Document of
The World Bank

Report No. 17178-BR

PROJECT APPRAISAL DOCUMENT

FOR A

PROPOSED LOAN

IN THE AMOUNT OF US$155.0 MILLION

TO THE

FEDERATIVE REPUBLIC OF BRAZIL

FOR A

SCIENCE AND TECHNOLOGY REFORM SUPPORT PROJECT

November 26, 1997

Department of Human Development
Brazil Country Management Unit (LCC5C)
Latin America and the Caribbean Region

CURRENCY EQUIVALENTS

(Exchange Rate as of April 1997)
Currency Unit = Real (R$)
US$1.00 = $1.00 Real

FISCAL YEAR

January 1 to December 31

WEIGHT AND MEASURES

The metric system has been used throughout this report

SELECTED ABBREVIATIONS AND ACRONYMS

ABC	*Academia Brasileira de Ciências* (Brazilian Academy of Sciences)
ABIPTI	*Associação Brasileira de Institutos de Pesquisa Tecnológica* (Brazilian Association of Technological Research Institutes)
ANPEI	*Associação Nacional de Pesquisa Econômica e Industrial* (National Association for Economic and Industrial Research)
ASPE	*Assessoria de Programas Especiais* (Special Program Office)
BNDES	*Banco Nacional de Desenvolvimento Econômico e Social* (National Bank for Economic and Social Development)
CAPES	*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (Coordinating Agency for Graduate Education)
CAS	Country Assistance Strategy
CA	*Comitê Assessor* (Advisory Council, PADCT)
CS	*Comitê Supervisor* (Supervisory Committee, PADCT)
CCT	*Conselho Nacional de Ciência e Tecnologia* (National Council for Science and Technology)
CNI	*Conselho Nacional da Indústria* (National Council of Industry)
CNPq	*Conselho Nacional de Desenvolvimento Científico e Tecnológico* (Brazilian National Council for S&T Development)
CSCG	*Colegiado da Secretaria de Coordenação e Gerenciamento* (Collegiate of the SCG)
EMBRAPA	*Empresa Brasileira de Pesquisa Agropecuária* (Brazilian Corporation for Agricultural Research)
FAP	*Fundação de Amparo à Pesquisa* (State Foundation for the Advancement of Research)
FINEP	*Financiadora de Estudos e Projetos* (Brazilian National Foundation for Technology Development)
GCCT	*Grupo Consultivo de Ciência e Tecnologia* (International Consultative S&T Group)
GERD	Gross Expenditure on R&D
GDP	Gross Domestic Product
GOB	Government of Brazil
GPA	*Grupo de Planejamento e Avaliação* (Planning and Evaluation Group)

Vice President	**Sahid Javed Burki**
Director	**Gobind T. Nankani**
Country Sector Leader	**Patricio Millan**
Task Manager	**Alcyone Saliba**

GTC	*Grupo Técnico de Coordenação* (Technical Coordinating Group for Monitoring and Evaluation)
IBGE	*Instituto Brasileiro de Geografia e Estatística* (Brazilian Bureau of Census
INMETRO	*Instituto Nacional de Metrologia* (National Institute of Metrology)
INPI	*Instituto Nacional de Propriedade Industrial* (National Institute of Industrial Property)
INT	*Instituto Nacional de Tecnologia* (National Institute of Technology)
IPT	*Instituto da Pesquisas Tecnológicas* (Technological Institute for Research)
IRR	Internal Rate of Return
LCSHD	Department of Human Development, LAC
LENA	Project Appraisal Phase of the Lending Cycle
LENN	Project Negotiations Phase of the Lending Cycle
LENP	project preparation phase of the lending cycle
M&E	Monitoring and evaluation
MCT	*Ministério da Ciência e Tecnologia* (Ministry of Science and Technology)
MO	*Manual Operativo* (operational manual)
MSTQ	Metrology, Standards, Testing, and Quality
NGO	Nongovernmental organization
NIC	Newly industrialized country
NPV	Net present value
OECD/DSTI	Organisation for Economic Cooperation and Development/Division of Science, Technology and Industry
PACTI	*Programa de Apoio à Ciência e Tecnologia Industrial* (Program for the Advancement of Industrial Technology)
PADCT	*Programa de Apoio ao Desenvolvimento Científico e Tecnológico* (Program to Support Scientific and Technological Development)
PATME	*Programa de Apoio Técnico às Micro-Empresas* (Technical Support Program for Small Businesses)
PIP	*Plano de Implementação do Projeto* (Project Implementation Plan)
PIs	principal (scientific research) investigators
R&D	Research and development
R&D&E	Research and development and nonroutine engineering
S&T	Science and technology
SBPC	*Sociedade Brasileira de Progresso para a Ciência* (Brazilian Society for Scientific Development)
SCG	*Secretaria de Coordenação e Gerenciamento* (Management and Coordination Secretariat) of PADCT
SEBRAE	*Serviço Brasileiro de Apoio às Micro e Pequenas Empresas* (Brazilian Support Service for Small Businesses)
SECAV	*Secretaria de Acompanhamento e Avaliação* (Secretariat for Monitoring and Evaluation, MCT)
SETEC	*Secretaria de Desenvolvimento Tecnológico* (Secretariat for Technological Development, MCT)
SME	Small- and medium-scale enterprises
SOE	Statement of expenditures
TIB	*Subprograma de Tecnologia Industrial Básica* (Basic Industrial Technology Subprogram)
US NSF	United States National Science Foundation
WB	The World Bank
WDR	World Development Report, The World Bank

BRAZIL
Science and Technology Reform Support Project

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International Bank For Reconstruction and Development
International Development Association

Latin America and the Caribbean Region
LAC: Country Department I

PROJECT APPRAISAL DOCUMENT SUMMARY

BRAZIL
Science and Technology Reform Support Project

Date: November 26, 1997											
Task Team Leader: Alcyone V. R. Saliba						Country Manager: Gobind T. Nankani					
Project ID: BR-PE-38947						Sector: Human Development					
POC:											
Lending Instrument: Investment Maintenance Loan						PTI:	X	YES		NO	
Project Financing Data:	X	Loan		Credit		Guarantee		Other (Specify)			
For Loans/Credits/Others:											
Amount (US$m/SDRm): $155 million											
Proposed Terms:		X	Multicurrency			Single currency					
Grace period (years):	5 yrs	X	Standard variable			Fixed		LIBOR-based			
Years to maturity:	15 yrs										
Commitment fee:	0.75 %										
Service charge:	Variable										
Financing Plan(US$m):											

Source	Local	Foreign	Total
Government of Brazil	155.0		155.0
Cofinanciers (private firms)	50.0		50.0
IBRD	61.0	94.0	155.0
Total:	270.0	94.0	360.0

Borrower: Federative Republic of Brazil					
Guarantor: n.a.					
Implementing agency: Ministry of Science and Technology (MCT)					
Estimated disbursements (Bank FY/US$m)	1998	1999	2000	2001	
Annual	15	30	50	60	
Cumulative	15	45	95	155	
Expected effectiveness date: May 1998		Closing date: May 2002			

Block A: Project Description

1. Project development objectives

The objective of the project is to improve the overall performance of Brazil's science and technology sector by undertaking activities that promote scientific research and technological innovation in an efficient manner. It will support reform efforts and finance investments designed to: (a) stimulate private sector financing and execution of research and development; (b) increase and improve the stock of S&T human capital; and (c) supply support services required to increase the efficiency of public and private investments in S&T activities. To accomplish its objecctive, the project will:

- Promote cooperative research and development and nonroutine engineering (R&D&E) activities between firms and the S&T community;
- Improve the quantity, quality, and relevance of S&T research and advanced training;
- Reduce the regional disparity in S&T capacity;
- Rationalize public investments in S&T;
- Strengthen IPR (intellectual property rights) administration and MSTQ (metrology, standards, testing, and quality) services to foster a favorable environment for investment in R&D by firms.

Priority will be given to subprojects of social and economic relevance; at least 10 percent of the funds of the Technology Development and the Science and Technology research components will be allocated to subprojects that, in addition to meeting the technical merit and social relevance criteria, also can contribute to strengthening S&T capacity in the less developed regions of the country. These and the other criteria and principles for subproject selection are described in the project implementation plan (PIP) or the operational manual (MO), or both.

2. Project components

Component	*Categories*	*Cost (US$m)*	*Total (%)*
1. **Technology development to stimulate R&D&E activities in the private sector, focusing, inter alia, on innovations[1] by small- and medium-scale enterprises (SMEs)**, on ways to streamline access to public incentives for R&D (such as tax exemptions programs) and on greater productive use of scientific and technological resources (both human and physical) by firms. It will support subprojects competitively selected and co-financed by firms.	Physical investment and institution building	147	41

[1] Innovation includes research, development, and nonroutine engineering and is abbreviated by the acronym R&D&E. Nonroutine engineering involves activities connected with new products and processes; for example, retooling or detailing designs and/or specifications, introducing Total Quality Management or ISO 9000 programs, reorganizing production plants, and readapting mechanisms.

Component	*Categories*	*Cost (US$m)*	*Total (%)*
2. **Science and technology research to increase and improve the stock of high-level human capital**, focusing, among other things, on investments on scientific research and graduate training under improved procedures and policies, including incentives mechanisms aimed at shifting scientists' and technicians' focus toward areas more relevant to the productive sector.	Institution-building and project management	147	41
3. **Sectoral support to improve efficiency and quality throughout the S&T system.** This will support portfolio reforms, improved monitoring and evaluation systems, protection of intellectual property rights, and provision of metrology, standards, testing, and quality (MSTQ) services. These activities will provide important quasi-public goods (such as the strengthening of the intellectual property rights regime) required for greater private sector investment in technological innovation.	Physical investment and institution building	44.4	12
(Unallocated plus contingencies plus project management)		21.6	6
	Total	$360	100%

3. Project strategic management

See Annex 3 for a summary of the project's administrative structure; the details are in the project implementation plan (PIP) and in the operational manual (MO).

4. Benefits and target population

The proposed project is expected to have (a) financial benefits, because it will improve the efficiency of the Government of Brazil's (GOB's) portfolio of investments in the sector; (b) economic benefits, because it will increase the private sector's investment in R&D; and (c) institutional benefits, because it will introduce performance criteria for public institutions that provide services to the S&T and R&D communities. The immediate beneficiaries will be (a) firms that will have greater access to more relevant research and development capacity, including an improved stock of human capital for S&T; (b) graduate students in S&T-related fields who will receive advanced training through their work with principal investigators on original research; and (c) scientists who will work in a system with greater capacity to interact with private firms and to produce world-class research. Firms and scientists will also work together more efficiently, since the project will bundle funding instruments which would otherwise be fragmented (such as funds for equipment, maintenance, consumables, and graduate students). Until now, fragmented resources and excessive bureaucratic requirements of different funding agencies have delayed and disrupted research. Long-term development benefits are expected to accrue to the general society through advances in specialized fields (such as health and agriculture) through increased economic productivity, and through the public sector's improved performance in managing funds.

5. Institutional and implementation arrangements

The organizational framework for the project is presented in the Project Implementation Plan (PIP) and is detailed in the Operational Manual (MO). Both documents were produced by Brazil's Ministry of Science and Technology (MCT). The PIP and MO are the basic reference documents for the project. MCT will have the coordinating role, while separate agencies will implement component activities. Most S&T activities will be implemented by Brazil's funding agencies for higher education (CAPES), research (CNPq), and technology (FINEP). Initially, the Technology Development Component will be implemented primarily through FINEP and SEBRAE. Other activities will be located in: (a) science policy-making councils, such as the National Council for Science and Technology (CCT), Brazil's highest-level S&T policymaking body (which is chaired by the President of Brazil); (b) agencies with special responsibilities, such as the Brazilian Bureau of Census (IBGE) and the National Institute for Industrial Property (INPI); and (c) universities or foundations that manage S&T research funds.

