32] tax incentives are in the right direction, but are still timid.

3. Framework conditions for R&I

3.1 General policy environment for business

Brazil's growth has persistently decelerated in recent years. The impulse from decade-old reforms, expanding labour income, and favourable external conditions, which enabled a consumption and credit-led growth, has lost vitality. A major expansion in the operations of the National Development Bank (BNDES), in the last few years has failed to boost investment, which has been slow since 2011 when the economy has lost competitiveness, the business environment has worsened and commodity prices have fallen from record highs. Moreover, structural sources of pressure on fiscal spending have necessitated a high tax burden. At the same time, unnecessary microeconomic interventions have contributed to reduced dynamism and increased financial stress in key sectors. Likewise, a high regulatory burden slowed implementation of the infrastructure investment programme, especially in its initial phases (IMF, 2015).

The research system has effectively developed during the past decade – this, 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 deep from 2005 with the passing of the federal innovation law, still presents key structural bottlenecks such as a small number of networks involving industry, regional and local authorities; weak private sector research in terms of number of firms and expenditures and government incentives with limited scope and reach.

According to the Doing Business Index, in 2015 Brazil was ranked as 111 and in 2016, 116, with a change in rank of -5 positions.[33] Additionally, progress in reforming the regulatory framework has been uneven. Bureaucratic obstacles include lengthy processes for launching a business and obtaining permits. The non-salary cost of employing a worker adds to the cost of doing business, and labour regulations remain intimidating.

[32] Weisz, 2006 "Mecanismos de Apoio à Inovação Tecnologica": http://www.inova.unicamp.br/sites/default/files/documents/Mecanismos%20de%20Apoio%20a%20Inova%C3%A7%C3%A3o.pdf.
[33] Available at: http://www.doingbusiness.org/data/exploreeconomies/brazil/.

Likewise, according to a recent OECD Economic Survey published in November 2015, starting a business requires 12 procedures in Brazil and takes 83 days, while Chile, Colombia and Mexico require fewer procedures that can be accomplished in less than 11 days. With this result, Brazil ranks at 167 out of 185 economies surveyed for starting a business.

However, recent government initiatives are aiming to reduce these administrative burdens significantly in regard to the timing of opening a company in the country by allowing the beginning of operations while awaiting the formal license in the case of low-risk activities, which include about 90% of all activities.

An important factor behind the low productivity levels of Brazil's industry is the low qualification level of the labour force. Skill shortages affect particularly the industrial sector, with 65% of industrial companies finding hiring high-skilled workers an obstacle to their productivity and growth in Brazil. The share of students both at the secondary and tertiary levels enrolled in professional and technical degrees in Brazil is low in international comparison and wage premiums of up to 20% for secondary level graduates with technical training over those without reflect Brazil's dearth of technical skills (CNI, 2013). Brazil is addressing this issue by creating additional vocational training opportunities under the umbrella of the *Pronatec* programme. Further expanding the participation in vocational training programmes would alleviate the skill shortages faced by industrial (and other) companies and allow stronger productivity gains.

Key policy recommendations for improving the business climate and boosting industrial performance according to the OECD Economic Surveys on Brazil (2015) are: Consolidate indirect taxes at the state and federal levels and work towards one value added tax with a broad base, refunds for inputVAT paid and zero-rating for exports; Reduce the level of trade protection steadily by lowering tariffs and scaling back local content requirements; Strengthen competition by streamlining regulation on product markets and implementing planned reductions in entry regulations; Improve the technical capacity and planning for infrastructure concessions and elaborate more detailed tender packages prior to launching tender calls; Further expand the participation in vocational training to alleviate skill shortages for technical workers.

3.2 Young innovative companies and start-ups

The Brazilian Institute of Geography and Statistics (IBGE) conducted a research on innovation (PINTEC) in 1998, releasing the first results in 2000. The following versions are 2003 (triennium 2000-2003), 2005 (triennium 2002-2005) 2008 (triennium 2006-2008) and 2011 (triennium 2009-2011). Innovation rate revealed in the latest survey was 35.7%, three percentage points less than in the previous version of the survey. The latest results available are from 2011. The results of the research conducted in are expected to be released in March 2016.

The PINTEC 2011 shows that industrial companies spent 0.71% of its net sales in research and development in 2011, higher than the 0.62% recorded in 2008. The investment in innovative activities of enterprises from all sectors came €16 billion, 2.56% of the net sales of enterprises. The survey also shows that between 2009 and 2011, 35.7% of the 128,699 companies with ten or more employees innovate in products and/or processes.

Among the main programmes, Startup Brazil [34], National Programme for Startups Acceleration, is an initiative of the federal government through the Ministry of Science, Technology and Innovation (MCTIC) in partnership with accelerators to support the emerging technology-based companies, the startups. The programme works by editions with duration of one year. In each edition are released two public calls, one to qualify and enable accelerator, and one for the selection of startups with half-yearly rounds. The

[34] http://startupbrasil.org.br/?lang=en.

programme has the goal of leveraging the acceleration of a greater number of startups each year (150 by the year 2014), who's innovative products and services will reach international markets. In 2013, €5 million was allocated to the programme, in addition to €3.8 million allocated for infrastructure, workshops, consultancies, grants, etc. In 2013, more than 1,600 startups responded to the Start-Up Brasil call.

As a representative body of the segment of companies and innovative institutions, the National Association for Research and Development of Innovative Companies (Anpei) works with the government, the productive sector and opinion leaders, highlighting the importance of technological innovation for the competitiveness of companies and the development of Brazil.

The organisation consists of companies that continuously invest in research, development and innovation, of all sizes and sectors, with multisectoral nature. Another important initiative of Anpei is the Thematic Committees which consists of monthly meetings for discussion and exchange of experience. Currently, three committees are active: ICT-Enterprise Interaction Promotion; of Intellectual Property Management; and High Performance in the R & D Centre Management.

The National Association of Entities Promoting Innovative Enterprises (Anprotec) brings together about 300 members, including business incubators, technology parks, educational and research institutions, public agencies and other entities related to entrepreneurship and innovation. Leader of the movement in Brazil, the Association operates through the promotion of training activities, coordination of public policies, generating and disseminating knowledge. With the growing number of incubators in Brazil, Anprotec endeavoured to consolidate a model to encourage improvements in the results presented by these innovative environments.

Furthermore, there are in Brazil, the "S system". The system is the group of organizations focused corporate entities for professional training, social assistance, consultancy, research and technical assistance, which besides having his name started with the letter S, have common roots and similar organizational characteristics. Some of the organizations that are part of the S System: National Industrial Training Service (Senai); Social Service of Commerce (SESC); Social Service for Industry (Sesi); and National Service of Commercial Learning (Senac). The system also has a network of schools, laboratories and technology centres throughout the country.

The Brazilian Support Service for Micro and Small Enterprises (Sebrae) is also part of the S System. It is a private entity that promotes competitiveness and sustainable development of micro and small enterprises - those with annual gross revenues of up to €1 million. It operates throughout the country focusing on strengthening entrepreneurship and accelerating the process of formalization of the economy through partnerships with the public and private sectors, training programmes, access to credit and innovation, stimulating associations, fairs and business rounds.

Sebrae created the Local Innovation Agents Programme (ALI), which, together with the National Research Council (CNPq), aims to promote the continued practice of innovation activities in small businesses through proactive, free and personalized guidance. This guidance is performed by the ALI, which are CNPq fellows, selected and trained by the Sebrae, to accompany a group of companies defined by the specific Sebrae unit in the Brazilian States.

The ALI programme thus, has national coverage and is consolidated as a differential and competitive strategy for small business. When the programme started in 2008, it counted with the support of only 396 Innovation agents, and attended about five thousand companies. Six years later, the programme had more than 1,400 agents and over 55,000 companies supervised annually.

3.3 Knowledge transfer and open innovation

Innovation in the business sector in Brazil, outside of the state-supported industries that are S&T leaders, is primarily through the acquisition of foreign technology that is adapted for developing products for local and regional markets. As the South American economy, Brazil's in particular, has grown in the past decade; strong customer demand has enabled Brazilian companies to grow regionally without necessarily becoming more innovative or globally competitive. Companies are unmotivated to push the boundaries of technology, despite having a skilled and efficient engineering workforce. This reticence results in part from Brazil's tradition of state-supported industrial development.

A key weakness in Brazil's innovation system is the gap in university-industry interaction and collaboration, caused in part by companies' lack of involvement in R&D driven innovation and the dearth of doctoral-level researchers in industry. Academic researchers are disconnected from activities related to commercialization and innovation, and they typically collaborate with industry over short-term consulting projects and training, not long-term collaboration.

Additionally, according to the Innovation Survey 2011 (Pintec/IBGE), the 71,500 people employed in RD&I activities in companies, 55,800 (78%) are researchers. PINTEC indicated that of the total number of researchers onçy 16,4% had graduate degrees, which shows the need for greater presence of masters and doctors in business innovation environments.

