

From:
**OECD Science, Technology and Industry Outlook
2008**

Access the complete publication at:
http://dx.doi.org/10.1787/sti_outlook-2008-en

Brazil

Please cite this chapter as:

OECD (2008), "Brazil", in *OECD Science, Technology and Industry Outlook 2008*, OECD Publishing.
http://dx.doi.org/10.1787/sti_outlook-2008-34-en

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

BRAZIL

Brazil's R&D intensity, at 1.02% of GDP in 2006, is quite low by OECD standards, although it exceeds that of Portugal, Turkey, Poland and Mexico. Among some non-OECD countries, its R&D intensity is below that of China and Russia, but higher than that of Argentina. The weight of public and business R&D are similar, with business expenditure on R&D at 0.49% of GDP. Brazil is one of the leading non-OECD recipients of foreign direct investment, and around 60% of patent applications at the Brazilian patent office come from non-resident inventors.

Human resources are a key challenge. Currently there are only 1.48 researchers per 1 000 total employment (2006) and only 10.7% of all university graduates have degrees in science and engineering. More generally, 7.8% of the population aged 25 to 64 had attained tertiary education in 2004, and 18.4% of total employment was in science and technology occupations.

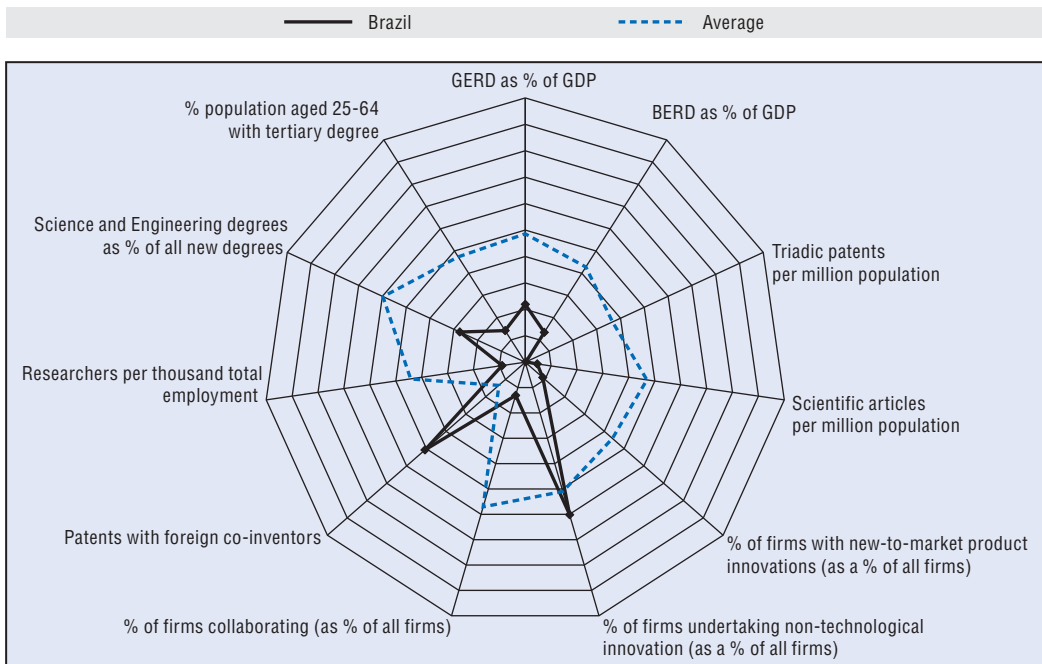
Brazil produces 0.31 triadic patents per million population, which puts it on par with China and Russia. Academic patenting has gained momentum in recent years, as exemplified by the University of Campinas' Inova agency: patent applications increased by a third, and technology licensing revenues by 60%, between 2004 and 2005. Brazil's share in world scientific articles rose to 1.4% in 2005, a share as high as Sweden's, after more than doubling between 1995 and 2005; this falls short of growth in China and Korea but is similar to growth in Portugal and Singapore.

A business innovation survey conducted by the Brazilian Statistics Bureau revealed that about a third of Brazilian firms with

more than ten employees engaged in some kind of innovation and that one-fifth engaged in product innovation between 2003 and 2005. Purchase of equipment and machinery was considered the main source of innovation. Few firms co-operate on innovation, and co-operation between firms and universities is also low. Instead, Brazilian firms regard clients and suppliers, as well as competitors, as important sources of knowledge and information for innovation. Cost, economic risk and lack of external financing, as well as a shortage of skilled labour, were considered the main obstacles to innovation. The law on innovation, which came into force in 2005-06, is expected to improve the situation.