Block B: Project Rationale

6. CAS objective(s) supported by the project

Document number: 16582-BR Date of latest CAS discussion: June 12, 1997

The project's development objective is to improve the performance of the Brazilian S&T sector and thus contribute to the GOB's national development strategy to accelerate private sector-led economic growth (that is, growth financed and generated primarily by firms). The World Bank supports this strategy, which "gives high priority to raising the private sector's productivity and international competitiveness [by] ... increasing investments in human capital; and developing the country's capacity to innovate through investments in the science and technology sector" (6/27/97 CAS: para. 27). Project activities support several important CAS objectives: (a) The rationalization of MCT's portfolio and improved sectoral monitoring and evaluation will contribute to the objective of public sector reform aimed at "improved fiscal performance at the national and subnational level (para. 24). (b) The matching grant subcomponent is designed to remove information and other barriers to technological investments via improved cooperation between firms and the S&T sector, thus leading to productivity and competitiveness gains, which are explicit CAS goals (para. 27). (c) Improved IPR administration and strengthened MSTQ services should also improve productivity and competitiveness, especially in export-oriented firms. (d) Technology assistance to SMEs will contribute to the CAS objective of improving the efficiency and competitiveness of SMEs. The SME sector is an important part of the economy but "lags in modernization, product quality, and production efficiencies" (para. 42). Most nations fund R&D because these activities generate important externalities and help overcome market imperfections associated with the creation and dissemination of knowledge. The cooperative nature of activities in this project will both increase the volume of private sector R&D funding and maintain a focus on the areas where potential externalities are greatest.

7. Main sector issues and government strategy

Sector Issues

Underinvestment by the private sector in R&D. Brazil spends comparatively little of its gross domestic product (GDP) on R&D: it spent about 0.5 percent in 1992, which is only slightly more than the Latin American and Caribbean (LAC) regional average of 0.4 percent. This figure is significantly lower than expenditures of the newly industrializing countries (NICs) in Asia, which were on average 1.3 percent of GDP during the same period. Moreover, the public sector provides about 75 percent of Brazilian R&D funding, compared to 25 percent in the NICs. However, such patterns can be changed fairly quickly. Only two decades ago, the Republic of Korea had levels of R&D spending and patterns of funding similar to those in Brazil.[2] Since then, R&D investment in Korea increased significantly, and it is believed that the substantial growth of private sector involvement in innovation contributed to a dramatic rise in productivity.

Protected far too long by trade barriers, Brazilian industry has neither invested substantially in R&D, cultivated links with the S&T community, nor engaged in activities that promote long-term competitiveness. The current economic stabilization, trade liberalization, and regulatory reform (including the new intellectual property rights law) have improved the economic environment for innovation, and there are already signs of increased private sector interest in R&D&E activities. However, the institutional structure for joint R&D activities is still weak: information exchange is poor, and firms have little experience cooperating with public entities.

Limited science and technology capability. Although pockets of international-quality research exist in Brazil,[3] in general, the quantity produced is smaller than would be expected and generally does not have the quality and relevance it should, given Brazil's ambitions and economic importance. With respect to quantity, Brazil is the world's seventh largest economy, accounting for 2.2 percent of global GDP, yet it produces only 0.73 percent of the world's published scientific research.[4] Conversely, Korea has almost four times the number of researchers to total labor force (32 versus 9 per 10,000). With respect to quality, citations of Brazilian research in international journals and patents granted to Brazilians are still quite low. With respect to relevance, very few researchers work in the private sector (just 2.5 percent, compared with 50 percent in Korea).

Inefficient use of public resources for S&T research and human capital formation. Public investment in S&T has been fragmented and uneven; it also has lacked continuity and client orientation. The Bank-supported PADCT I & II projects helped create an atmosphere that facilitated the production of international-level research by promoting the principles of transparency, competition, peer review, and client responsiveness. With the new project, efficiency should improve even more, as the principles will be operationalized throughout the sector. In particular, the project will streamline client access to MCT services by promoting a "one-stop shop" approach to finance innovations.

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[2] Korea had one corporate R&D laboratory in 1971; it had 455 by 1987 (Kim, Linsu, "National Systems of Industrial Innovation: Dynamics of Capability Building in Korea" in *National Systems of Innovation*, R. Nelson, editor).

[3] Partly due to the PADCT I & II projects, both of which were cofinanced by the World Bank.

[4] T. Schott, University of Pittsburgh, manuscript. Figures based on analysis of ISI data for 1993-95.

Lack of reliable information to guide policymaking. Databases of sectoral data exist — but these are limited, not highly reliable, and often *ad hoc* in their timelines and institutionalization. While data collection has improved in recent years, overall M&E is seriously deficient for a sector in which roughly US$2 billion is invested annually and for an economy of the size and complexity of Brazil's. The M&E data produced under the project will be a critical input to a midterm review, during which the progress of both the project and sector reform will be judged, on the basis of reliable S&T indicators to be routinely produced within MCT. At that point, the World Bank will reassess its support to the sector; continued support for the post-midterm review phase of the project will be determined, among other things, on the basis of information generated by the project-supported M&E.

Regional disparities in S&T capacity. S&T capacity, especially of an international quality, is concentrated in the south and southeast, as is illustrated by the geographic distribution of the research groups that receive funding under MCT programs. For example, the PRONEX program rigorously reviews the performance and credentials of applicant research groups and awards multi-year "core funding" grants to those deemed outstanding. Of these, 97 percent are in six states of the south and southeast — Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, and São Paulo.

Government Strategy

The government's multi-year plan (*O Plano Plurianual 1996-2000)* seeks to raise the percentage of GDP invested in S&T to a level more comparable to that of economically advanced countries: from the currently estimated level of 0.7 to 1.5 percent[5]. For the S&T sector, the priorities are to:

a) increase the percent of R&D by the private sector (from its current 20 to 40 percent) while expanding the overall amount of resources available for S&T;
b) improve the efficiency of resource allocations and integrate existing programs to promote more S&T;
c) monitor program impacts more closely;
d) increase university and industry cooperation;
e) increase the number of qualified scientists, engineers, and technicians, according to the needs of the economy;
f) provide essential support services for the S&T sector, such as protecting intellectual property rights and providing metrology, standards, testing, and quality (MSTQ) services;
g) introduce greater stability and continuity in the flow of resources to academic and technological research;
h) decrease the regional disparity between R&D in the south and southeast, which currently obtain most of the funds for this purpose, and the north, northeast and center west, which receive very little;
i) redefine the role of S&T agents and institutions within the context of a more efficient public administration;
j) improve tax and fiscal incentives to foster more private firm-led R&D;
k) improve the management performance and improve the client orientation of the country's technological institutes; and
l) expand the national role in the space and military fields.

[5] For comparison, the OECD average is 2.2 percent.

This strategy was developed through dialogue among various national and international agencies, including the OECD, IADB, World Bank, SRI, and various universities and private consulting firms. Over the past two and a half years, many jointly sponsored fora for discussion were organized. These included: (a) a conference on the direction of S&T policy in Brazil (summarized as WB Discussion Paper No. 325 "Institutional and Entrepreneurial Leadership in the Brazilian Science and Technology Sector: Setting a New Agenda"); (b) a series of sector studies, including "Estudo da Competitividade da Indústria Brasileira" (L. Coutinho, editor), "Science and Technology in Brazil: A New Policy for a Global World," and "Ciência e Tecnologia no Brasil: Política Industrial, Mercado de Trabalho, e Instituicões de Apoio" (S. Schwartzmann, editor); (c) a "Logical Framework" workshop attended by key stakeholders (Brasília, June 3-5, 1996), at which critical issues for the sector were discussed; and (d) the compilation and analysis of all the GOB's investments in the sector, in "An Overview of Brazilian S&T Portfolio."

As a result of this dialogue, the government committed itself to a six-year program of reform and investment in the sector. The GOB's intentions are stated in a summary of sector policies, attached as Annex 1, which describes the nature of the reform the MCT is spearheading. The project will support the first phase (four years) of this reform. During the midterm review of the project, the Bank may consider supporting the second phase, assuming the objectives of the four-year PADCT III will have been achieved. The GOB has stated that it intends to carry out phase two of the reform program, even if alternative sources of financing need to be sought.

8. Sector issues to be addressed by the project and strategic choices

The project will directly address priorities (a) through (h) listed in the Government of Brazil's strategy. That is, it aims to help the GOB in its goals to:

a) Increase private R&D expenditure from its current 20 to 40 percent of the total investment;
b) Improve resource allocation and integrate existing programs for S&T;
c) Monitor program impacts more closely;
d) Increase university and industry cooperation;
e) Increase the numbers of qualified scientists, engineers, and technicians in Brazil, according to the needs of the economy;
f) Provide essential support services, such as strengthening intellectual property rights and providing metrology, standards, testing, and quality (MSTQ) services;
g) Improve stability and continuity of resources for academic and technological research;
h) Decrease the regional disparity in R&D capacity (relative to economic capacity) in the richer south and southeast regions, and the north, northeast, and center west.

These issues fall directly under the project's three main goals: (a) fostering more R&D investment by firms, (b) improving advanced training (via, among other things, improved quality of research output), and (c) providing the support services needed for (a) and (b) to materialize.

Priorities (i) through (k) will not be directly targeted, but may nevertheless be indirectly and positively influenced as a result of the project activities. While they are important adjuncts to the objectives, the project is considered meritorious and its objectives attainable without them. The GOB is also addressing these priorities through other means. Priority (l) will not be addressed by the project.

9. Project alternatives considered and reasons for rejection

Providing technical assistance for policy reform only. Improvement of the policy environment for innovation is needed, but by itself is not sufficient to create a more efficient sector. Most constraints to R&D are institutional or regulatory, or both: constraints include: fluctuating and fragmented S&T resources, bureaucratic delays that interrupt research, and lack of transparency. Increased investments in scientific research, coupled with improved funding mechanisms, are critical to overcome these constraints. In the same way, private sector input is essential to the relevance of the R&D agenda, and can be accelerated with proper incentives, which will be supported by PADCT III.

Reforming federal and state technological institutes. Many Brazilian public research and technological institutes are isolated from their intended clients in industry. They concentrate on publishing research rather than technical problem-solving, do not produce leading research, and are generally overstaffed and inefficient. However, in the most important cases, reform is already underway. For example, EMBRAPA, the largest federal agricultural research institute, was reorganized recently to improve its client orientation; it is receiving World Bank support for an operation that will decentralize and diversify the national agricultural research system. The *Instituto de Pesquisas Tecnológicas* (IPT) in São Paulo reduced its staff by more than 1,000, while increasing its annual revenue from outside sources from $10 million in 1994 to $24 million in 1996. The *Instituto Nacional de Tecnologia* (INT) is also undergoing a self-initiated reform. It was decided not to make reform of state-level institutes (where the bulk of the inefficiencies exists) a major project focus because, as they are state rather than federal entities, they are not under the jurisdiction of the MCT. Any "outside" top-down attempt to reform them could be impeded by complex issues (about employment and related regulations) surrounding state and federal authority. Nonetheless, it is hoped their reform will be promoted through the general rationalization of the sector that will occur under the project and through their participation in some of the project activities (for example, in the area of MSTQ).