Among the main programmes in Brazil, the National Industrial Training Service (Senai) foresees the implantation of 26 Institutes of Innovation (ISIs), in order to stimulate the integrated development of products, processes, applied research, the solution of complex problems and the anticipation of technological trends. 15 were already operating in 2015 with 122 contracted projects. The ISI are directed to different areas of knowledge, among which: production, microelectronics, surface engineering and photonics, materials and components, communication and information technology, construction technology, energy and defence, microelectronics and micromachining.

The Academic Industrial PhD programme (DAIA) of the Federal University of ABC (UFABC) in Santo André, São Paulo is a pioneer in Brazil. The programme started in 2013 and is a result of an agreement made with the National Research Council (CNPq). There are four ongoing projects, distributed in the areas of nanoscience in advanced materials and energy. For the company to be a partner in the programme it must have within its structure at least one professional acting with research, development and innovation. Thus, the project is designed in partnership between the university and the company. The company must provide the infrastructure for the development of the project and indicate an industrial supervisor who acts as a co-supervisor. At the same time, the student also has an academic advisor and the entire university infrastructure available.

As regard technology parks, in order to update the information on the current status of these initiatives in Brazil, the Secretariat of Technological Development and Innovation of the Ministry of Science, Technology and Innovation in partnership with the Centre for Technological Development of the University of Brasilia, held in 2013 the Study of High Complexity Projects – Technology Parks Indicators.[35]

According to the study, in 28 parks respondents who consider themselves in operational stage, 32,200 jobs were accounted in companies and resident research institutes and management team, mostly higher level. The 939 companies installed generate approximately 30 thousand formal jobs. The study also highlights the large number of teachers and doctors involved, approximately 4000 (13%), with the indication that

[35] http://www.mct.gov.br/upd_blob/0228/228606.pdf.

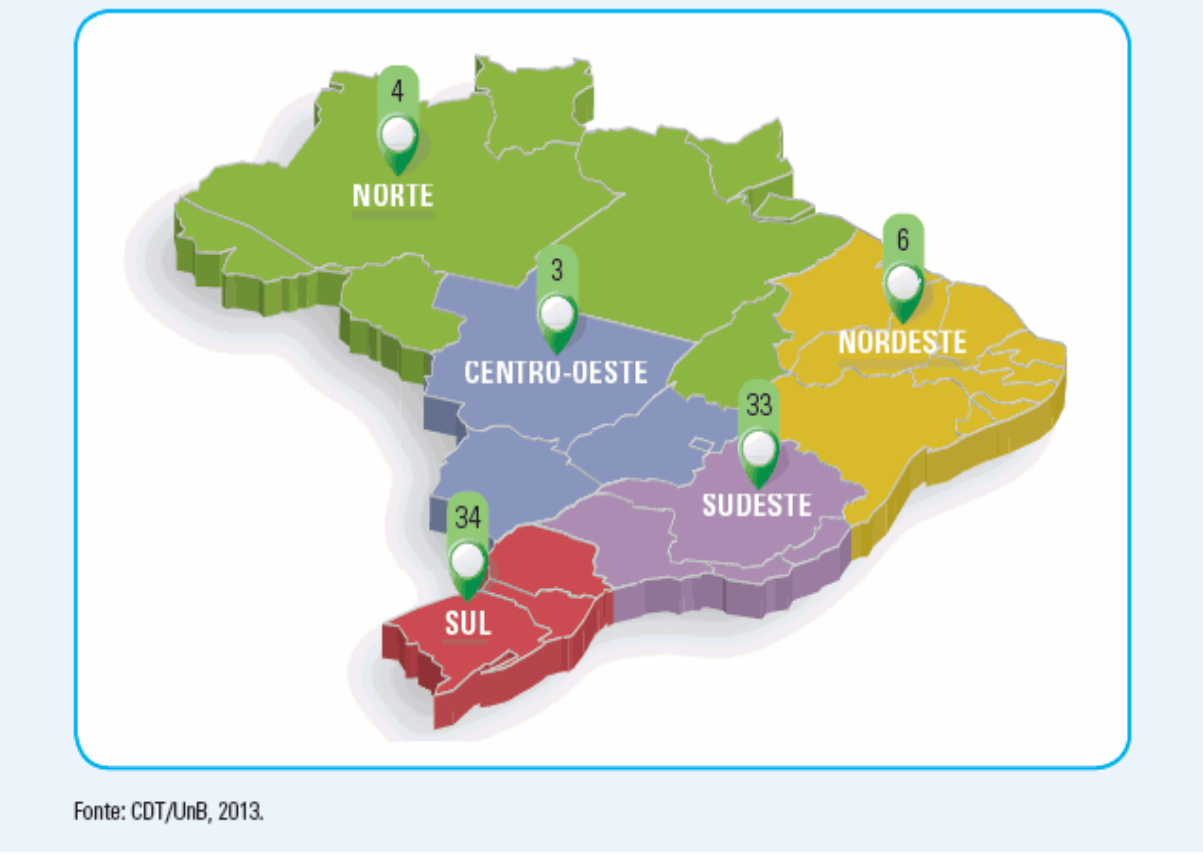
considerable portion of these professionals acts directly in companies, in contrast to the Brazilian business sector whose workforce has little participation of masters and doctors.

Another important finding was that for every €1.00 invested by the federal government for the implementation and consolidation of technology parks, other €4.00 were invested by State and municipal governments and the private sector. This result is highly significant, with clear demonstration that the federal government is acting properly in its role of inductor in the implementation of these innovation habitats.

The South (43%) and Southeast (41%) concentrate 84% of respondent parks. The other areas add up to a percentage share of only 16% in the number of parks spread across the Northeast (7%), North (5%) and Midwest (4%). The survey results also show that the parks have generated skilled jobs, with high professional training. Of the 29,909 jobs generated by companies at the parks, 1,098 are occupied by professionals who hold the title of doctor, 2950 by professionals with master degree, and 2364 by graduates of specialisation courses and 17,630 for graduates.

One notes that the parks project receives proportionately fewer resources in all sources of funding. However, the federal government has the largest share of investment (€4.5 million - 54%) in parks in the design stage, overcoming state and local governments (€2.8 million - 34%) and the initiative private (€950 thousand - 12%). Once made in operation the main source of funds comes from the private sector (about €525 million - 55%). The resources of the federal government (€275 million - 29%) and state and local governments (€153 million - 16%) are still relevant to the parks in operation, but the private sector plays a significant participation in its development.

Figure 15 - Technology Parks per Region in Brazil



Source: CDT/UnB, 2013

3.4 Assessment

The creation of cooperative controlled environments for technology companies places the country in a promising situation, especially when we are about to celebrate thousand companies located in 30 Technology Parks in operation. Another big boost to technological developments reflected at the ENCTI 2016-2019 is regarding the 400 incubators held in the country. Of them were born thousands of technology companies, generating billions in revenue for the economy. Considered an advanced and very promising tool to complete the governmental support system innovation, Embrapii reduces the risk of innovative projects demanded by companies in the pre-competitive stage, to act quickly enough to enable progress to promote business competitiveness even in an international market.

4. Smart specialisation approaches

4.1 Governance and funding of regional R&I

The Brazilian federated states are autonomous sub-national entities (self-government, self-legislation and self-collection) provided with own government and constitution which together form the Federative Republic of Brazil. The political and administrative organization of the Federative Republic of Brazil comprises the Union, the states, the Federal District and the municipalities.

As example of what happens at the level of the Federal Executive, the theme of science, technology and innovation (STI) is present within the State Executive, but out of the 26 states and Federal District, 20 define in their State Constitutions the percentage of tax revenue intended to fund for science and technology activities (S&T) and 6 establish this percentage in law or budget. Constitutionally, the highest percentage for the S&T is the from the State of Goiás (3%) and the lowest is the State of Pará (0.3%). Some State Constitutions define that resources are privately administered.

The National Council of State Research Foundations (Confap) is a non-profit organization whose goal better articulate the interests of state agencies for research. Officially established in 2006, the Council adds foundations of 25 states, including the Federal District.

The National Council of Secretaries for Science, Technology and Innovation Affairs (Consecti) is a private, non-profit organization founded in 2005 with the purpose of representing the Departments of Science, Technology and Innovation or related agencies in the States and the Federal District. The Consecti's mission is to coordinate and articulate the common interests of the State Departments of STI and contribute to the improvement of the National Policy of Science, Technology and Innovation. The majority of Brazilian States has a Secretariat of Science, Technology and Innovation. Though, in some States, the STI domain is under other Secretariats such as the economic development.

The establishment of Consecti in 2005 and Confap in 2006 as a private non-profit organizations enhance the important role of these institutions as interlocutors of the Ministry of Science, Technology and Innovation in the formulation and implementation of the National Policy for STI throughout Brazil.