As described in the 2006 *OECD Economic Survey of Brazil*, enhancing the contribution of innovation to productivity growth and competitiveness is one of the three structural challenges facing Brazil, and the main challenge for Brazil's innovation policy is to encourage business sector innovation. To this end, policy is beginning to take a broader approach in order to exploit potential synergies between promotion of science and technology, support for R&D, and fostering trade competitiveness. A four-year national plan for science, technology and innovation was approved at the end of 2007. Its goals are to increase the number of qualified human resources, investment in R&D, and enterprise innovation. It emphasises: strengthening the national science and technology system; innovation; R&D in strategic areas such as biotechnology, nanotechnology, information technology, energy, climate change and the Amazon; and science and technology for social development.

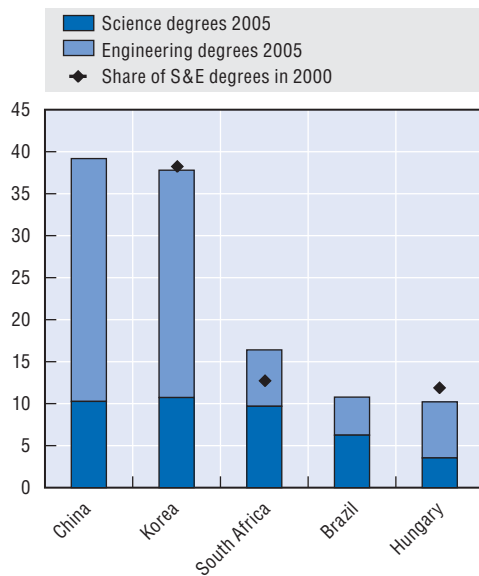
Science and innovation profile of Brazil



StatLink <http://dx.doi.org/10.1787/454220075446>

Science and engineering graduates, 2005

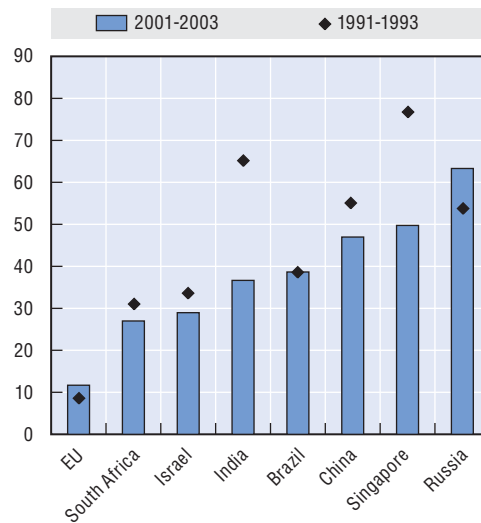
Percentage of all tertiary graduates



StatLink <http://dx.doi.org/10.1787/454223745073>

Foreign ownership of domestic inventions, 2001-03

Percentage



StatLink <http://dx.doi.org/10.1787/454341514666>

Chapter 3

Science and Innovation: Country Notes

This chapter complements Chapters 1 and 2 by providing an individual profile of the science and innovation performance of each OECD country, as well as observers to the OECD Committee on Science and Technology Policy (Brazil, Chile, China, Israel, Russia and South Africa), in relation to their national context and current policy issues. The graphs enable countries to see some of their relative strengths and weaknesses as compared to other countries' performance.

The common indicators in the first (radar) graphs were selected on the basis of current policy issues. They focus on research and innovation inputs, scientific and innovation outputs, linkages and networks, including international linkages, and human resources. A standard set of indicators is used; however, when data are not available, alternative indicators may be applied. The annex provides a full list and description of the indicators, methodological notes and data sources.

For each indicator in the radar graph, the country with the maximum value is set at 100, taking into account all OECD and non-OECD countries with available data. The average is calculated by taking into account all OECD countries with available data (non-OECD countries are excluded from the average). The annex provides further details.

The radar graphs are accompanied by country-specific figures that further illustrate national characteristics and underpin policy-specific comments. The selection of comparator countries in these graphs aims to highlight the general position of the focal country and, in some instances, data on other countries may also be shown.