Promoting R&D through venture capital. Private sector R&D may be constrained by lack of access to venture capital. However, preliminary investigations suggest that the project should not focus on financial institutions; rather, it should first address other bottlenecks in Brazil's innovation system. This decision was based on indications that external financing is not the major constraint, and that strengthening the financial markets was a substantial task unsuited for this project. Private sector cofinancing of matching grants is expected to be raised internally within the firms or consortia executing the grants. Moreover, studies indicate that developing capacity in the private financial services industry for R&D funding will require strengthening of the intellectual property rights regime (to be supported by the current operation). This is a necessary condition if venture capital initiatives focused on innovation are to succeed.

Establishing a foundation to develop technology. Initially, the idea of creating a special foundation to promote and market technology for strategically selected areas of national comparative advantage (patterned after the Fundación Chile model) was considered. However, it was decided that a broader technology promotion program would be more suitable to Brazil's large and differentiated economy.

Focusing only on technology or research. This project intervenes in the innovation process on both the demand side, by working with firms, and the supply side, by working with research institutions. Alternatively, the project could concentrate on either supply or demand, depending on the nature of the constraints. In Brazil, however, both supply of R&D workers and the demand for them have been depressed for some time. Thus, the project will help the economy move to a higher level of R&D by influencing both sides of the innovation process.

10. Major related projects financed by the World Bank or the IADB
(completed, ongoing, and planned)

		Latest Form 590 ratings	
Sector issue	*Project*	*IP*	*DO*
• *Bank-financed*			
Competitive funding mechanisms	Brazil: Science and Technology Project (2489-BR: closed 12/31/91)	2	1
Support for S&T areas of critical relevance to Brazil's development	Brazil: Science Research and Training (3269-BR: closed 12/31/96)	S	S
Agricultural research and technology development	Brazil: Agricultural Technology Development	n/a	n/a
Reform of technological institutes	India: Industrial Development Project (2064-CR: ongoing)	S	S
Science and technology infrastructure	Mexico: Science and Technology Infrastructure Project (3475-MX: ongoing)	S	S
Science and technology research	Korea: Universities Science and Technology Research Project (3203-L: closed 12/31/95)	S	S
Science education	Korea: Program for Science and Technology Education (2437-L: closed 06/30/89)	S	S
• *IADB-financed*			
Technological modernization for firms	IDB Brazil: Science and Technology Program (880/OC-BR 9/95: ongoing)		
Research funding and technology development	IDB Brazil: Science and Technology Development Program (BR-0217 2/91: ongoing)		

11. Lessons learned and reflected in the proposed project design

Several lessons were learned from two previous Bank-supported S&T projects in Brazil (PADCT I & II) and in other countries. Those from the Brazil projects include:

- Macroeconomic stabilization must occur before the productive sector will invest in R&D. The PADCT I & II projects were implemented during a period of persistent high inflation and macroeconomic imbalance. Firms could earn high returns on liquid assets and therefore had no reason to undertake riskier investments in R&D.

- Specific incentives targeted to firms must be in place to induce private sector cooperation and cofunding of R&D activities. PADCT I & II did not achieve significant private sector involvement in setting research priorities and directions or in executing research, in part because firms, which usually are unaware of the benefits from R&D, were not offered any direct incentives to change their behavior.

- Maximum autonomy should be given to principal investigators (PIs) to control research funds; also, any agencies involved in disbursing project funds to researchers should be required to adhere strictly to performance criteria. Fragmented funding and excessive bureaucratic control of resources create delays that impede high-quality research. For example, the inability of PIs to modify equipment requests during the life of a project (based on initial research results) can halt an investigation and make research output irrelevant or meaningless. Thus, grant awards should allow for the funding via a single grant to finance all items (including equipment, training, and access to state-of-the-art scientific information) required for the carrying out of scientific research. The PI, who has the greatest stake in the output of the project, is the logical custodian of these funds.
- Monitoring and evaluation of the sector, protecting intellectual property, and providing metrology, standards, testing, and quality (MSTQ) services are specific subfields within the S&T domain. They may require individually designed, longer-term, and programmatic funding and administrative structures. They should not be funded in the same manner as scientific investigations, as occurred under PADCT I & II.

Lessons from projects in other countries include: (a) clear and objective criteria must be established for including institutions in the project and for deciding on research projects to be financed, in order to create a selection process that stakeholders see as equitable and in which private institutions are more apt to participate (Korea: Universities S&T Research Project, OED Report No. 15754); and (b) a coordinator is needed for specific tasks related to subcomponents (preparation plans through ICR) for multi-ministerial initiatives like science education (Korea: Program for Science and Technology Education, OED Report No. 9569).

An evaluation of the 1996 Industrial Technology Development Project for India cited several pre-conditions for reforming technology institutions: (a) committed leadership within the institutions and parent organizations; (b) a "hard" budget from the government; and (c) autonomy for the institutions, which would allow them to implement changes and hire and fire staff. As these are lacking at the Brazilian state-level technology institutes, it was decided not to directly reform them under this project. They will, however, be indirectly influenced as they compete for funds under its components.

12. Indications of borrower commitment and ownership

Within the S&T sector, the GOB has engaged in an active program of growth and reform, providing significant funding for research and innovation in recent years, and developing an extensive policy agenda. With respect to this project, the GOB has demonstrated commitment and ownership by (a) strongly promoting the project; (b) citing the operation as a top priority in the September 1995 CPPR meeting and similar meetings held afterwards; (c) cooperating with the Bank for the past two years on the S&T policy agenda and sectoral analyses required for project preparation; (d) producing the "Overview of the Brazilian S&T Portfolio" (a detailed synopsis of all federal investments in S&T) and other substantial nonformal sector work; (e) devoting substantial time and resources to revising the project proposal; and (f) sponsoring a participatory "Logical Framework" workshop to plan the reform activities the project would involve. Also, the Government has stated its intention to continue the reform and the investment program into a second phase, after the project is completed, even if funding must be sought from sources other than the World Bank. Phase one (this project) and phase two together constitute a six-year program of reform and investment in the sector.

13. Value added of World Bank support

The Bank has substantial experience in the Brazilian S&T sector as the result of two previous successful operations (PADCT I & II) over the past twelve years; also, it has been an integral partner in the evolving dialogue on S&T policies. In addition, the Bank has expertise in the areas of technology development, private sector incentives for R&D, science funding, and sources of M&E technical assistance. It will continue to facilitate high-level exchange on S&T policy with appropriate international counterparts (for example, the OECD/DSTI, the US NSF, the German National Foundation, and the South African Council of Scientific and Industrial Research). This exchange is essential to defining and implementing a policy agenda commensurate with international best practices. Also, the presence of the Bank as an impartial body helps unify a fragmented sector that has many institutional stakeholders representing various interests and diverse levels of influence over policymakers.

Block C: Summary of Project Assessments

14. Economic assessment

There are several major reasons why the GOB is working with the private sector to increase the level of private R&D&E activities in the country. First, the new macroeconomic environment, which increased competition and monetary stability, has created incentives for greater private sector innovation. Thus, the public sector can accelerate the rate of innovation by improving the market for R&D&E. This includes correcting market information failures and creating institutional mechanisms for bringing together firms and potential R&D&E workers and infrastructure. Second, many innovations have social returns that far exceed their private returns. Finally, the public sector involvement can help correct for the underinvestment in innovation from a social perspective, such as those in S&T for improvements in preventive medicine.

The net present value (NPV) and internal rate of return (IRR) will vary with the project's impact on the growth and efficiency of private sector R&D&E investments. Calculations were made for a range of values. The project would have a positive NPV even at extremely modest levels of impact (0.6 percent growth in investment); at larger rates of growth, it could generate returns in the range of US$0.5 billion. See Annex 5 for the complete economic analysis.

15. Financial assessment

Annexes 4 (Estimated Project Costs) and 6 (Financial Summary) provide a detailed financial assessment of the project. The recurrent costs are well within the capacity of the federal budget for S&T. The project is expected to generate efficiency gains in federal support to the sector, which will contribute to its sustainability.

16. Technical assessment

The project is technically sound. The Science and Technology Research and Sectoral Support Components draw on 12 years of project experience. Several major structural changes, as well as scores of procedural changes, have been introduced based on analyses of previous project performance. The Technology Development Component draws on successful pilot initiatives by the GOB. Project components and performance objectives were also formulated on the basis of international experience and tailored to regional and local conditions.

17. Institutional assessment

The project involves significant cooperation among the coordinating agencies in MCT and various implementing agencies, some of which are not administratively linked to MCT. As a result of considerable dialogue, the various sets of actors defined their roles and responsibilities, and created innovative implementation procedures to solve the main institutional difficulties encountered in previous projects, such as disbursement delays and excessively bureaucratic requirements on PIs. Under the new procedures, if delays of more than 30 days occur in either contracting or disbursing funds, principal investigators can alert the SCG, which will resolve the issue at the *Colegiado da Secretaria de Coordenação e Gerenciamento* (CSCG)'s monthly meeting. Among other things, the CSCG (but not the principal investigators) can initiate the transfer of a grant to a different administrative agency. It should be emphasized that these strict criteria were self-imposed, that is, devised by the implementing agencies themselves. The financial management stems from the two previous projects; the existing system is undergoing significant improvements aimed at adding expediency, reliability, and accountability. The system was assessed and the Bank is satisfied with the project's internal control, accounting and staffing procedures, and audit arrangements as well as its capacity to produce reports in a timely manner. In addition, project management indicators were established.

18. Social Assessment

n.a.

19. Environmental assessment

Environmental Issues:	Major: None
Other:	Appropriateness of guidelines for handling laboratory reagents and for enforcing biosafety.
Environmental Category:	B

20. Participatory approach

	Preparation	Implementation	Operation
Beneficiaries/community groups	IS, CON, COL	IS, CON, COL	IS, CON, COL
Intermediary NGOs	IS, CON	IS, CON, COL	IS, CON, COL
Academic institutions	IS, CON, COL	IS, CON, COL	IS, CON, COL
Private sector	IS, CON	IS, CON, COL	IS, CON, COL
Local government (State)	IS, CON, COL	IS, CON, COL	IS, CON, COL
Other donors	IS, CON		

21. Sustainability

Sector reform will be sustained by the project fostering changes in attitudes and expectations within the S&T community and the private sector. In the case of the former, the new procedures will impose transparency and free the researchers from bureaucratic impediments. The project's operating manual will include procedures that mandate larger grants and direct allocation of resources to principal investigators, and new peer review processes that will allow, for example, the use of international peers, as necessary. With respect to the private sector, subsidies will gradually be eliminated, as firms will begin earning returns from their R&D investments. Moreover, the project addresses the problems experienced during the transition to a more knowledge-based, internationally competitive economy. As a one-time investment in the sector, it would achieve the objective of helping firms adjust their investment in R&D behavior to the new open market conditions.

22. Critical Risks

(see also fourth column of Annex 2)

Risk	*Risk Rating*	*Risk Minimization Measure*
1. Insufficient ownership of project by some implementing agencies and limited consensus on project goals could lead to implementation delays and inconsistencies.	MR	Past consultation and information sharing among representatives of 14 S&T-related agencies; participation of these representatives in a series of policy and procedure seminars; additional workshops and consultations are planned with project support.
2. Deterioration of the macroeconomic situation could limit the private sector's willingness to invest in R&D, as well as halt contracting and payments.	MR/NR	In the event of a serious macroeconomic deterioration, cancellation of the uncommitted part of the project would be sought through standard Bank remedies.
3. Project complexity could hinder or slow implementation.	MR	The task team and supervisory committee would cooperatively restructure, modify, or cancel affected subcomponents.
4. Administrative capacity of the project coordination unit and/or implementing organizations could weaken, if staff turnover (so far almost non-existent) occurs.	MR	Implementation progress will be closely monitored via milestones in the Project Indicators Matrix and through management contracts. If problems are minor or isolated, administration/ implementation would be transferred to other institutions. If problems are significant or widespread, restructuring would be sought.
5. Inadequate response by the private sector to the incentives included in the project.	MR/NR	Incentives to the private sector would be adjusted as appropriate, and the regulatory framework would be revisited.