A remarkable example of this dialogue took place in 2004, when the Confap and Consecti, then organized as forums, reached a consensus with the MCTIC, known as Letter of Salvador, related to the following assumptions: (i) regarding the STI actions, the preservation of the Federal Pact implies the implementation and consolidation of partnerships between States and the Union; and (ii) those partnerships should result in significant growth of resources for the area of STI throughout the national territory and constitute an instrument for gradual overcoming of regional inequalities. Based on these assumptions, criteria were adopted for definition of State counterparts to federal funding

contributions, taking into consideration the disparities in gross domestic product and the scientific basis of the States.

The Letter of Salvador, also foresees hiring new agreements, especially as regards of the diversification of shares of national energy matrix; formation and establishment of advanced human resources; the technological development of Local Productive Arrangements; the establishment and consolidation of Technological Parks; the dissemination and popularization of science; the establishment of new business incubators and consolidation of existing ones; the generation of state indicators of Science and Technology.

4.2 Smart Specialisation approaches

In Brazil, the concept of smart specialisation is close to what is called Local Productive Arrangements (APLs). In other words they are: local innovation systems, local production systems, clusters, among others. These various denominations have in common the emphasis on the importance of local aspects of the development and competitiveness of enterprises.

More specifically, the Local Productive Arrangement is an agglomeration of companies, located in the same territory, which present productive specialisation and maintain links of coordination, interaction, cooperation and learning from each other and with other stakeholders, such as government, business associations as well as credit, education and research institutions.

In the 50s and 60s, there were specific policies aimed at encouraging the development of such arrangements in less developed State capitals. These agglomerations usually attract industries from all sectors in pursuit of tax incentives, consumer markets, good logistics conditions, good access to services and infrastructure, skilled labour, among others. These policies were related at the national level with industrial policies that encouraged rapid industrialization, mainly through import-substitution policies and support for sectors with export potential.

Thus, from the national point of view, these policies were designed mainly to import-substitution and increased external competitiveness of certain industrial chains. From a regional point of view, these policies were intended primarily to develop backward regions that had great competitive potential by having good sources of inputs and other logistical advantages.

The formalization concretely occurred from 1999 under the Ministry of Science and Technology (MCT). In partnership with the States of the Federation clusters in which were supported cooperation projects between research institutes and companies have been identified, aiming to improve products and processes. During the period, it was also included for the first time an action on Local Productive Arrangements (APLs) in the Multi-Year Government Plan (PPA 2000-2003).

In the first half of 2003 was created the interministerial group of APLs, to integrate existing and implementation actions. The group was coordinated by the Ministry of Development, Industry and Trade (MDIC) and had the participation of 21 agencies working at the federal level. This group was formalized in August 2004, with the name of the Permanent Working Group for APLs (GTP), going to involve these and other governmental and non-governmental actors. The first goal was to coordinate, articulate and integrate the different actors, policies and promotion of APLs, at the federal level, carried out by public and private bodies.

In the Multi-Year Plan (PPA) of the Brazilian federal government (2004-2007 and 2008-2011) set out the APLs as axes of industrial policy and regional development. In the PPA 2016-2019, there is a recommendation to support the Local Productive Arrangements for the consolidation of national production chains. Another line of action is linked to the National Integration Routes seeking joint production chains and strengthening of Local

Productive Arrangements (APLs), aiming at technological improvement and increased sales of goods produced in these spaces.

In a Local Productive Arrangement two different types of cooperation are identified. The first is the productive cooperation, in order to obtain economies of scale and scope, and improving quality and productivity indexes. The second is innovative cooperation, which results in decreased risk, cost, time, and especially in interactive learning, fostering the innovative potential of Local Productive Arrangement.

There are three types of APLs according to their stage of development:

- Incipient arrangements: disarticulated, lacking legitimate leaders. Lack of integration between companies, public authorities and the private sector and a broader vision for the business. There are no research centres or professional training that could help develop and implement new production processes.
- Arrangements in development: important for local development, for attracting new businesses and encourage entrepreneurs to invest in competitiveness as a condition for its survival. There is a concern about the other links in the production chain, with a direct impact on the quality of their products. Leaders are more empowered and legitimized by organizing themselves in unions, defending regional interests rather than individuals. They present an incipient integration between government and business.
- Developed arrangements: productive arrangements whose interdependence, articulation and consistent links result in interaction, cooperation and learning, enabling product, organizational and processes innovation and generating greater business competitiveness and social empowerment.

Main supporting institutions to APLs:

- The Research Network Systems of Local Productive Arrangements (RedeSist)[36] is an interdisciplinary research network, formalized since 1997, based in the Economics Institute of the Federal University of Rio de Janeiro, and with the participation of several universities and research institutes in Brazil, and maintains partnerships with other institutions in Latin America, Europe and Asia. Among its activities are: research; postgraduate and specialisation courses; coordination and debate among institutions and experts from Brazil, Mercosur, Latin America and other parts of the world.
- The National Research Council (CNPq) also supports the development of APLs through public calls for proposals to support training projects, training and technological research and innovation.
- FINEP also objectively supports the development of APLs is through public calls for funding of research projects, innovation, modernization.

The articulation of SMEs with State character supporting institutions such as Brazil's Support Service for Micro and Small Enterprises (Sebrae), the National Industry Service (Senai), Technology Research Institutes (IPTs) and the Brazilian Agricultural Research Corporation (Embrapa) is relevant and enables clustered companies to have access to infrastructures such as: i) support the improvement of quality (standardization bodies, testing laboratories and quality control and research centres); ii) training of human resources (training and professional specialisation); and iii) dissemination of management techniques and technologies (courses and lectures directed to the development of intellectual capital, access to technical information, production and market).

[36] http://www.redesist.ie.ufrj.br/.

4.3 Regional linkages to economic competitiveness

In such a huge country the decline of regional inequalities is a challenge since all territory must be engaged in the efforts of promoting the national development process in order to enhance regional diversity and to overcome the low economic dynamism. Production systems, therefore, involve many actors with strong relationships in pursuit of common goals that as a result could contribute to the improvement of the indicators of income, employment and quality of life. In addition, they can provide better regional development to all the territory.

It is possible to say that depending on the development stage of the arrangement the competitiveness gain can be noticed. For example in the arrangements in development, an intermediate phase, some assessments show that these APLs become more competitive in the national market. As regard of the developed arrangements, it is also detected a more competitive behaviour and possibilities even internationally.

As a local example, a series of industrial clusters (*Arranjos Produtivos Locais*) for small and medium enterprises have received public support in the state of São Paulo since 2004. These are co-ordinated by the Federation of Industries of S. Paulo State and the local SME promotion agency, with financing from the Inter-American Development Bank (IDB). Empirical evidence suggests that these policies have increased exports by participant firms, which may be the result of productivity improvements, but no evidence exists on how these improvements can be compared to the cost of the programme.

4.4 Assessment

In the set of productive development policies, APLs assume an auxiliary function to various initiatives focusing on different industries or production systems. Among the systems for which local production arrangements represent an important role include some considered knowledge-intensive (aviation industry), large-scale (shipbuilding) and traditional (textiles and clothing, leather, footwear and artifacts; wood and furniture, agribusiness).

The local systemic perspective is thus, an opportunity to promote greater coordination within production networks and to promote processes of generation and dissemination of knowledge and technology. In this dimension, the APLs are also focused on STI policy programmes.

The wide range of studies conducted by RedeSist highlighted as one of the main obstacles / challenges: access to credit. This is a key factor for companies in APLs can expand their productive and innovative capabilities, taking advantage of opportunities and enhancing their competitiveness. This is especially relevant in the case of micro and small businesses and in the case of innovative projects with less certainty about the results

Under the Sector Dialogue Support Facility 8th call there is a supported action betweenDG Regio and the Brazilian ministry of Integration with the aim to define the a technical cooperation pilot project for implementation of a "regional innovation system" (SRI) in the state of Pernambuco, in northeastern Brazil, whose vectors are regional development, technology and innovation in support of increased local productivity and strengthening competitiveness of priority areas of Brazilian and European regional policy.

5. Internationalisation of R&I

The prominent international presence of Brazil came during President Lula's government. The President and his Foreign Minister, Ambassador Celso Amorim, understood the new dynamics of international relations and deepened Brazilian significance abroad. The Brazilian Foreign Policy has never been homogeneous, but the continuity of its basis was maintained in the second Lula government (2010). "Autonomy through diversification", briefly translates Lula's Foreign Policy.

The "autonomy through diversification" was a symbol of high Brazilian self-esteem internationally. The President and his Foreign Minister, Ambassador Amorim, privileged the Brazilian Foreign Policy by strengthening bilateral relations and South-South coalitions (BRICS, IBSA, G-20, BASIC), by having cooperative, proactive and purposeful attitudes (Reform of the Security Council), by trusting traditional partners (US and Europe) and by focusing on regional integration (MERCOSUR and UNASUR).

However, it can be said that during Dilma's mandate Brazil's Foreign Policy has not evolved in the same way that had evolved over the past years. For the first time since the 1990s, there was a change of priorities in the continuity of the Brazilian Foreign Policy. The employees from the Ministry of External Relations as well as opinion makers perhaps have implicitly represented President Dilma's Foreign Policy as "autonomy by the indifference".