Table of Contents

Executive Summary	11
Chapter 1. Global Dynamics in Science, Technology and Innovation	17
Introduction	18
Drivers of economic growth	18
R&D dynamics: the changing landscape	20
Innovation in key technologies	33
Innovation performance varies across countries	37
Financing innovation	39
Patents and scientific publications surge	42
Demand for human resources accelerates	46
Summary	55
Notes	55
References	55
Chapter 2. Main Trends in Science, Technology and Innovation Policy	57
Introduction	58
National strategies for science, technology and innovation	60
Strengthening public research and public research organisations	71
Support for business R&D and innovation	77
Enhancing collaboration and networking among innovators	87
Globalisation of research and innovation	90
Human resources for S&T	93
Evaluating innovation policies	99
Outlook: future challenges	101
Notes	102
References	102
Chapter 3. Science and Innovation: Country Notes	103
Australia	104
Austria	106
Belgium	108
Canada	110
Czech Republic	112
Denmark	114
Finland	116
France	118
Germany	120
Greece	122

Hungary	124
Iceland	126
Ireland	128
Italy	130
Japan	132
Korea	134
Luxembourg	136
Mexico	138
The Netherlands	140
New Zealand	142
Norway	144
Poland	146
Portugal	148
Slovak Republic	150
Spain	152
Sweden	154
Switzerland	156
Turkey	158
United Kingdom	160
United States	162
Brazil	164
Chile	166
China	168
Israel	170
Russian Federation	172
South Africa	174
Annex 3.A1	176
Chapter 4. Assessing the Socio-economic Impacts of Public R&D: Recent Practices and Perspectives	189
Introduction	190
Defining the impacts of R&D	190
Key challenges for assessing the socio-economic impacts of public R&D	192
Approaches to impact assessment of public research in OECD countries	193
Impact assessment of research councils and public research organisations	200
Impact assessment of research programmes	207
Non-economic impacts	211
Conclusions	214
Notes	216
References	216
Chapter 5. Innovation in Firms: Findings from a Comparative Analysis of Innovation Survey Microdata	219
Introduction	220
Using microdata from innovation surveys	220
Innovation indicators	223
Technological and non technological innovation	235

Innovation and productivity	239
Innovation and IPR	246
Final remarks	253
Notes	254
References	255
Annex 5.A1. Tables	257

Boxes

1.1. Science performance and research intensity: PISA results	52
2.1. Recent research and innovation policy developments at European Union level	75
2.2. Recent research and innovation policy developments in the United States	78
2.3. Recent research and innovation policy developments in China	79
2.4. The SME offensive in the Netherlands	86
2.5. Life-cycle support of human resources in S&T (HRST) in Korea	96
2.6. International mobility policies of the European Commission	98
2.7. Evaluation of the impact of S&T and innovation policies in Portugal	100
4.1. Eleven dimensions of the impacts of science	191
4.2. The main challenges for analysing the economic and non-economic impacts of public R&D	193
4.3. Guellec and van Pottelsberghe de la Potterie's macroeconomic model	195
4.4. Capitalisation of R&D: methodological issues	197
4.5. Linking GBAORD data to publication and patent data sets: the example of human health	201
4.6. The Monash model	204
4.7. Reductions in the direct costs of illness through NIH medical research	206
4.8. The role of the NIH in reducing disease	206
4.9. The NEMESIS model	208
4.10. The Business Reporting System Survey	210
4.11. Swedish traffic safety research	213
5.1. Defining innovation	225
5.2. The model in a nutshell	240
5.3. Some measurement hurdles	243
5.4. The model	252

Tables

1.1. Investment in intellectual assets in five OECD countries, by asset category	40
2.1. Revised or new national plans for science, technology and innovation policy in OECD countries and selected non-member economies 2008	64
2.2. Targets for R&D spending	72
2.3. Recent or proposed changes in R&D tax incentives in OECD and selected non-member economies, 2008	81
2.4. Recent or proposed changes in IPR-related policies in OECD and selected non-member economies	88

2.5. Recent policy changes to promote inward R&D and innovation investments through foreign direct investment.	92
2.6. Recent efforts to improve the development of human resources in science and technology (HRST).	95
3.A1.1. Radar graph indicators and values	179
3.A1.2. Radar graph country data notes.	182
3.A1.3. Radar graph: country with maximum value	185
3.A1.4. Radar graph data sources and methodological notes	186
3.A1.5. Country-specific figures: data sources	187
4.1. Public R&D budget shares by socio-economic objectives, 1995 and 2006	200
5.1. Which firms are more likely to be innovative?	242
5.2. Which firms spend more on innovation?	244
5.3. What is the impact of product innovation on labour productivity?	245
5.4. Product innovation and labour productivity: robustness checks	246
5.A1.1. Summary of findings from the factor analyses	257
5.A1.2. Impact of the different modes of innovation on productivity.	258