23. Possible controversial aspects

This project provides for public involvement in private sector investment decisions on R&D&E. In particular, it allows public funds to be used for proprietary research, which is not necessarily deemed desirable. However, market imperfections in R&D&E activities are a major justification for these public expenditures, and their long-run impacts on the Brazilian economy suggest they are worthwhile and necessary if R&D&E is to become more innovative and efficient.

Block D: Main Loan Conditions

24. Effectiveness conditions

The following conditions to effectiveness were agreed upon during negotiations:

a) That each of the agreements between MCT and (i) CAPES; (ii) CNPq; and (iii) FINEP, respectively, have become effective;
b) That the project management unit in MCT (SCG) has been established;
c) That the Annual Operating Plan for the first year of project implementation has been furnished to the Bank;
d) That the Loan Agreement has been duly registered by *Banco Central.*

25. Other:

None.

Block E: Compliance with Bank Policies:

This project complies with all applicable Bank policies.

Task Manager: Alcyone Saliba, LCSHD

Country Director: Gobind T. Nankani, LCC5C

ANNEX 1: SUMMARY OF SECTOR POLICIES

This section describes the Government's program in the science and technology (S&T) sector, including its objectives and proposed reforms and the specific steps that will be taken to ensure its implementation. To assist in its implementation, the Government of Brazil has requested financial and technical assistance from the World Bank.

A. Science and Technology In Brazil

1. Over the last four decades, Brazil has invested a significant amount of resources to build its S&T capacity. A relatively large S&T system and a broad array of institutions and policies evolved during this period. These years were also characterized by an inward-oriented strategy of development and chronic high inflation, which were not conducive to innovation or the building of efficient public S&T-related institutions. With notable exceptions, the ability of Brazil's S&T system to produce top quality research and develop high-level human capital that could promote innovation remained relatively weak despite significant public investment in these activities.

2. Over the last few years, however, Brazil's macroeconomic environment and trade policies have improved significantly. Under the *Plano Real*, inflation has declined to less than 2 percent per month for most of the period since July 1994, eliminating the bias against long-term investment (hence innovation) by the private sector, and uncertainty, fluctuation, and erosion of real budgets for public S&T institutions. At the same time, pressure on the private sector to innovate in order to raise productivity and maintain competitiveness has increased substantially with the opening of the trade regime. Finally, the regulatory framework has been modified to provide incentives to industrial research and development. Technology transfer controls, including, among other things, restrictions to import computer software, have been virtually eliminated. The new Intellectual Property Rights Law, which was introduced in May 1997, now provides protection to innovation. In addition, better fiscal incentives to R&D are now available through Law 8661 of 1993 and Law 8248 of 1991 (the latter for computer software).

3. The reform of the S&T sector is a priority because of its potential to increase competitiveness in Brazil's productive sector. Brazil performs relatively poorly in R&D&E when compared to developed countries. Official data indicate that the country spends comparatively little of its GDP on these activities (close to 1 percent). Moreover, the public sector still provides an excessive share of the R&D&E funding — 75 percent compared to 25 to 50 percent in the newly industrialized countries. The scientific and technological community is growing and strengthening. However, further strides are needed in the quality, quantity, and relevance of research and researchers to industry for Brazil to reach international standards. The ratios of scientific production to economic output, of researchers to total labor force, and of researchers in the private sector to researchers in the public sector all fall below the levels generally deemed appropriate for an economy of the size and complexity of Brazil's. Other constraints to companies' investments are: limited experience of the productive sector in R&D; lack of a tradition to cooperate with the scientific community on a customer-contractor basis; insufficiently supportive S&T public policies and programs; and fiscal incentive regulations that are not well suited to small firms. The reform efforts being spearheaded by MCT also seeks solutions to these problems.

B. Government Strategy

Objectives and Principles

4. The Government of Brazil has embarked on an ambitious reform effort to create an environment conducive to increased and better-focused S&T expenditures. The objective of this reform, as described in the multi-year program (1996–00), is to improve the competitiveness of Brazilian industry by stimulating R&D and the commercialization of research results. With these, the GOB hopes to raise the share of GDP invested in S&T from close to 1 percent currently to 1.5 percent, and to increase the share of R&D expenditures by the private sector from 20 to 40 percent of total expenditures by 2000.

5. This will be achieved through a mix of policy reforms and investment programs aimed at transforming the current S&T system into one that can better innovate and adapt, and which is based on international best practices. This will be achieved by significantly increasing the participation of the private sector in the financing and execution of publicly funded R&D; fostering a better regional balance of S&T expenditures; promoting access of small firms to technology; reorienting human capital formation in S&T to better provide for the personnel needs of industry and academia; establishing adequate mechanisms for sector regulation, oversight, monitoring, and evaluation; and strengthening technology support infrastructure and services.

6. Reform of public spending in S&T will be guided by the principles of client responsiveness and attentiveness to demand; promoting partnerships between public and private entities in defining research priorities and funding measures to encourage competition, transparency, and fairness in resource allocation; widening the use of peer reviews; protecting intellectual property of research results; and sharing the financial benefits of research between public and private participants in the form of royalties and dividends, if commercialized products, processes, and patents turn out to result from MCT-funded partnerships between public and private entities.

(a) Reorienting federally funded research

7. With respect to federally funded scientific research executed by the scientific community in response to government-established priorities, reform will aim at increasing its internal and external efficiency and relevance to a level comparable with best international practice. This will be achieved by:

- Concentrating investments on economically relevant areas (avoiding dispersion of efforts), and ensuring continuity in their funding;
- Rationalizing government programs by coordinating and eliminating overlaps between programs and funding sources;
- Streamlining client access to services of the Ministry of Science and Technology (MCT) and its agencies, by removing bureaucratic bottlenecks in contracting processes and establishing performance criteria for funding agencies;
- Strengthening regional scientific capacity by: (a) promoting platforms of regional interest and financing projects emerging from them; (b) supporting young researchers willing to establish themselves in research groups outside traditionally strong universities; and (c) encouraging twinning relationships;

- Changing criteria and procedures for awarding scholarships for graduate programs, to make their allocation more responsive to academic and industrial demands, and to supply better trained researchers.

(b) Promoting partnerships between public research institutions and private firms

8. MCT intends to substantially expand its programs to finance needed research and development, executed with the scientific community and cofinanced by firms, with MCT playing a catalytic role to bring the productive sector and academia together, by:

- Providing demand-driven, co-financed, matching grants to public institutions (universities, public R&D centers, or technological institutes) that enter into partnerships with private enterprises, to carry out proprietary and non-proprietary R&D oriented toward commercial application;
- Seeking to increase the private sector's share of the financing of the partnership to 50 percent of total global costs of cooperative projects by the end of the program's first phase (the end of the year 2000); and promoting the recovery of the funding by the public sector sharing in royalties, dividends, or other fees that result from research, or other mechanisms, such as recovering equipment and material costs or transforming public grants into loans, where projects produce commercial successes;
- Supporting special programs for SMEs, such as technology assistance, dissemination activities, and outreach programs of SEBRAE, CNI/SENAI, and universities' business offices; using these agencies to get small entrepreneurs to participate in defining research priorities for publicly funded programs, and to promote information-sharing on technological opportunities suited to small businesses.

(c) Building a regulatory environment and research support infrastructure

9. Costs and risks of innovation may also be reduced through better regulations and support infrastructure. These are expected to increase incentives to research, improve access to researchers and research results, and protect the property of research results. In this respect, the government intends to:

- Review on an ongoing basis the remaining regulatory and bureaucratic constraints to private R&D investment, and propose changes for the National Council for Science and Technology (CCT) to consider. For example, such reviews might lead to identifying fiscal incentives that will encourage SMEs to conduct R&D, which are in addition to those already adopted in tax-exempt areas; or, designing better mechanisms to permit inventors in public institutions to be financially rewarded;
- Administer the compliance with the new law on intellectual property rights by strengthening the institutions involved;
- Continue to improve the country's metrology, standards, and testing services and infrastructure.

(d) Improving monitoring, evaluation, and information services

10. Finally, it has become essential to establish mechanisms that can measure the impact and evaluation of government policies and programs and establish reliable international comparisons. To that effect, MCT will:

- Pursue efforts to establish a comprehensive system of M&E with the technical assistance of internationally experienced institutions. It is expected that the system will be established and functioning satisfactorily by mid-1999;
- Promote information exchanges on research programs and results, and help the productive sectors and research community identify new business opportunities that could emerge from them.

C. Institutional Mechanisms to Promote Sectoral Reform

11. The GOB has created institutional mechanisms at the highest level to promote ongoing regulatory and institutional reform and needed changes in the S&T sector. An Inter-Ministerial National Council for Science and Technology (CCT) was established (Law 9257 of January 9, 1996) as an advisory body to the President of the Republic. The CCT has a broad legal mandate to: (a) propose national S&T policy; (b) coordinate government plans, goals, and priorities for S&T, including instruments and resources; (c) evaluate the implementation of S&T policy; and (d) advise on matters related to the development and regulation of S&T. The CCT is chaired by the President of Republic and is composed of seven ministers and seven representatives of producers and users of S&T.

12. In that context, CCT will establish an inter-ministerial Working Group on Sector Reform to identify and propose legal and regulatory changes, and initiate and promote inter-ministerial reform of research programs. This group (whose membership and agenda will be defined by CCT) will also benefit from the work of a Policy Advocacy Group composed of experts invited to perform relevant policy-oriented studies requested by CCT. MCT, as the Executive Secretariat of CCT, will provide budgetary and administrative support to both groups, in particular through its PADCT Coordination Secretariat.

13. Proposals for rationalizing programs managed by MCT and its agencies will be prepared under the leadership of MCT's Coordinating Committee (MCT-CC). This committee has the authority to approve or reject the proposals and mandate their implementation. MCT-CC is presided over by the Minister of Science and Technology and composed of MCT's secretaries and presidents of MCT's agencies (FINEP and CNPq).

D. Costs of the Program

14. It is estimated that implementation of the entire reform and investment program will require funding in the order of about US$700 to US$800 million over six years. The actual first phase of this program (a total of US$360 million) began in mid-1997. This first phase is expected to last about three years. The second phase would begin in the year 2001, after results of the first phase are evaluated and adaptations are made, if deemed necessary.

15. It is understood that full implementation of this program presupposes stability of the current macroeconomic and regulatory frameworks. Significant changes would necessarily imply a reorientation of the sector's priorities and the curtailment of allocations to components.

E. World Bank Participation

16. The World Bank has been invited to participate in both phases of the program. It has agreed to provide funding for the first phase to support all its elements. It will have the opportunity to decide on its possible commitment to the second phase after the midterm review of the first phase; this review is planned for mid-1999.

17. The Government is firmly committed to these reforms and believes World Bank assistance would contribute significantly to their success.