5.1 Brazil in the global R&I system

Brazilian foreign policy for cooperation in science, technology and innovation is universal, directing to countries from all continents and different levels of development. There is, in any case, interest in prioritizing the strengthening of partnerships with countries of South America, especially MERCOSUR, and with similar scientific and technological dimensions. It gives thus particular attention to the political and strategic relationship with the countries of the IBSA (India, Brazil and South Africa) and BRICS (Brazil, Russia, India, China and South Africa), as well as strengthening of scientific and technological relations with traditional partners.

According to UNESCO, in the field of Science and Technology, the greatest challenge in Brazil has been in designing and implementing a long-term policy that enables scientific and technological development to reach the population in order to improve life quality. Due to the country's dimensions, to difficulties encountered in its management structure, and, above all, to implementing national policies capable of simultaneously addressing varied regional needs, the scientific and technological knowledge produced is still slow to produce significant changes in the social inequities found in some regions. Therefore, the problems faced by Brazil in the fields of Science and Technology are complex and can hardly be solved in the short term.

5.2 Main features of international cooperation policy

Brazil has been working in partnership with countries and international organizations for nearly six decades. Technical cooperation projects and programmes generate important benefits for social development, governance, environment, energy, agriculture, education and health, which allowed build stronger institutions able to perform their duties at a higher level of excellence.

Technical international cooperation arouses great interest in a large segment of society, including government departments, and the general public by allowing a faster access to technology, knowledge, information and training. The role of the Brazilian Cooperation Agency (ABC) is coordinator and responsible for negotiation and supervision of the different programmes and projects negotiated and implemented at the bilateral, regional and multilateral level, as well as official government representative in technical cooperation activities. The Agency is linked to the Ministry of Foreign Affairs.

The Ministry of Foreign Affairs of Brazil has assumed an important role in political and in the wider national strategy of development of the country - even though there is great potential to expand its performance. In addition to the traditional participation in the promotion of Brazilian exports, the Ministry seeks to attract to Brazil knowledge, technologies, processes and intensive investments in research, development and innovation, in what is called "diplomacy of innovation."

The concept refers to a series of actions and international negotiations involving transfer, licensing and co-development of critical technologies for the qualitative transformation of the profile of the domestic industry. It is a negotiating approach in which Brazil does not

seek simply to increase or enhance the stock of scientific knowledge available, but use the diplomatic action to induce new investment and technological partnerships for industrial and productive development. Innovation diplomacy is focused therefore more demand problems than to the simple supply of knowledge and technology.

A particularly significant initiative for the strengthening of the Brazilian innovation system of which the Foreign Ministry participates, is the mobilization of Brazilians outside working in the area of science, technology and innovation abroad, particularly in Europe and the United States, in line with the guidelines of the "Science without Borders" and industrial policy. The goal is to link these Brazilians with the national productive sector. Internationalization is one of the main objectives of the Science without Borders programme and it was absolutely contributed to this end.

5.2.1 National participation in intergovernmental organisations and schemes and multilateral agreements

Brazil participates and develops its international cooperation through interregional mechanisms as well as in regional integration groups. The interregional groups are: India-Brazil-South Africa (IBSA) Dialogue Forum; The Africa - South America Summit (ASA); Summit of South American-Arab Countries (ASPA); Community of Portuguese-speaking Countries (CPLP); Forum for East Asia –Latin America Cooperation (FEALAC); Ibero-American Community of Nations; the African Union – the New Partnership for Africa's Development (NEPAD); The League of Arab States (LAS) and the Alliance of Civilizations. The regional groups are: Common Market of the South (MERCOSUR); Union of South American Nations – UNASUR; Community of Latin American and Caribbean States (CELAC); Amazon Cooperation Treaty Organization (ACTO) and The Latin American Integration Association (ALADI).

Additionally, Brazil has Scientific Cooperation Agreements or Memorandums of Understanding with the following countries: South Africa, Germany, Angola, Argentina, Australia, Austria, Belgium, Canada, Chile, China, Singapore, Colombia, South Korea, Costa Rica, Denmark, Egypt, El Salvador, Ecuador, Slovenia, Spain, Ethiopia, United States , Finland, France, Greece, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Jordan, Latvia, Macedonia, Malaysia, Mexico, Norway, New Zealand, Netherlands, Panama, Pakistan, Peru, Poland, Portugal , United Kingdom, Czech Republic, Russia, Senegal, Sweden, Switzerland, Thailand, Ukraine, European Union, Uruguay, Venezuela, Vietnam. Also, scientific cooperation under the scope of the following groups: OECD, IBAS, MERCOSUR; UNASUL, BRICS, to name a few.

5.2.2 Bi-and multi-lateral agreements with EU countries

Brazil was one of the first countries to establish diplomatic relations with the, at the time, European Economic Community, in 1960. Since then, the bilateral relationship has undergone several changes, despite always keeping its high profile in the context of Brazilian foreign policy. With the signature of the Strategic Partnership, in 2007, Brazil-EU bilateral relations have reached new heights. Opportunities for dialogue on global challenges and opportunities for bilateral or bi-regional interests (MERCOSUR and CELAC with the EU) have broadened with the Partnership, which has contributed to deepen political relations, revitalize economic ties and diversify initiatives for cooperation.

Relations at the strategic level require intense dialogue and systematic consultations, which occur through a series of meetings between representatives of the Brazilian Government and EU bodies. In addition to the Annual Summits, at presidential level, there are regular meetings among senior officials, experts and technicians. Given the diversity of topics addressed by the Strategic Partnership, there are more than 30 sectoral dialogues in progress in areas such as peace and security, trade, investments, regulations, services, energy, information society, sustainable development, climate change, education and culture.

The cooperation between the Union and Brazil on research and innovation is governed by the Agreement for Scientific and Technological Cooperation (2004, entered into force in

2007 and renewed in 2012 for 5 more years). A Cooperation Arrangement under the existing bilateral Agreement was signed on 24 January 2013 in Brasília between the Joint Research Centre (JRC) and the Brazilian Ministry of Science, Technology and Innovation (MCTI). In the area of Fusion Energy Research, an agreement (under the Euratom Treaty), was concluded in 2009 and entered into force in January 2013. Brazil is one of the first non-ITER parties with which Euratom has signed a bilateral cooperation agreement. The importance of cooperation on research and innovation in addressing the shared economic, environmental and societal challenges within the context of the overall EU-Brazil relations has been reiterated at the EU-Brazil Summit of February 2014.

5.3 Assessment of options for JRC collaborations

Collaboration with the Brazilian Ministry of Science, Technology, Innovation and Communications (MCTIC)

Following the signature of the JRC and the Brazilian Ministry of Science, Technology and Innovation (MCTI) Cooperation Arrangement (CA) for scientific and other cooperative activities in the fields of common interest on 24 January 2013, at the 6th EU – Brazil Summit, both sides have been progressing with its implementation.

Up to now three JRC – MCTI Steering Group Meetings took place. The third was held on 28 September 2015 by DVC.

This collaboration has benefited and will be further supported by the EU–Brazil Sectoral Dialogues Support Facility. In 2015, for the third consecutive year, several Brazilian projects to which JRC is a partner have been selected for funding under the EU-Brazil Sector Dialogue Support Facility.

Science without Borders cooperation

Discussions related to the Brazilian 'Science without Borders' mobility programme started in summer 2012 when the JRC was approached by the Delegation of the European Union to Brazil to consider cooperation possibilities between JRC and Brazil. On this basis, the JRC and CNPq signed a Specific Arrangement in September 2014.

A total of 46 projects have been proposed by the various JRC Institutes. From this total, the twelve projects with the highest priorit (i.e. two per institute) were selected for the 1st call and in total 6 positions were filled.

There is a proposed bill to be voted in the Brazilian Congress (PLS 798/2015). The first recommendation of the bill is the continuation of the Science without Borders, despite the financial difficulties. It also proposes the guarantee of minimum resources to meet the compromises already made and further scholarships in order to enhance strategic projects for the country's development.

Another objective is that the programme should become a state policy and not just government. Another suggestion was that the government should intensify the search for partnerships in the private sector to diversify the sources of funding for the programme. It was also proposed that overseas exchanges are prioritarily given to graduates enrolled in full doctorate degrees, post-doctoral and master's degrees.

Overview of other scientific interactions

Previous scientific interactions with other Brazilian partners such as IPEN (Brazilian Institute for Nuclear and Energy Research) on metrology, IGBE (Brazilian Institute of Geography and Statistics) on agriculture statistics and IBAMA (Brazilian Institute for Environment and Renewable Natural Resources) took place.

More recently, the JRC provides continuous support by exchanging know-how in the area of disaster management with Brazil's CEMADEN (National Centre for Natural Disasters Monitoring and Alerts). Also, the JRC cooperates with the National Institute for Space Research (INPE), to map human settlements in Brazil using tools developed by the JRC.