Figures

1.1. The sources of real income differences, 2006	19
1.2. Contribution to growth of GDP, G7 countries, 1985-2006 and 2001-06	20
1.3. R&D trends, 1996-2006.	21
1.4. GERD Intensity by country, 1996, 2001 and 2006	22
1.5. Business R&D spending by area, 1996-2006	23
1.6. BERD intensity by country, 1996, 2001 and 2006	24
1.7. Business R&D intensity and share of R&D performed by firms with 500 or more employees, 2005 (or nearest year).	24
1.8. Business R&D expenditures in services and manufacturing, 1995-2004	25
1.9. Government-financed R&D, 1996, 2001 and 2006	26
1.10. Change in government R&D budgets, 2002-07 (or latest available years)	27
1.11. Direct and indirect government funding of business R&D and tax incentives for R&D, 2005 (or latest available year)	28
1.12. R&D performed in higher education and government research institutes by area, 1996-2006	29
1.13. Higher education research and development, 1996, 2001 and 2006	30
1.14. Higher education research and development expenditure by field of study, 2005.	30
1.15. Share of higher education R&D financed by industry, 1996, 2001 and 2006	31
1.16. R&D funds from abroad, 1996, 2001 and 2006	32
1.17. R&D expenditure of foreign affiliates, 1995, 2000 and 2005	33
1.18. Total expenditure on biotechnology R&D by biotechnology-active firms, 2003 (or latest available year)	34
1.19. Nanotechnology patents as a percentage of national total (PCT filings), 2002-04.	35
1.20. Countries' shares in environmental technology patents filed under the PCT, 2000-04	36
1.21. Renewable energy patenting, by energy source, 1990-2005	36

1.22. Share of turnover from new-to-market product innovations, by firm size, 2002-04 (or latest available years)	37
1.23. Non-technological innovators, 2002-04 (or latest available years)	38
1.24. Firms with foreign co-operation for innovation, 2002-04 (or latest available years)	39
1.25. Venture capital investment, 2006.	41
1.26. Share of high-technology sectors in total venture capital, 2005 (or latest available year)	42
1.27. Triadic patents, 2005	43
1.28. Annual growth rates of patenting, 1997-2004	44
1.29. Patents with foreign co-inventors, 2002-04	45
1.30. Scientific articles, 2005	45
1.31. Growth of scientific articles by area, 1995-2005	46
1.32. Growth rate of HRST occupations and total employment, 2000-06	47
1.33. Growth of HRST employees by industry 1995-2004 (or latest available years)	48
1.34. R&D personnel, 2006	48
1.35. Growth of R&D personnel, 1996-2006	49
1.36. Women researchers by sector of employment, 2006.	50
1.37. Science and engineering degrees, 2005	51
1.38. PhD graduates in science, engineering and other fields, 2005	53
1.39. Distribution of foreign students by country of destination, 2005	54
1.40. Distribution of international and foreign students by field of education, 2005	54
2.1. Governance of S&T Policy in the Netherlands	68
2.2. Civilian GBOARD by main socio-economic objectives, selected OECD countries, 2007	72
2.3. Tax treatment of R&D in OECD and non-member countries, 2008	83
2.4. Venture capital investment as a percentage of GDP, 2003 and 2006	84
4.1. Overall GBAORD by socio-economic objective, OECD countries, 2006	199
4.2. Evolution of global GBAORD by socio-economic objective, 1995-2006	199
4.3. Relationship between “enhanced” health GBAORD data and main health-related publications, 2004.	201
4.4. Relationship between “enhanced” health GBAORD data and health-related patents (PCT), 2004.	201
4.5. Framework for analysing the effects of research on well-being	212
5.1. Firms having introduced a product or process innovation (as a % of all firms), 2002-04 (or closest available years)	226
5.2. Firms having introduced a marketing or organisational innovation (as a % of all firms), 2002-04 (or closest available years)	227
5.3. Share of turnover from product innovations (as a % of total turnover), 2002-04 (or closest available years)	228
5.4. Output-based modes, all firms, 2002-04 (or closest available years)	230
5.5. Output-based modes, all firms, employment weights, 2002-04 (or closest available years)	231
5.6. Output-based modes manufacturing and services, 2002-04 (or closest available years)	232

5.7. Output-based modes manufacturing and services, 2002-04 (or closest available years)	232
5.8. Innovation status, all firms, 2002-04 (or closest available years)	233
5.9. Share of firms collaborating on innovation, 2002-04 (or closest available years).	234
5.10. Share of firms collaborating on innovation, 2002-04 (or closest available years).	235
5.11. Patent families per million population	248
5.12. Propensity to use IPR (patents and trademarks)	249
5.13. Propensity to use IPR (patents and trademarks)	249
5.14. Propensity to use IPR (patents and trademarks)	250
5.15. Propensity to use IPR (patents and trademarks)	250
5.16. Incentive effects of patents on firms' total innovative effort	251
5.17. Incentive effects of patents on firms' R&D effort	251