ANNEX 2: PROJECT DESIGN SUMMARY[6]

Narrative Summary	Key Performance Indicators[7]	Monitoring and Supervision	Critical Assumptions and Risks
CAS Objective			
1. Growth of the Brazilian economy sustained	GDP increases	IBGE, Central Bank IMF, WB Data	**Risk**: factors outside the control of the GOB negatively influence the macroeconomic performance
2. Social conditions (health, sanitation, environment, transport, etc.) improved	Statistics in the relevant sectors show improvements	FIOCRUZ (health and sanitation), IBAMA (environmental conditions), IBGE (social conditions)	
Project Development Objectives			
Improved technological performance in Brazil	Number of fully commercialized innovations increased	Occasional specific studies	**Risk**: benefits from increased productive R&D&E investments and improved S&T capacity could be outweighed by deterioration in one or several other internal factors which bear on economic performance (such as exchange rate policy or stability of the banking system)
	Innovations become commercialized more rapidly.	Occasional specific studies	

[6] See Appendices 3 and 5 of the Project Implementation Plan (PIP) for descriptions of M&E activities. These appendices include specific impact and outcome indicators, as well as milestones for their production and for the improvement of data collection activities.

[7] Key performance indicators were defined with reference to the best available baseline data, which are in many cases deficient. Thus, a principal objective of the project is to improve, among others, the quality of data collection and reporting. As the M&E activities are satisfactorily implemented and begin to generate higher quality data and information, adjustments to these indicators may be necessary.

	Positive science- and technology-related externalities increase (in health, sanitation, etc.) or existing negative externalities (pollution, etc.) decrease	Occasional specific studies	
Project Outputs			
1. Private sector investment in R&D&E activities increased	Private sector investment in R&D increases 3 percent more per year than GDP rates increase[8]	ANPEI/IBGE Data	**Assumption**: Results of increased R&D&E activities will be successfully commercialized by firms
	Rate of growth of employment of scientists and engineers in the private sector grows 2.5 percent per year faster than total private sector employment[9]	IBGE/CNPq Data	
2. Number and quality of scientists and engineers trained increased	Enrollment of students in Master's and Ph.D. programs in PADCT-supported disciplines increases at 1.1 times the overall rate of increase of Master's and Ph.D. enrollment. Graduation rates show corresponding increase within appropriate time.	CAPES/CNPq data	**Assumption**: Students respond to increased opportunities for advanced training in scientific and technological disciplines

8 As adjusted for privatization of state-owned enterprises. That is, accounting transfers of R&D activities from the public to the private sector due to privatization of the enterprise conducting R&D will not be counted as fulfilling project objectives of increasing private sector R&D. An increase in the rate of R&D expenditure in an enterprise on or after privatization would be so counted.

9 Idem.

3. Quantity and quality of S&T research improved	Increased number of publications and other bibliometric measures of scientific quality and productivity	Initially outsourced to firms specializing in analysis of ISI data (while MCT personnel are trained in these methods of analysis)	
4. Regional disparity in S&T capacity (with respect to local economic capacity) decreased	Rate of increase in active researchers employed in less favored regions 5 percent above national average	CNPq database/ National Registry of Scientific Capacity	Industry has more regionally balanced access to needed S&T capability; students have more equitable access to advanced training opportunities
	Enrollment of students from disadvantaged regions in Master's and Ph.D. programs in PADCT-supported disciplines increases at 1.2 times the rate of increase of total Master's and Ph.D. enrollment	CAPES/CNPq data	
	Graduation rates show corresponding increase within appropriate time	CAPES/CNPq data	
5. Efficiency gains to public support for S&T	Annual Report on the State of Science and Technology in Brazil; milestones from Indicators Matrix	Secretariat of the Brazilian National Council on Science and Technology (CCT)	Greater orientation and relevance of public investment to ultimate use of S&T capacity by the productive sector
Project Components			**(Components to Outputs)**
1. Technology Development (a) "*Platforms*" which provide a forum for R&D&E stakeholders to identify problems amenable to technological solutions and to establish cooperative R&D&E agendas	US$4 million committed and disbursed to meritorious proposals, as judged by the GCCT	Project Monitoring Unit	**Assumptions:** Information barriers within firms and the R&D&E community reduced or eliminated

(b) *Matching grants* for nonproprietary cooperative R&D&E activities	US$36 million committed and disbursed	Project Monitoring Unit	Economic conditions continue to be conducive to increasing rates of long-term technological investments by firms
(c) *Matching grants* for proprietary cooperative R&D&E activities	US$73 million committed and disbursed	Project Monitoring Unit	
(d) *Technology assistance* for R&D&E activities in SMEs	US$33 million committed and disbursed	Project Monitoring Unit	
2. Science and Technology Research Competitive funding of S&T research in traditional disciplines through improved procedures and mechanisms	US$132 million committed and disbursed	Project Monitoring Unit	Improved competitive funding mechanisms and procedures lead to improved S&T research and training
Special *grants,* including targeted postdoctoral fellowships and "twinning arrangements," to strengthen S&T capacity at universities in less favored regions	US$15 million committed and disbursed	Project Monitoring Unit	(a) Increased number of qualified researchers in scientifically underdeveloped regions, which in turn increases S&T capacity (b) Long-term links between strong and emerging research groups improve research quality and relevance
3. Sectoral Support (a) *Rationalization* of the sector undertaken by task forces with links to National Council on Science and Technology (CCT)	US$9 million committed and disbursed	Project Monitoring Unit	(a) Undue duplication of effort, fragmentation of resources, and unproductive public investments identified and reduced

(b) Sectoral M&E: *technical assistance, training, and coordination of activities* to improve data collection, dissemination, and analysis	US$11 million committed and disbursed	Project Monitoring Unit	(b) Policymakers demand timely, reliable information about the sector
(c) Transitional *fund* for maintenance of existing scientific equipment	US$5 million committed and disbursed	Project Monitoring Unit	(c) Productive physical capital maintained
4. Technology Investment Environment for Firms			
(a) Administration of intellectual property rights by INPI: *technical assistance and institutional strengthening*	US$4 million committed and disbursed	Project Monitoring Unit	(a) Clear and user-friendly legal protection of research results encourages private R&D&E activities
(b) MSTQ: *training, development and dissemination of (industrial) standards, updating and strengthening* of national and regional accreditation system for testing laboratories	US$16 million committed and disbursed		(b) Timely, adequate, and accessible standards and metrology and testing services promote rapid commercialization of research results

ANNEX 3: PROJECT COMPONENTS SUMMARY

PURPOSE

The project will help transform the Brazilian S&T infrastructure into a system that promotes technological innovation or adaptation, or both. This will be accomplished by support to ongoing sector reforms and by investing in: (a) technology development (TD) activities that will encourage the private sector to expand its funding and execution of R&D&E and promote the role of SMEs in modern innovation systems; (b) S&T research and high-level training, based on, among other things, improved peer-review mechanisms and funding mechanisms; and (c) sectoral support activities to strengthen the enabling environment for R&D&E and the overall efficiency of public support for S&T.

To promote S&T capacity in regions of Brazil where it is weak (in relation to economic activity), the project will fund S&T initiatives that strengthen interactions between well-established groups in the south and southeast and nascent groups in the north, northeast, and center west regions of Brazil. It will also provide fellowships to attract recent graduates from Brazil's doctoral programs to establish themselves in research groups in these regions. Each general Request for Proposals (RFPs) issued under components A and B below will reserve a minimum of 10 percent of resources for projects that promote this development of regional S&T capacity.

COMPONENTS

A. The Technology Development Component (US$147 million, or 41 percent of total project costs). This component has three subcomponents:

(1) *Platforms* (US$4.2 million): Support for cooperative pre-competitive research to foster partnerships among industries, universities, technological institutes, and appropriate government agencies through which economically and socially relevant problems amenable to technological solutions can be identified, and preliminary strategies for solving these problems through cooperative research projects can be formulated.

Activities: The project will fund meetings and other fora that will bring together relevant stakeholders to devise R&D agendas to solve technological problems. Platforms will focus on broader research areas and macro-level problems such as health, transport, and communications, as well as specific topics, such as pest management for the orange juice agro-industry. Both types will be expected to produce proposals for cooperative R&D projects (the former tend toward publicly-led and the latter toward private sector projects). Proposals for platforms will be competitively selected.

Implementation procedures: Requests for proposals will be issued by the Strategic Group for Planning and Management (*Grupo de Planejamento e Gerenciamento Estratégico — GPGE*). Proposals will be selected by an advisory committee (Comitê Assessor [CA], appointed by the GPGE), according to their potential economic and social relevance, technical assessment of their amenability to R&D&E-based solutions, and indications of the proponents' ability to unite a "critical mass" of appropriate stakeholders. Initially, grants will range from US$50,000 to US$250,000 and will cover the direct cost of the meetings, but not the time of the participants (which will be in-kind contributions from their firms or institutions). The meetings and conferences are to occur from three to six months after a grant is awarded.

(2) *A matching grant facility, providing two types of grant programs.*[10]

(a) *Publicly-led cooperative projects* (US$36.2 million) to foster partnerships between the public and private sectors for the financing and execution of R&D.

Activities: This subcomponent will partially fund socially and economically relevant research and development projects that involve public and private sector cooperation and will be cofinanced with matching funds from participating firms. It is expected that proposals generated by the Platforms will be submitted for funding under this subcomponent, but all proposals which meet the guidelines may compete, regardless of whether they were conceived with findings from the platforms.

Implementation procedures: GPGE will issue Requests for Proposals (*editais*) for projects. To ensure competition, transparency and fairness, all proposals will be appraised and selected by advisory committees (CAs) through a competitive process that reviews both technical and business merits. All *editais* are subject to the World Bank prior review and approval. The matching grant component will finance up to 77 percent of project costs, up to a maximum of $750,000. The implementing agency (FINEP) will contract with grantees and monitor and evaluate the projects.

(b) *Privately-led cooperative projects* (US$73.2 million) to foster cooperation between individual firms and public sector R&D entities with the purpose of producing proprietary R&D outputs.

Activities: This subcomponent will partially fund R&D projects executed by one or more public sector R&D entities cooperating with individual firms or consortia of firms. These projects will be cofinanced with matching funds from the participating firms and the outcomes will be proprietary.

Implementation procedures: This subcomponent will be implemented according to procedures similar to those for publicly-led projects, with minor adjustments to the selection process to protect confidentiality and emphasize intellectual property contracts. It will finance up to 50 percent of project costs, up to a maximum of US$400,000.

(3) *Assistance for technology adoption by SMEs* (US$33.4 million) to enhance their capacity to innovate.

Activities: This subcomponent will fund the existing federal SME program (*Programa de Apoio Técnico aos Micro-Empresas — PATME*).[11] The PATME program currently provides small grants for initial technological problem-solving in SMEs. Its expansion will augment overall program funding and add follow-on financing for initial projects that produce promising results.

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[10] According to Brazilian law, private firms cannot directly receive grants funded by the project; grants to benefit firms will be mediated by their academic partners.

[11] PATME has been appraised and will be the initial conduit for SME support. If in the future, the GOB decides to choose another program to deliver the SME subcomponent of the project, the new program would need to be appraised by the World Bank, which would focus its appraisal on the capacity of the new program to yield the results expected of PATME under PADCT III.

Implementation procedures: Initially this subcomponent will be implemented by FINEP and SEBRAE, with slight modifications to current operating procedures. Initial grants could be up to US$12,000, and follow-on grants up to US$75,000 for 6-month projects.

B. Science and Technology Research Component. (US$147 million, or 41 percent of total project cost.This component will award grants for scientific research and for developing regional S&T capacity. It will consolidate the positive accomplishments of PADCT I & II by funding research and graduate training in scientific and technological areas of relevance for economic and social development. This will expand Brazil's human resource and knowledge bases in S&T, and provide trained personnel in areas relevant to industry. Initially six scientific disciplines will receive funding (see Annex 4).

Activities: This subcomponent will finance peer-reviewed, competitively awarded grants for scientific and technological research in priority S&T disciplines.