Likewise, Brazil is currently trying to build a Brazilian Research and Innovation Observatory, on the model of the two observatories which are being managed by the JRC: The Research and Innovation Observatory (RIO) and the Bioeconomy Observatory.

Prospects for collaboration in Brazil

According to the JRC-MCTI cooperation arrangement cooperation, the curernt priorities are: Disaster prevention and crisis management, Climate change and Sustainable management of natural resources; Energy, including bioenergy. smart grids, renewables and nuclear safety and Security; Food security; Bioeconomy; ICT, including geo-information and space applications; Nanotechnologies.

At the National Strategy for Science and Technology (2016-2019), the following areas were mentioned as priorities for Brazil: food security; nuclear technologies; bioeconomy; energy; space research etc. These areas reflect the ones mentioned in the JRC-MCTI cooperation agreement. There are many ongoing activities in these areas between the EU and Brazil, but there is still a lot of room for further cooperation.

The following infrastructures and programmes deserve special attention:

1) Oceanographic Research Vessel 'The Vital de Oliveira' is one of the top five ocean research platforms in the world with scientific advanced equipment integrating the new creation of National Institute for Ocean and Waterways Research (Inpoh), which will have the task of increasing the production of knowledge science and technology acquired over the oceans and its social and economic benefits. Studies and services in physical oceanography, chemical, biological and geological, ocean-atmosphere interaction, marine and coastal biodiversity, coastal and subsea engineering, instrumentation and ocean energy are some potential areas for prospective collaboration.

2) Sirius, the new synchrotron light source of the latest generation, which is able to promote leaps in the understanding of matter for industrial or scientific purposes. With dimensions and similar significance, the Brazilian Multipurpose Reactor project (RMB), among other benefits, has the potential to make the country self-sufficient in radiopharmaceuticals and ionizing compounds and in nuclear materials of great commercial strategic value and major contributor to the maintenance of human health.

3) Supercomputer Santos Dumont is installed at the National Laboratory for Scientific Computing (LNCC). Currently the Santos Dumont stands out for being the computer with the highest data processing speed of Latin America, offering ample opportunities for users that require high performance scientific computing services. In this field it is worth mentioning the high-performance networking provided by the National Network of Education and Research (RNP), an initiative constantly expanding users and gaining transmission capacity and availability of new solutions.

4) In the field of biofuels, emphasis should be given to the National Laboratory of Science and Technology of Bioethanol (CTBE) for technology of second generation ethanol production and research advances of third generation. Linked to Petrobras, the Center for Research and Development Leopoldo Américo Miguez de Mello (Cenpes) has been active in the development of encouraging technologies of Hydrogen application as an energy vector, description and removal of environmental contaminants, cleaner of fuels, as well as other technologies aimed at reducing the impacts of burning fossil fuels.

5) Another important aspect is the production of nuclear fuel, which contributes both to the energy mix and to self-sufficiency in all stages of radiopharmaceuticals production. Such materials are distributed by the National Nuclear Energy Commission (CNEN) to centres specialised in the diagnosis and the therapy for the treatment of cancer, heart disease and neuropathies, enabling the achievement of more than a million and half of annual medical procedures in Brazil.

6) Chico Mendes Institute (ICMBio), as regards biodiversity, is also a reference institution in Brazil. The Office shall perform the actions of the National System of Conservation Units and may propose, implement, manage, protect, supervise and

monitor the protected areas. It should also promote and implement research programs, protection, preservation and conservation of biodiversity and exercise the power of environmental police for the protection of federal conservation units. The Institute has 15 centers for Research and Conservation. They constitute decentralised units of the local authority who must produce, through scientific research, planning and technical analysis data, the knowledge necessary for conservation of biodiversity, the speleological heritage and socio-biodiversity associated with traditional peoples and communities.

7) The National Institute of Metrology, Quality and Technology (Inmetro) is a federal agency under the Ministry of Development, Industry and Foreign Trade, who acts as Executive Secretariat of the National Council of Metrology, Standardization and Industrial Quality (Conmetro). Within its broad institutional mission, the objective of Inmetro is to support domestic companies, increasing their productivity through the adoption of mechanisms for improving the quality of products and services. Among its objectives are: to run the national metrology and quality policies, to check the compliance with the technical and legal standards in relation to units of measurement, measurement methods, material measures, measuring instruments and pre-measured products, to keep and maintain the standards of measurement units, as well as to deploy and to maintain the chain of traceability of standards of measurement units in the country, in order to make them harmonious and internally consistent at international level, to strengthen Brazil's participation in international activities related to metrology and quality and to promote exchanges with entities and foreign and international organisations.

5.4 R&I linkages between countries in this study

The relationship between Brazil and the EU is governed by the EU-Brazil framework cooperation agreement (1992). Brazil is a founding member of Mercosur, an organisation with which the EU signed a Framework Co-operation Agreement in 1995.

The EU and Brazil have upgraded their relations to a strategic partnership in 2007. This has led to a significant widening of the scope of their relationship, with over 30 ongoing sectorial dialogues ranging from agriculture, environment and climate change, to air and maritime transport, culture and education, drugs, non-proliferation and international peace and security, financial services, industry and SMEs, science and technology, energy, space cooperation, etc. A good number of these dialogues are active, with 5 new dialogues launched in the last two years (UN matters, drugs, non-proliferation, peace and security, energy) and new dialogues are being prepared (cyber, migration).

The cooperation between the EU and Brazil on research and innovation matters is governed by the Agreement for Scientific and Technological Cooperation (2004, entered into force in 2007 and renewed in 2012 for 5 years). A Cooperation Arrangement under the existing bilateral Agreement was signed on 24 January 2013 in Brasilia between the Joint Research Centre (JRC) and the Brazilian Ministry of Science, Technology and Innovation (MCTI).

The importance of cooperation on research and innovation in addressing the shared economic, environmental and societal challenges within the context of the overall EU-Brazil relations has been reiterated at the EU-Brazil Summit of February 2014 in Brussels. This Summit contributed to the Association Agreement between EU and Mercosur by reaffirming at highest political level the aim to reach an ambitious, broad and balanced agreement.

Brazil has very similar approaches to R&I as Mexico and over the last years, is facing similar difficulties with data as China. All countries, however, has some challenges in identifying similar approaches to smart specialisation as a broad national policy within their country, as well as other evaluation criterias of STI policies and programmes used by the European Union. R&I is considered a central issue for the strategic development of all the above-mentionned countries.

5.5 Research mobility and joint laboratories

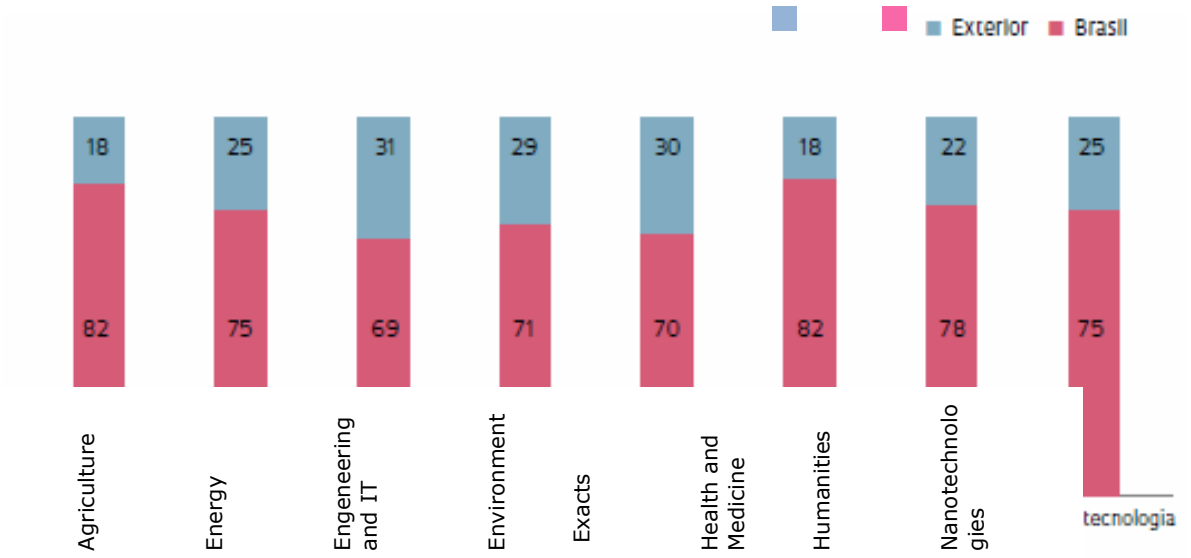
5.5.1 Researchers from abroad and national researchers

Brazilian researchers tend to work and pursue a career very close to the institutions that attended the graduation, suggesting low mobility within the country. The phenomenon was also seen among the researchers who conducted post-doctorate abroad: 81% returned to Brazil and settled in their regions of origin. In the article, published in Plos One [37] journal as part of a UFMG researchers' efforts to use data from the Lattes Platform, which brings together 4 million academic curriculums, to study phenomena and trends of Brazilian science confirms a career standard by which the most researchers do a doctorate in the country and only in stages as postdoctoral degrees they strenghten collaborations with external groups. The trajectories observed in the study show the trend of the Brazilian to stay in the same institution or region throughout his career.

Additionally the study also shows that only 32% of researchers linked to National Institues of Science and Technology (INCTs) had some kind of advanced study, such as post-doctorate, in different states of origin or outside Brazil. The behavior, however, varies with the region. For example, São Paulo and other states of the Southeast, analyzed separately in the article, are locations where most researchers come from the region itself. On the other hand, North, Northeast, Midwest and South regions have a temporary migratory pattern. This means that a significant fraction of researchers leave these regions to undergraduate, master's or doctoral degree elsewhere and then returns to work. The article also indicates that the Brazilian contingent that settle outside is small. These characteristics contrast with the global scenario.

One of the factors that explain this trend in Brazil is that in Brazilian public universities it is difficult for researchers to change their institution, in view of the procurement rules of public service. In this model, the researcher is hired as a public servant, which favors fixing at a very early statge in a institution. In the case of federal universities and some state universities, the entry of a new teacher must occur at assistant professor level, regardless of degree, and progression between one level and another career may require the range of 24 months. This discourages researchers with a consolidated career change institution. The figure below shows the percentage of titles obtained in Brazil and abroad by researchers connected to 101 INCTs in each knowledge area.

Figure 16 - Percentage of titles obtained in brazil and abroad by researchers conneted to the INCTs by knowledge area



Source: Revista Fapesp No. 239.

[37] http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0141528.

5.5.2 Scope of joint laboratory collaboration in Brazil or in Europe

A project which deals with the international regulation on nanotechnology was formalised with the signing of a cooperation agreement during the biannual general meeting in Lisbon at the end of May 2015. Brazil joins South Korea as the only official members outside the continent. Australia, Canada, United States and Japan are employees. The scientific coordination of NanoReg in Brazil will be at the National Institute of Metrology, Quality and Technology (Inmetro) while management within government will be in Micro General Coordination and Nanotechnologies (CGNT) of the Ministry of Science, Technology, Innovation and Communications (MCTIC) together with the Interministerial Committee of Nanotechnology (CIN). Brazil's participation in NanoReg was set in September 2014.

Eight Brazilian laboratories will contribute to five of the seven work packages proposed by the project in order to structure the research. Among them are the National Institute of Metrology, Standardization and Industrial Quality (Inmetro), the Northeast Strategic Technologies Center (Cetene), the Brazilian Agricultural Research Corporation (Embrapa), the Federal University of Rio Grande do Sul (UFRGS), the University of São Paulo (USP), the Federal University of Rio Grande (FURG), the Federal University of Minas Gerais (UFMG) and the State University of Campinas (Unicamp).

5.6 R&D related FDI

This result of a study conducted in 2013 [38] leads us to infer that multinational corporations consider the possibility of access to scientific and technological assets in the country as a determining factor when directing investments in R&D in Brazil. Availability of skilled labor" explains the central role of the technological driver for the Brazilian subsidiaries. The perspective that human resources equipped with technical competence, proactivity, creative capacity and flexibility are fundamental assets for the good performance of R&D activity contribute towards explaining the concentration of company in the country. Other conclusions of this study is that the market is indeed what attracted and maintained R&D at Brazilian subsidiaries of foreign companies that conduct activities with more value-added technological content and participate in global networks for product development. They do not consider the technological potential installed at the local environment, because this does not seem important for these companies choices. Therefore, the infrastructure installed in Brazil for technology and innovation does not seem to be a determining factor for attracting R&D units of foreign companies that conduct more complex R&D activities on a global scale.

5.7 Assesment

The number of skilled researchers who remain in Brazil, as well as a rising number of research infrastructures and the characteristics of Brazilian researchers found in recent studies suggests that there is a contigent of people to perform P&D in the country. Therefore, FDI could constitue a continuous souce of investment for P&D in the country, since due to political and economic instability in the country, the government investment and programmes are constantly threatened. In most countries, the tenaciousness of national policies, such as STI, infrastructure, education, FDI and innovation, among others is a determining factor in shaping up an attractive environment for Multinationals' R&D activities. In the case of Brazil, in spite of a few recent initiatives to induce innovation and R&D investments – such as the "Innovation Law" and the EC 85/2015 and other legal instruments reflecting a more seriously committed of Government Policy regarding Innovation, there are still no specific policies to attract FDI, and even less those directed to R&D investments.

[38] R&D Investments in an Emerging Economy – an analysis on driving forces versus type of R&D in Brazil, Available at: http://www.altec2013.org/programme_pdf/1158.pdf.

6. Conclusions

6.1 Structural challenges of the national R&I system

Several countries have faced the dilemma of how to adjust the legal framework to the rapid changes underway in the production of scientific knowledge and development of new products, processes and services. Such settings are passing through building new incentives for innovative activity and the strengthening of public research and it is a vital improvement of the instruments allowing the articulation of these two dimensions to advance in STI.

In Brazil, this picture adjustments is marked by recent advances in three legislative initiatives: (1) Constitutional Amendment 85/2015; (2) the New Legal Framework Law 13,243/2016; and (3) the Biodiversity Law 13,123/2015. These new legal frameworks require specific regulations in order to have the desired effect by the federal legislator. Major investments in laboratory infrastructure were also carried out in the country, especially through funds from the National Scientific and Technological Development Fund (FNDCT).

One of the weaknesses of the Brazilian system stems from the fact that a large portion of business investment is intended for import of technology and services. The bias of innovation developed in the country is still concentrated in the production chain in order to reduce costs, and strongly associated with existing technology ownership. Another challenge is the reduction of risks in scheduling activities, encouraging commitment to RD&I products and services with high added value, providing the replacement of technological imports and the country's integration into new supply chains. At this juncture, the formation of innovation ecosystems have been one of the strategies adopted to improve institutional conditions aimed at increasing business competitiveness from adding value to products, processes and services.

Likewise, regional disparities are of concern to all societies, including Brazil. Public policies to overcome this challenge have been undertaken and made by various governmental actors, leaving those who work in the STI issue a greater concern with the factors that contribute to the production and access to knowledge and production techniques.

Brazil has the historical shortcomings to be overcome, especially with regard to social inequalities, which must be the object of public policies that coordinate STI acitivities aimed at social inclusion. The socio-productive development in its broad spectrum, assumes the connection of several initiatives aimed at inserting the portion of the population that is in social vulnerability. Such a development can be promoted by the social roots of STI directed to the solution of regional issues, promoting, disseminating and diffusing scientific and technological education, combined with traditional knowledge.

The intensification of actions that enhance production and access to CT & I will allow the identification of alternatives that minimize the negative impacts of human activities in relation to the occupation and use of land and the sustainable use of natural resources belonging to the National Heritage it is another major challenge in Brazil.

6.2 Meeting structural challenges

Despite the progress made, there are still many promising fields to receive proper research infrastructure. In the current scenario of global competitiveness and complex social challenges, Brazil, which also faces serious internal problems, should increase investments in STI, which is a crucial strategy for overcoming adversity conjuncture of the nation.

Following the precepts presented in this report, there is a great expectation that the National Strategy for Science, Technology and Innovation for the period 2016-2019 (ENCTI 2016-2019) to consolidate the planning effort unfolded in Action Plans to address

in detail the priorities and resources for the implementation of programmes and projects related to the strategic themes for the National STI system. Similarly there is great expectation for the budget constraints that hamper progress in the sector are overcome, especially from the recovery and strengthening of FNDCT.

6.3 Main lessons and implications for the EU and its Member States

Member States have different strengths and capacities to build their cooperation with Brazil and to interact with the other EU Member States from a perspective of the scientific cooperation being developed in collaboration with the EU Delegation to Brazil.

For example, States such as France, UK, Italy, Germany have the structure to manage an effective bilateral cooperation, to organise events and programmes with the support of a substantial number of their scientists located in Brazil. These efforst legitimate it as an 'European work' with the Brazilians.

Other MS have a strong technological booster, both in the quality of their research and the strength of their industry as the Netherlands, Belgium, Austria, Finland, Sweden, Denmark. Some of them identified the cooperation with the EU as a strong support for making themselves known amongh the Brazilian Institutions. It is not a coincidence that at present many of them are starting negotiations and/or signing agreements with Brazilian institutions which are main partners of the EU as Confap and Fapesp.

Concerning the aspect of the dimension and regional inequality in terms of economic and technological progress in Brazil, is sometimes hard for Member States to promote outreach activities trought the country. In these sense, in 2014 The Tour of Brazil initiative was launched in cooperation with the EU Delegation to Brazil.