Implementation procedures: Proposals will be submitted to advisory (selection) committees (CAs), in response to RFPs issued by corresponding GPAs (planning and evaluation groups). The first set of *editais* was approved in August 1997, and five more sets are expected to be issued before the midterm review. *Editais* will permit "spontaneously generated" cooperative proposals to be received at any time of the year; however, evaluation and selection will only occur quarterly. The CAs will select grantees on the basis of peer reviewers' rankings. Implementing agencies will administer grant agreements and monitor and evaluate the projects.

C. Sectoral Support Activities. (US$54.3 million, or 41 percent of total project costs). This component will have five subcomponents.

(1) *Support to working groups involved with sectoral reform* (US$8.9 million). The reform of the sector is an indispensable activity for the new operation. It is to be based on the principle of rationalizing the system through coherent planning (to avoid duplicating efforts) and management. These activities will be carried out by several working groups, including, among other things:

(a) *The MCT Working Group on Sector Reform (the CSCG)*. At the level of the MCT, the *Colegiado da Secretaria de Coordenação e Gerenciamento* (CSCG — an operations-level management and advisory group for the Secretaria de Coordenação e Gerenciamento, the project coordinating unit) will have the added responsibility of developing a plan to reform institutions and programs directly under MCT's control. The CSCG will submit this plan as an annual report to the MCT's Coordinating Committee (chaired by the Minister of Science and Technology).

(b) *The Policy Studies and Advocacy Group*. At the level of the entire federal sector, a Policy Studies and Advocacy Group will support the *Conselho Nacional de Ciência e Tecnologia* (CCT — the GOB's high-level group for S&T policy composed of ministers whose ministries are responsible for S&T issues and private sector representatives). The CCT is presided over by the President of the Republic. This group will actively recruit and engage the experts required as inputs into the policymaking process, convene public fora and meetings on policy issues, and commission studies on relevant topics. It will solicit relevant policy-oriented studies as requested or required by the CCT agenda, and will

monitor implementation of the emerging policy recommendations. The group will consist of *ad hoc* members selected by the CCT Secretary, and will solicit studies through bidding and direct contracting.

(2) *Support for improving sectoral monitoring and evaluation* (US$10.4 million) to improve the quality, coverage, and accessibility of information about the performance of the S&T sector.

Activities: This subcomponent will support initiatives among the main agencies with M&E responsibilities in the sector (for example, CNPq, CAPES, IBGE, state FAPs) to accomplish the following: (a) more accurately determine Brazil's gross expenditure on R&D (GERD), and a number of related indicators; (b) develop and implement standards for reporting by federal S&T institutions; (c) complement the existing national database of active research groups and researchers with more complete information on employment patterns for S&T graduates (to be done with tracer studies of the graduating cohorts); and (d) support periodic and routine evaluation of the quality and relevance of Brazilian research output, using bibliometric indicators and other tools for assessing research productivity.

Implementation procedures: A Technical Coordinating Group (TCG) will oversee and direct the activities of this subcomponent. It will be composed of directors of the main institutions with M&E vocations or responsibilities (CNPq, IBGE, IPEA/MINIPLAN, CAPES, CCT Subcommittee on Information) plus three non-Brazilian M&E specialists. The TCG will analyze and approve the technical content of all proposed initiatives, determine (and allocate) the required resources for these initiatives, establish a strategy for integrating and/or making M&E efforts compatible, and plan the long-term sustainability of sectoral M&E at internationally acceptable levels of quality.

(3) *Support for administering and enforcing the intellectual property rights regime* (US$4 million).This activity will support part of the ongoing restructuring efforts of INPI, which is aimed at preparing the institution for effective enforcement of the new (1996) industrial property law. It includes (a) dissemination efforts focused on the new IPR regime and its benefits; (b) training human resources in intellectual property rights; (c) developing local agencies that specialize in providing industrial property technical assistance and information services; and (d) developing national indicators for trademarks and patents. The PIP contains explicit plans for an independent analysis of the INPI, similar to the recently completed study, which will serve as the baseline.

(4) *Support for metrology and standards services* (US$16.3 million).This subcomponent will fund several activities that will improve the quality of the metrology, standards, and testing services available to the Brazilian productive sector. These will involve: (a) enhancing the National Metrology Laboratory and the Brazilian system of reference laboratories; (b) developing certification of reference materials; (c) enhancing the Brazilian Network of Calibration Laboratories; (d) training professionals in metrology; (e) modernizing the Brazilian Association of Technical Standards; (f) consolidating the Brazilian Network of Testing Laboratories; and (g) disseminating technology management tools within firms.

(5) *Interim Fund to provide for the maintenance of scientific equipment* (US$4.8 million). A small fund will be available to which researchers can apply for maintenance funds for equipment acquired under PADCT I & II. To avoid the continuous need for a separate equipment maintenance fund, the system will change to one where maintenance funds

are included within the budget proposals for purchasing equipment under PADCT III: under this project, all maintenance funds for new equipment will be included in the grants for purchases. Other S&T research funding programs managed by MCT and its agencies are expected to adopt this system as well. The transitional fund will be managed by the chairs of the GPAs (*Grupos de Planejamento e Avaliação)* for each discipline, with the technical support of one staff of the SCG.

PROJECT ADMINISTRATIVE STRUCTURE

The project will be implemented by MCT with the administrative assistance of FINEP, CNPq, and CAPES, plus the contracted services of numerous entities, including private firms, universities, nongovernmental organizations (NGOs) (such as SEBRAE), and state governmental agencies (such as FAPs). Overall monitoring and coordination of the project will be the responsibility of SGC, a unit within MCT, which will include staff with the required expertise, including experience in the execution of Bank-financed projects. At agreed intervals, SGC will receive counterpart funds from the Treasury. Funds will then be transferred to the respective implementing agencies for ultimate disbursement to the beneficiaries. The implementing agencies will enter into contracts with the beneficiaries that will spell out the responsibilities, conditions, and obligations of both parties. An operational manual, detailing procedures and responsibilities, was submitted to the Bank in draft form, as a condition of negotiations.

Within the MCT, the new operation will be administered by a Management and Coordination Secretariat (SCG). The responsibilities of the SCG will include (a) overseeing project implementation according to the guidelines and by-laws of the basic document and operating manuals; (b) defining and initiating the overall program and strategic planning; (c) providing assistance (including operational) to the project's normative ("supervisory commission"), strategic ("executive groups"), and other decision-making bodies and technical advisory groups; and (d) mobilizing and deploying resources for all aspects of program management. The Project Implementation Plan (PIP) contains descriptions of all administrative and management structures as they relate to each of the three project components; the routine implementation details are in the *Manual Operativo* (Operational Manual). The SCG will be supported by several committees and agencies. The most prominent ones are listed below.

(a) *Supervisory committee (Comitê Supervisor [CS]).* The CS will provide overall strategic direction for the project. This committee is presided over by the Executive Secretary of the Ministry of Science and Technology. Its vice president is the Executive Secretary of PADCT, who also functions as the secretary for the CS. Other Committee members are the heads of the three federal implementing agencies (FINEP, CNPq, and CAPES); one representative of the FAPs; one representative each (for a total of four) named by ABC, CNI, ANPEI, and SBPC; two other S&T experts named by the Minister of Science and Technology; and one representative named by the CCT (*Conselho Nacional de Ciência e Tecnologia*). Members should be individuals with records of distinguished scientific, technological, and/or related policymaking experience; they are to bring a balanced perspective to decisions on allocating resources across scientific and technological disciplines. In this new framework, the CS will (a) recommend to the MCT the appointment of GTG members selected from three lists prepared by the SCG collegiate, with input from the S&T community; (b) approve the members proposed by the other groups; (c) examine and ultimately approve the PADCT III annual plans submitted by the SCG; (d) examine and comment on the Annual Monitoring and Evaluation Report, to be produced by the SCG; (e) approve revisions in the *Manual Operativo*, based on proposals submitted by the GPAs and the SCG; (f) approve the constitution of

cooperative programs; and (g) submit to the Minister of Science and Technology, after due consideration by the GCCT, proposals for reallocating resources among the PADCT III subprograms and project components, at the project midterm review.

(b) *Strategic groups and advisory committees*. In most cases, projects will be selected through competitive peer review processes organized and administered by strategic groups (GPAs) and carried out by advisory councils (CAs). Detailed procedures for the functioning of these groups are contained in the *Manual Operativo*.

(c) *Implementing and financial agencies*. The Science and Technology Research Component will operate principally with the three federal implementing agencies that worked for PADCT II: FINEP, CNPq, and CAPES. These agencies are responsible for contracting, disbursing funds, and monitoring projects that fall within their jurisdiction. As a rule, CAPES administers projects that focus principally on human resource training, CNPq administers projects that focus on science and technology research, and FINEP administers projects that focus on technological development. In the Technology Development (TD) Component, FINEP and SEBRAE will administer most of the projects. State science funding agencies (FAPs) will be encouraged to help implement both SR and TD projects which pertain to regional development. FAPs may become accredited as implementing agencies by making formal agreements with the SCG.

(d) *International Consultative Oversight Group (GCCT)*. Like PADCT I & II, the new operation will have an independent advisory council composed of Brazilian and international members. This group, tentatively named the *Grupo Consultivo de Ciência e Tecnologia* (GCCT), will meet annually to review and discuss the broad directions of the program and make recommendations to the minister and the World Bank on program performance. It is a new version of the GEA (*Grupo de Especial Acompanhamento*), which advised the Bank and MCT on the performance of the PADCT I & II projects. The GCCT will provide strategic advice on all components of the new operation. The new mandate and composition reflect the emphasis on technology development and the increased relevance to the productive sector of scientific and technological research. The terms of reference for the GCCT are in the *Manual Operativo*.

ANNEX 4: ESTIMATED PROJECT COSTS

Table 4-1 Estimated Project Costs (in US$ millions)

Project component	*Local*	*Foreign*	*Total*	*% foreign*	*% total*
Technology Development	**119.0**	**28.0**	**147.0**	**19**	**41**
Platforms	4.2	0.0	4.2		
Matching grant facility					
Publicly-led cooperative projects	28.4	7.8	36.2		
Privately-led cooperative projects	62.5	10.7	73.2		
SME focused projects	23.9	9.5	33.4		
Science and Technology Research	**90.9**	**56.1**	**147.0**	**38**	**41**
Chemistry/chemical engineering	23.7	17.1	40.8		
Geoscience/mineral technology	18.6	9.5	28.1		
Biotechnology	16.7	10.1	26.8		
Applied physics	7.4	3.1	10.5		
New materials	14.2	11.2	25.4		
Environmental science	10.3	5.1	15.4		
Sectoral Support Activities	**35.2**	**9.2**	**44.4**	**21**	**13**
Working Group on sectoral reform	8.2	0.7	8.9		
Support for sectoral M&E	7.9	2.5	10.4		
Support for the IPR regime.	3.0	1.0	4.0		
Support for MSTQ services	12.5	3.8	16.3		
Equipment maintenance fund	3.6	1.2	4.8		
Project management	**9.3**	**0.6**	**9.9**	**1**	**3**
Total Baseline Cost	**254.4**	**93.9**	**348.3**	**27**	**98**
Physical contingencies	0.7	0.0	0.7		
Price contingencies	1.0	0.0	1.0		
Total contingencies	**1.7**	**0.0**	**1.7**	**0**	**--**
Unallocated	**10.0**	**0.0**	**10.0**	**n.a.**	**2**
Total Project Cost	**266.1**	**93.9**	**360.0**	**26**	**100**

Table 4-2: Project Financing by Component (in US$ millions)

Component	*GOB*	*IBRD*	*Private sector*	*Total*
1. Technology development	44.0	53.0	50.0	147.0
2. Science and technology research	70.0	77.0		147.0
3. Sectoral support	30.0	16.0		46.0
4. Project management	6.0	4.0		10.0
5. Unallocated	5.0	5.0		10.0
Total	155.0	155.0	50.0	360.0

ANNEX 5: ECONOMIC ANALYSIS

Recent economic reforms in Brazil have been followed by a stabilization of macroeconomic indicators and the opening of the private sector to both domestic and international competition. The real GDP growth rate has risen from -0.8 percent in 1992 to 4.2 percent in 1995. Increased growth and stronger competition have created greater demand for investment in the Brazilian economy, as shown in Table 5.1. Growth of investment by more than 2 percent of GDP within five years is a remarkable achievement.