This initiave concerned a series of events organised by the RTD sector of the Delegation, Euraxess Links Brazil, the bilat (until last December it was Bbice+, at present Incobra) and the Member States. Different Brazilian States were visited by EU and MS presenting the opportunities for RTD cooperation in different subjects from energy and innovation to marine sciences and agriculture. The effort aimed to explore synergies between the scientific and industrial community of EU and MS with Brazilian States not only focusing in S.Paulo, Rio de Janeiro and Brasília. This joint effort was also coordinated with the local governments of the visited places. Between 2014 and 2015, fifteen events have been organised with the presence of almost 1.500 participants.

Another important contact group for the discussions on the MS-Brazil activities is the WG Brazil of SFIC. At present this group is coordinated by Tiina Vihma-Purovaara of the Finnish Ministry of Education and nine Member States are actively participating. The WG drafted a road map which suggests: Advising the SFIC on potential areas for more coordinated approach; Collecting and sharing information on EU/MS/AC S&T activities towards and with Brazil; Analysing the variety of on-going successful cooperation activities; Developing a SFIC Action plan towards Brazil; Making Europe visible in Brazil; Supporting the development of a European initiative to enhance the European participation to the Science without Borders programme; Establishing of a European Brazilian GSO.

References

BRITO CRUZ, Carlos Henrique (2007). Ciência e Tecnologia no Brasil. REVISTA USP n.73, 58-90.

Centro de Gestão e Estudos Estratégicos (CGEE), 2014. Dimensão territorial no planejamento de CT&I.

Centro de Gestão e Estudos Estratégicos (CGEE), 2013. Dimensões estratégicas do desenvolvimento brasileiro: as fronteiras do conhecimento e da inovação: oportunidades, restrições e alternativas estratégicas para o Brasil. [v.2].

Centro de Gestão e Estudos Estratégicos (CGEE), 2008. Avaliação de políticas de ciência, tecnologia e inovação: diálogo entre experiências internacionais e brasileiras.

Centro de Apoio ao Desenvolvimento Tecnológico(CDT/UnB), Ministério da Ciência, Tecnologia e Inovação (MCTI), 2013. Estudo de Projetos de Alta Complexidade: indicadores de parques tecnológicos.

Comissão Permanente de Monitoramento e Avaliação Ministério da Ciência, Tecnologia e Inovação (MCTI), 2012. Política de Monitoramento e Avaliação do MCTI.

Confederação Nacional da Indústria (CNI), 2015. Competitividade Brasil 2014: comparação com países selecionados.

DE NEGRI, João alberto et KUBOTA, Luis Claudio (org.) (IPEA, 2008). PolÍticas de Incentivo à Inovação Tecnológica no Brasil.

European Parliamentary Research Service (EPRS). Author: Elena Lazarou, 2015. At a glance: Brazil economic situation.

Fernanda DE NEGRI, Flávia de Holanda Schmidt SQUEFF: IPEA: FINEP: CNPq, 2016. Sistemas setoriais de inovação e infraestrutura de pesquisa no Brasil.

FUINI, Lucas Labigalini, 2014. Governance in Local Productive Arrangements (APLs): Some Theoretical and Methodological Considerations.

International Monetary Fund (IMF), 2015. Brazil Country Report No. 15/121.

Instituto de Pesquisa Econômica Aplicada (IPEA), 2009. Radar: tecnologia, produção e comércio exterio" - n. 1 (abr. 2009)

Instituto de Pesquisa Econômica Aplicada (IPEA), 2015. Conditions For Innovation In Brazil: A Review Of Key Issues And Policy Challenges.

Jose Claudio PIRES, Tulio CRAVO, Simon LODATO, Caio PIZA. Industrial clusters and economic performance in Brazil. p. cm. — (International Development Bank - IDB Working Paper Series ; 475).

Ministério da Ciência e Tecnologia (MCTI), 2015. Proposta Da Estratégia Nacional De Ciência, Tecnologia E Inovação (ENCTI) 2016-2019.

Ministério de Ciência, Tecnologia e Inovação (MCTI), 2010. Plano de Ação em Ciência, Tecnologia e Inovação 2007 – 2010 Principais Resultados e Avanços.

Ministério de Ciência, Tecnologia e Inovação (MCTI), 2012. Estratégia Nacional de Ciência, Tecnologia e Inovação 2012 – 2015: balanço das atividades estruturantes 2011.

Ministério de Ciência, Tecnologia e Inovação (MCTI), 2015. Indicadores Selecionados de Ciência, Tecnologia e Inovação, Brasil 2015. http://www.mct.gov.br/upd_blob/0237/237254.pdf.

OTTAVIANO, Gianmarco I. P. et Sousa, Filipe Lage de (2008). O Efeito do BNDES na Produtividade das Empresas [chap.9].

OECD Science, Technology and Industry Outlook 2012. Science and Innovation: Brazil

OECD (2015), OECD Economic Surveys: Brazil 2015, OECD Publishing, Paris. http://dx.doi.org/10.1787/eco_surveys-bra-2015-en

OECD Science, Technology and Industry Scoreboard 2015. Innovation for growth and society. DOI:10.1787/sti_scoreboard-2015-en. http://www.keepeek.com/Digital-Asset-Management/oecd/science-and-technology/oecd-science-technology-and-industry-scoreboard-2015_sti_scoreboard-2015-en#.V_-b0UYldgI#page2.

Scimago Journal & Country Rank (2016). http://www.scimagojr.com/countryrank.php.

World Bank. 2016. Doing Business 2016: Measuring Regulatory Quality and Efficiency. Washington, DC: World Bank. DOI: 10.1596/978-1-4648-0667-4. License: Creative Commons Attribution CC BY 3.0 IGO.

World Bank.2016 . Research and development expenditure (% of GDP).http://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?contextual=default&end=2013&locations=BR&name_desc=false&start=2000&view=chart.

Abbreviations

PACTI	Action Plan on Science and Technology
Anprotec	Association of Incubated Businesses and Technological Parks
ABC	Brazilian Academy of Sciences
EMBRAPA	Brazilian Agricultural Research Agency
IBICT	Brazilian Institute for Information in Science and Technology
IBGE	Brazilian Institute of Statistics
SBPC	Brazilian Society for the Progress of Science
Sebrae	Brazilian Support Service for Micro and Small Enterprises
SIBRATEC	Brazilian Technology System
MEI	Business Mobilization for Innovation
CGEE	Centre of Strategic Studies and Management
NIT	Centres of Technological Innovation
ISIs	Institutes of Innovation
ALI	Local Innovation Agents Programme
APLs	Local Productive Arrangements
MAPA	Ministry of Agriculture and Supply
MD	Ministry of Defence
MDIC	Ministry of Development, Industry and Commerce
MS	Ministry of Health
MME	Ministry of Mines and Energy
PMA	Monitoring and Evaluation Policy
SAPI	Monitoring System of Technology and Business Incubators Parks
Anpei	National Association for Research and Development of Innovative Companies
Anprotec	National Association of Entities Promoting Innovative Enterprises
BNDES	National Bank for Economic and Social Development
CNI	National Confederation of Industry
Confap	National Council of State Research Foundations

Consecti	National Council of State Secretariats for Science, Technology
FNDCT	National Fund for Science and Technology
INPI	National Institute of Industrial Property
INMETRO	National Institute of Metrology, Quality and Technology
INCT	National Institutes of Science and Technology Programme
NIP	National Programme for Support of Technological Parks and Incubators
ICT	National Science and Technology Institutes .
SNCTI	National System of Science, Technology and Innovation
FIOCRUZ	Oswaldo Cruz Foundation
PPA	Plano Plurianual
CCTCI	Standing Committee on Science and Technology, Communication and Informatics

List of Figures

List of Tables

Annexe 1 - List of the main research performers

1. **ABC** – The Brazilian Cooperation Agency integrates the structure of the Foreign Affairs Ministry and it has as attributions to negotiate, coordinate, implement and follow up the Brazilian programmes and projects of technical cooperation.

2. **BNDES** – The Brazilian Development Bank is the main financing agent for development in Brazil. It plays a fundamental role in stimulating the expansion of industry and infrastructure in the country and also reaches a world scale.

3. **CAPES** – The Coordination for the Improvement of Higher Education Personnel plays a key role in the expansion and consolidation of post-graduate studies (Masters and PhD) in all states of the Federation.

4. **CNPq** - The National Research Council is an agency of the MCTIC and has as attributions to foster scientific and technological research and encourage the formation of Brazilian researchers.

5. **Confap** – The Brazilian National Council for the State Funding Agencies is a non-profit organization created in 2006 to articulate the interests from Brazilian State Funding Agencies. In terms of international cooperation, it has participated in missions to United Kingdom, China, Finland, Russia, Canada, and others.

6. **Embrapa** – The Brazilian Agricultural Research Corporation (Embrapa) was founded on April 26, 1973, and is under the aegis of the Brazilian Ministry of Agriculture, Livestock, and Food Supply. It has taken on the challenge to develop a Brazilian model of tropical agriculture and livestock to overcome the barriers that limited the production of food, fiber and fuel in Brazil.

7. **FINEP** – The Studies and Projects Financing Agency allow repayable loans and grants to research institutions and Brazilian companies. The support covers all sages and dimensions of scientific and technological development cycle: basic research, applied research, innovation and development of products, services and processes.

8. **Fiocruz** – The Oswaldo Cruz Foundation is attached to the Brazilian Ministry of Health and promotes health and social development, forge and disseminate scientific and technological knowledge. Fiocruz became a think tank concerned with the Brazilian reality and experimental medicine.

9. **IBGE** – The Brazilian Institute of Statistics is a public foundation responsible for geosciences and social, demographic and economic statistic, which includes conduct censuses and organize the information obtained to supply the federal government, state and municipal level as well as other institutions and the general public.

10. **INPE** – The Institute for Space Research aim to foster science and technology in earth and space context and be able to offer products and regular services in benefit of the country. It also intended to assist in the institutionalization of international cooperation initiatives, particularly with regard to the realization of space missions and participation in global multilateral agreements.

11. **INPI** – National Institute of Industrial Property is a federal agency under the Ministry of Industry, Trade and Services, responsible for processing, dissemination and management of Brazilian system of concession and guarantee intellectual property rights for the industry.

12. **MCTIC** – Ministry of Science, Technology, Innovations and Communications has as competencies the national policy of scientific, technological and innovation research, planning, coordination, supervision and control of the activities of science and technology, IT development policy and automation, national biosafety policy, space policy, nuclear policy and control the export of sensitive goods and services.

13. **MDIC** – The Ministry of Development, Industry and Foreign Trade is responsible for formulate, implement and evaluate public policies to promote competitiveness, foreign trade, investment and innovation in business and in consumer welfare.

14. **USP** – The University of São Paulo, as the major institution of higher learning and research in Brazil, is responsible for educating a large part of Brazilian Masters and Ph.D's.

Annexe 2 - List of the main funding programmes

Name of the funding programme	Duration	Budget	Target group
Brazilian Association for Research and Industrial Innovation (EMBRAPII)	Public tenders	N/A	Support business projects that are innovation based through university-industry collaboration is also worth highlighting. The EMBRAPII's pilot project was completed in 2013 with the signing of 66 cooperative projects with companies involving financial resources of €65 million, shared equally by MCTI/Finep, scientific and research institutions and businesses.
Brazilian Technology System (SIBRATEC)	Public tenders	N/A	Aims to support the technological development of Brazilian companies, as well as improve the quality of products on the domestic and foreign markets, providing conditions for increasing the innovation performance and raise competitiveness.
Plano Inova Empresa	2013-2017	€8 billion	The funds are intended for companies of all sizes, aimed at direct investments in research, development and innovation (RD&I) economic subsidies to enterprises, partnership projects between research institutions and companies, shareholding interest in technology-based companies and credit for companies (credit, economic subsidies, investments, equity and non-reimbursable funds).
Science without Borders	Approved the second phase but is on hold due to budget constraints.	N/A	Undergraduate and graduate students aiming at pursuing their studies abroad. Different modalities of grants. The second phase will focus more on graduate students for post-doc grants.

Annexe 3 - Evaluations, consultations, foresight exercises

In Brazil, one of the first initiatives at the federal level in the area of foresight was the Development of Foresight Activities in Science and Technology Programme – ProspeCTar – from 2004. It was a Science Ministry's initiative in collaboration with the Ministry of Industry and Trade. This was a pioneering initiative from the government point of view, but unfortunately lacked continuity.

The Programme aimed to identify priorities for government and private sector investments in STI. This prospective study used the Delphi method, in national wide action, but focused on eight themes, namely: aeronautics; agriculture; energy; space; materials; water resources; health; telecommunications; Information Technology.

Centre of Strategic Studies and Management (CGEE):

In 2001, during the Second National Conference on Science, Technology and Innovation, the Centre of Strategic Studies and Management (CGEE) was created with the sole mission to promote and conduct high-level prospective studies and research in science and technology area and its relations with productive sectors, as part of efforts to promote increased awareness of the importance of such tools for innovation and the strengthening of the national economy.

According to the CGEE when it comes to prospecting exercise of national character, there is a notice that exploration activity is a relatively recent development field and the methodologies, methods, techniques and associated tools have been going through a renewal and adaptation process to new needs.

As an example of the performance of CGEE in prospective studies, its team of experts organized workshops on about 45 macro-thematic areas in the electricity sector in 2016, under the project "Technological Forecasting in Electricity"[39] by demand of the Brazilian National Agency of Electrical Energy (Aneel). The initiative aims to build technological and strategic roadmaps for the sector. Some of the macro areas on the agenda are: hydroelectricity, wind and solar energy. In the second phase of the project which is still ongoing, the team will work in the construction of future and technological roadmaps will be realized. A development agenda of a STI for the sector should be completed in the fall 2017.

Institute of Applied Economic Research (IPEA):

The Institute of Applied Economic Research (IPEA) also carries out prospective studies. One of the tools on the rise within the community of international scientists and managers is the use of prospective agent-based modelling, called ABMs (Agent-Based Models). ABMs allow modelling phenomena and analyse interactions and mechanisms between actors, developing scenarios for public policy actions. In this scope, one ABM is being developed under Ipea, continuing the Complex Systems Modelling Project for Public Policy. The current model consists of an artificial society (generated from random data that follow a set of predetermined settings). [40]

Since this type of model is built in modules and can be run on personal computers, one of the possibilities is to serve as a preliminary analysis tool (ex-ante) of public policies to be proposed by federal agencies. In the near future, this model may be part of a rapid response strategy in anticipation of policy outcomes to be implemented, with possible reduction of costs of public investment return and improve the population's quality of life.

[39] https://www.cgee.org.br/-/cgee-realiza-ciclo-de-reunioes-para-debater-prospeccao-de-ct-i-no-setor-de-energia-eletrica

[40] http://desafios.ipea.gov.br/index.php?option=com_content&view=article&id=3241&catid=29&Itemid=34

Ministry of Science, Technology, Innovation and Communications (MCTIC):

In the structure of MCTIC there is a Department of Policies and Programs of Research and Development. The main responsibilities of the Department is the implementation, coordination and monitoring of policies and stimulus programmes and support for scientific research and development. Additionally this department is responsible for the implementation of institutional mechanisms for prospecting and monitoring the evolution of scientific and technological progress in the country and abroad, especially in areas of strategic interest for national development. The Secretariat is also in charge for establishing, in conjunction with the Executive Secretariat, methodologies for monitoring and evaluating the implementation of policies, programmes, projects and activities in their areas.

Furthermore, in 2013 the Ministry of Science published an Annual Plan Monitoring and Evaluation 2013. Laid in Decree 397/2012, which established the Monitoring and Evaluation Policy (WFP), the document was prepared in three meetings of the Standing Committee on Monitoring and Evaluation also responsible for implementing the plan. The group has representatives from all departments of the MCTIC, the Brazilian Space Agency (AEB/MCTIC), the National Nuclear Energy Commission (CNEN/MCTIC, the National Research Council (CNPq/MCTCI) and Finep, the Brazilian Agency of Innovation, part of the Ministry as well. However, the Committee has not been active in recent years, after several changes in the direction of the Ministry.

The Science Ministry is the second federal portfolio to put its efforts in order to systematize a permanent and routine monitoring and evaluation programme of its policies and actions. In 2013, the evaluation sought to examine the infrastructure of research units and social organizations linked to MCTIC, the results of projects financed by sectoral funds, the Brazilian Antarctic Programme, the international cooperation initiatives of CNPq and the impact of the National Space Activities Programme (PNAE) in the technological development of domestic industry and the Good Law on private investment in research and development.

The monitoring was intended to monitor the implementation and execution of policies, programmes and actions, in search of information to guide decision-making. The plan involves, for example, the National Strategy for Science, Technology and Innovation (Encti), the implementation of the Multi-Year Plan (PPA) and social organizations supervised by the Ministry.

Monitoring of the National STI Strategy will be carried out by means of indicators that help the decision making of managers on the necessary adjustments in programmes and plans that fulfil the guidelines outlined in the document ENCTI 2016-2019.

The evaluations, consultations and foresight exercises in Brazil are sprayed inititives. Despite some efforts at a national level to institutionalize evaluation, monitoring and foresight exercises culminating in 2013, due to the political and economic crises aggravated in the following years it is possible to observe a discontinuity of these programmes and initiatives.

Europe Direct is a service to help you find answers to your questions about the European Union
Free phone number (*): 00 800 6 7 8 9 10 11
(*) Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server http://europa.eu

How to obtain EU publications

Our publications are available from EU Bookshop (http://bookshop.europa.eu),
where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents.
You can obtain their contact details by sending a fax to (352) 29 29-42758.

LF-NA-28337-EN-N

JRC Mission

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Serving society
Stimulating innovation
Supporting legislation

Publications Office

doi:10.2791/680135

ISBN 978-92-79-64590-7