Table 5-1: Selected Critical Macroeconomic Indicators

Year	*1991*	*1992*	*1993*	*1994*	*1995*
GDP growth rate	0.3	-0.8	4.2	5.8	4.2
Investment as percent of GDP	19.2	19.5	20.0	20.8	21.6

Source: Banco Central do Brazil.

Although there is increased demand for investment in the Brazilian economy, a number of constraints limit the opportunities for the type that fosters innovation. In this new economic environment, Brazil's Science and Technology (S&T) Reform Project will facilitate the country's economic growth through increased and higher-quality innovations. It will accomplish this with a number of related interventions at the level of the S&T community and the private sector that will increase both the capacity for economically relevant research and the rate of investment by the private sector in Research and Development and Non-Routine Engineering (R&D&E).

In order to evaluate this project, the following issues are particularly relevant. First, what is the impact of the project on the Brazilian economy? To measure this, it is necessary to determine the outcomes of the project and how these outcomes affect the economy. Second, it is important to assess to what extent the project can play a legitimate public sector role in the economy. If project activities merely replace potential private sector activities, then the project will be of limited value.

This project can be characterized as an investment in future well-being through increases in the level or the quality of technologic innovation in Brazil. With this investment orientation, the economic value of the project can be evaluated on the basis of the return on investment. The specific outcomes of the project which are assumed to have an impact on Brazilian income could be classified into three general categories:

- An increase in the levels of publicly-funded fundamental and applied scientific research, with an increasing emphasis on the economic value of the research;
- An increase in the level of private sector funding of R&D&E activities in cooperation with public sector research institutions, including universities;
- A strengthening of the S&T infrastructure, which will improve information flows in the sector. These activities include policy reform, strengthening intellectual property rights, improving institutional linkages, and improving MSTQ services.

In economic terms, the project can be characterized as improving both the supply and demand for innovation-related activities. The supply of human capital useful for innovation will be increased through publicly-funded research. At the same time, the private sector will gain greater access to the type of innovations that public sector researchers can provide. An important public sector activity here will be improving the conditions and institutions necessary for an efficient marketplace for R&D&E. As supply and demand expand, and as the conditions of the marketplace improve, the production of R&D&E will become easier and less costly.

International comparisons provide a perspective on the size of R&D in Brazil. National expenditures are about 0.88 percent of GDP, higher than most of Latin America, but lower than the Asian newly industrializing countries (NICs), and less than half the rate of most industrial nations. Government remains responsible for the bulk of these expenditures, while the private sector accounts for only 25 percent. This is a similar percentage to that of Argentina, India, and Mexico, but much lower than that of Japan (79 percent), the Republic of Korea (81 percent), the United States (52 percent), and West Germany (61 percent). In human resources, Brazil had approximately 35,600 scientists and engineers in research in 1993, which represented 0.05 percent of the work-force, and 235 workers per million population. This is a smaller proportion than that in Argentina (360 per million), the Republic of Korea (804 per million), Singapore (960 per million), and Taiwan, China (1,426 per million), but is similar to that in Mexico (216 per million).

The Economic Rationale for Public Sector Involvement

Increased private sector innovation will inevitably have private firms as drivers of the process. However, there are important reasons why it is important for the public sector to be involved.

First, the new economic environment in Brazil is conducive to increased innovation. Intensifying competition has increased the incentives for innovation, and a stable macroeconomic environment has reduced the risk of making long-term investments. The problem, however, is that adjustment to these new conditions will take time. Public sector interventions may be economically justified if they can accelerate the rate of innovation growth. Appropriate public sector roles would include correcting information failures, creating new institutional pathways, and generally promoting the conditions for a marketplace conducive to innovation.

Second, strong evidence shows that the social returns from innovation are higher than the private returns because of the positive externalities from expanding the knowledge base of society. These spillovers of knowledge from one firm to another can be significant, and occur because knowledge is a "quasi-public" good. Once created, firms are not able to fully control the use of knowledge because of the difficulty of enforcing property rights. To the extent that the rest of society benefits from innovation, and given the difficulties faced by the private sector in appropriating these benefits, public policies play an important role in fostering innovation.

Both arguments are likely to be pertinent in the Brazilian case, and they are not mutually exclusive. However, they lead to different implications for project activities. The first rationale for public intervention is to correct a transitory problem, and it will therefore provide a justification for such action only for a limited time. The second argument, however, is not limited by time: it is appropriate for the public sector to correct externalities by providing a public good at all times, and most governments fund some level of research and development. This implies a larger impact for the project during this transition period, and a lower but constant stream of benefits from public expenditures in the future.

Economic Issues for Project Evaluation

As already noted, the economic analysis of this project requires two types of questions to be addressed. The first group of questions deals with the overall value of the project output. This is the standard cost-benefit analysis. For a public sector project such as this, not only must the size of the net benefit of the project be measured, but the analysis must also determine whether this is an appropriate public investment. It must have benefits beyond those that private markets would produce, and the benefits should be greater than alternative public investments.

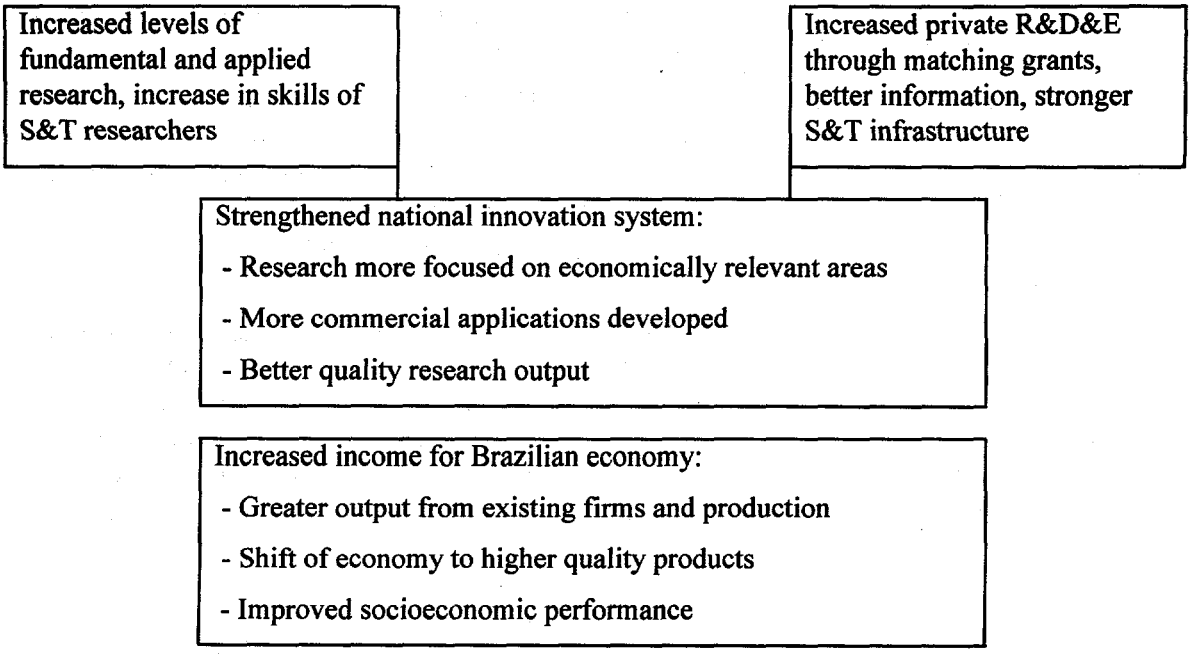
If it is shown that the outcomes of the project are desirable and appropriate for public investments, a second set of issues must address the question of the least cost method of achieving this outcome. In standard cost effectiveness analysis, project activities are compared with alternative ways of achieving the same outcome. Rather than generate alternative approaches, this analysis examines if project activities are efficient in producing project outcomes by employing appropriate economic principles and incentives.

Cost-Benefit Analysis

The cost-benefit analysis consists of the following steps. The outcomes of the project are defined, and the economic value of those outcomes is calculated and compared to the costs. In determining the outcomes, however, it is important to identify the changes that can be attributed to the project and separate them from those that would have occurred without the project activities. In part, the comparison of the project impacts with the "counterfactual" of what would have occurred without the project is a measure of the public sector relevance of the project, since it compares the project with what would have happened without public sector involvement.

The first step is to define the outcomes of the project, which intervene on both the demand and supply side of the market for innovations. Figure 5.1 provides a schematic illustration of its probable impacts. The project invests in various activities, including training, matching grants, intellectual property rights, and MSTQ. The expected results of these actions are listed in the first level of the graph: more research, better S&T skills, greater private sector investment, and a generally stronger innovation infrastructure. These activities will have a direct effect on the rate of commercial applications of R&D&E, as well as a strengthened innovation system that will create more research output of higher quality, and more economic relevance. Ultimately, this will translate into higher productivity in the Brazilian economy and a shift toward better quality goods and services.

Figure 5-1: Probable Impacts of the S&T Reform Project



To estimate the economic value of the project, this analysis uses a two-step approach. First, Brazilian data is used to estimate the value of innovation. With this value, the analytical methodology predicts the changes in both the quantity and quality of R&D&E that can be attributed to this project. This allows calculating a rate of return for the project, the net present value (NPV) of the project investment, and the internal rate of return (IRR). Because predictions are always inexact, the analysis provides a range of possible outcomes.

The Value of Innovation in Brazil

Information on both the rate of R&D&E in Brazil, and on its value for the private sector is sparse. One large data set that contains total costs of the largest 1,000 industrial firms is included in the Conjuntura Econômica — Fundação Getulio Vargas (Dec. 1993). However, there is no comparable data on R&D expenditures. A recent survey by ANPEI (the National Association for Economic and Industrial Research) is being used to build a database of annual figures about R&D among a subset of Brazilian firms.[12] Since 1992, ANPEI has conducted three surveys, with the most recent in 1995. These annual surveys were sponsored by PADCT II. The database includes information provided by 651 firms on a voluntary basis, including most large industrial firms in Brazil and several hundred micro, small-, and medium-scale firms that engage in significant R&D&E activities. ANPEI estimates that their sample covers about half the industrial GDP of Brazil (it does not include service industries or extractive industries, however), and covers the majority of R&D&E activities occurring in the country.

There are several methodological difficulties with the ANPEI data, including the interpretation of the sample selection bias. The analysis performed here is based solely on the most recent innovation survey by ANPEI. Within the survey, the type of information sought

[12] For more information, see R. Sbragia, and I. Kruglianskas, "R&D in Brazilian Industry: Recent Indicators," in *Research Technology Management*, Vol. 39, No. 3, May-June 1996.

makes it impossible to determine whether returns from new and improved products come from applying new knowledge, or whether it can be attributed to marketing a new version of an old product. Nevertheless, the survey provides an indication of the value of innovation in the current economic environment of Brazil.

ANPEI's figures for expenditures include not only R&D, but also engineering, involving those for nonroutine engineering services, technological support services, and technology acquisition, as a measure of innovation efforts. The impact of R&D&E expenditures is evaluated by the increase in revenue accruing from the generation of new products and improvements in the existing ones. Moreover, it is noteworthy that there may be cost reductions from the introduction of new and/or improved processes.

The ANPEI data show that within firms that engage in R&D&E activities, revenues from new and improved products represent 37.7 percent of all revenues. It was assumed that these products also produced 37.7 percent of profits. Firms also report that costs have fallen by 1.2 percent as a result of innovation. In addition, they report expenses on innovation equal to about 9.1 percent of profits (and 1.3 percent of revenues). Selected parameters calculated with the ANPEI data are provided in Table 5.2.

Table 5-2: ANPEI Survey Data from 1996

Number of firms	*651*
Shipments	147,562
Gross profit	21,311
R&D&E expenditures	1,943
Revenues from new products	55,587
Savings in operational costs	847
INP (%)	37.67
IEC (%)	1.16
Contribution of R&D&E (REV)	8,914
Return from R&D&E (%)	4.59

Note:

INP = Revenue from new products over shipments.
IEC = Savings in operational costs over gross profit.
REV = Gross profit (INP + IEC).
Return from R&D&E = REV over R&D&E expenditures.
Source: ANPEI calculations.

The ANPEI data indicate that the return to investment in R&D&E may be about 4.59 times larger than expenditures. However, these returns do not occur until some time after the investment takes place, and therefore must be discounted to compare with the costs. The lag between investment in R&D&E and return has been the subject of considerable research. Among

the best known is work by Edwin Mansfield.[13] Using a sample of US firms, Mansfield estimates that the average lag is about seven years.

In this analysis, it is also assumed that the benefits of R&D&E occur on average about seven years after expenditure. It is likely that Brazilian firms are much smaller than the US firms used by Mansfield, but other researchers have found much longer lags in the benefits.[14] When returns of about 4.59 percent are lagged by seven years, the IRR for these investments can be calculated to be about 24 percent. This is in the same general range of returns found by Mansfield for US firms.

The survey asks firms for the expenses and returns from all innovation activities. ANPEI claims that the data cover at least 70 percent of all R&D&E activities. Each firm will almost surely make use of knowledge and innovations produced by others. On this basis, the analysis assumes that it is capturing most investment in innovation wherever it occurs, and most returns wherever they occur. Thus, the estimate of a 24 percent rate of return is more closely associated with the social rate of return than with the private rate of return by firms.

What Is the Project Contribution to Innovation?

Innovation in Brazil appears to have a high return. Nevertheless, the ANPEI data show that a very small proportion of Brazilian firms are innovating. Thus, the low level of activity in R&D&E is indicative of possible constraints on the ability of firms to become involved. Market imperfections are commonly observed in R&D&E,[15] and have been used to explain why, despite the seemingly high returns for these activities, most firms do not engage in the expected amount.

In general, the argument is that firms make investment decisions based on their expectations of the returns. There are a number of reasons why those expectations may differ from actual returns. The primary problems include the following:

- *Inadequate information.* Firms may have misinformed expectations about the returns from innovation. This may be due to the recent changes in the economic climate, and the resulting uncertainty about the future. In addition, to the extent that the Brazilian industry was shielded from competition until recently, this may have reduced the need to keep current on information about innovations.
- *High costs of innovation.* Firms may face unusually high costs or risks to innovate. This may occur because of limited contact with the research community, inadequate protection of intellectual property rights, poor sectoral support (including metrology, standards, testing, and quality), and adverse policy conditions (including high real interest rates).
- *Difference between social and private returns.* Although firms may have accurate expectations of their returns from investing in innovation, these often are less than the total

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[13] See Edwin Mansfield, "Academic Research and Industrial Innovation," in *Research Policy*, vol. 20, 1991.

[14] For example, James Adams, "Fundamental Stocks of Knowledge and Productivity Growth," *Journal of Political Economy*, V. 98, No. 4, 1990, finds that engineering studies have a lag of 0 to 10 years, but science studies have a lag of about 20 years.

[15] For example, see Paul Romer, "Endogenous Technical Change," in *Journal of Political Economy*, V. 8 No. 5, 1990, or Zvi Griliches, "The Search for R&D Spillovers," *Scandinavian Journal of Economics*, supplement, 1992, or Paula Stephan, "The Economics of Science," *Journal of Economic Literature*, V. 34, Sept. 1996.

return that society receives from the new knowledge. This "public good" aspect of innovation is a common argument for why private firms engage in a suboptimal (for society) level of R&D&E.

While the shape of the distribution of expected rates of return from potential R&D&E investments is unknown, what is observed is that a small tail of the distribution is in the range of expected returns above which firms will commit to an investment. For the reasons listed above, it is assumed that the distribution of actual returns will lie to the right of the expected distribution: that is, there are firms for which the expected rate of return lies below the cutoff rate that justifies investing, but for which the actual rate of return (at least the social rate of return) is above the cutoff level.

In addition, two other biases affect the firms' expectations. The first is referred to as anchoring,[16] which results from firms systematically underestimating the variance of a distribution. Such estimates are anchored by the mean of the distribution, so that the size of the distribution extremes is underestimated. Second, there is a conservatism bias,[17] in which firms will not revise their estimates of the probability of successful investments as much as new experience would deem appropriate. In this case, new economic conditions may change the expectations on an investment, but firms may continue to operate on the basis of previous expectations.

The public sector in general, and this project in particular, can affect this distribution through changes in information, reduced costs for a given quality of innovation, and subsidization of innovations with high social benefits. By doing so, the project is designed to shift the distribution of expected rates of return for R&D&E to the right by some amount. The result is that an increasing number of Brazilian firms will initiate or increase their levels of investment in R&D&E, as illustrated in Figure 5.2.

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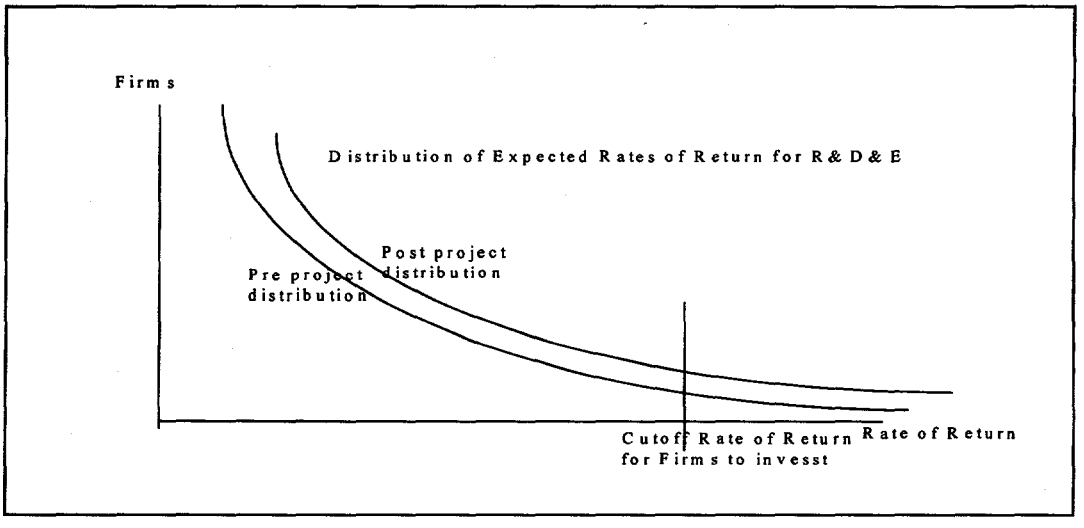
[16] See A. Tversky and D. Kahneman, "Judgment Under Uncertainty: Heuristics and Biases," in Kahneman, Slovak, and Tversky, *Judgment Under Uncertainty: Heuristics and Biases*, Cambridge University Press, 1982.

[17] See Ward Edwards, "Conservatism in Human Information Processing," in Kahneman, Slovak, and Tversky, *Judgment Under Uncertainty: Heuristics and Biases*, Cambridge University Press, 1982.

Figure 5-2: Distribution of Expected Rates of Return for R&D&E



In short, the project will improve the level of innovation in the Brazilian economy by shifting the expected distribution closer to the actual distribution of returns from R&D&E. In part, this will be done by improving the level of information in the sector, both in general awareness of the benefits of innovations, and in specific information needed to establish links with potential researchers. Project activities in the S&T infrastructure area and general S&T reform will lower the cost of conducting R&D&E. Increasing the supply of S&T researchers will be an important part of reducing costs for innovation. Finally, matching grants will bring the private returns from innovations with major social benefits more in line with their social value.

Measuring the impact of these interventions is difficult. It will depend on the size and efficiency of project interventions and the size of innovation activities. In general, however, the impact will be transmitted through two main channels:

- By correcting expectations, lowering costs, and reducing institutional barriers, the project will foster an increase in *private* R&D spending on innovation;
- By improving human capital, redirecting fundamental research, improving S&T infrastructure, and reducing institutional barriers, the project will promote an increase in the difference between (return-cost) of *all* R&D.

The size of each of these impacts can be estimated by making reasonable assumptions about the degree to which the project will stimulate private investment or improve the quality of Brazilian S&T researcher output. These assumptions are based on the relative size and type of project interventions.

The size of the current level of R&D&E activities can be estimated from data by ANPEI and the MCT. Earlier estimates put annual expenditures at about 0.5 percent of GDP. As shown earlier, investment overall has grown significantly in recent years, and ANPEI estimates that the addition of nonroutine engineering to conventional R&D places expenditures at about 1 percent of GDP. Also, ANPEI estimates that the addition of engineering raises the private portion of expenditures from about 20 to 30 or 40 percent. Given these estimates, the analysis uses the following assumptions:

Size of Brazilian economy:	US$600 billion
Total R&D&E:	US$6 billion
Private R&D&E:	US$2 billion

Project Impacts

Many of the project interventions, such as improving the information base and the S&T infrastructure, will have an impact on both the growth of private R&D&E and on the efficiency of all such activities. Although it will be difficult to estimate the effects of these activities in isolation, they form the necessary basis for efficient operation of the R&D&E marketplace. As such, their operation will be crucial for all aspects of the project, and will likely serve as a multiplier of the effectiveness of other interventions.

Matching grant activities presumably will have a more direct impact on private investment growth. In addition to the work supported directly by the grants, it is expected that the four years of project activities will introduce the private sector to cooperative research and increase their comfort level, thus shifting their expectations of costs and returns. This demonstration effect, combined with a selection of projects with significant spillovers for the remainder of the industry, is expected to spur significant sector-wide investment. Although the matching grant activity itself will operate at the level of about US$25 million per year, very small impacts on total private sector activity could have large results. Given the size of the private sector R&D&E, an increase in total investment of only 1 to 3 percent, for example, would result in additional annual investment of US$20 million to US$60 million.

In addition to the private sector R&D&E activities, the project will also continue the earlier (PADCT I & II) investments in scientific research, which was the major activity of the PADCT I & II projects. While this activity does not contribute directly to private sector activities, it is expected to have a major impact indirectly by increasing the efficiency and quality of all R&D&E in Brazil through improvements in the human capital. The two earlier projects in the S&T sector have resulted in important increases in the skills of the S&T community. A recent PADCT report estimated that project funding was instrumental in more than 6,000 national and international papers, and in the training of 796 Ph.Ds and 2,273 Master's degrees. This represents a significant increase in the level of science research skills and human capital formation.

The current project will fund basic research in major areas of the Brazilian economy by providing grants for a significant portion of researchers in several fields that are considered most economically relevant to Brazil. The science research component will maximize its economic relevance by focusing on the following six major areas of research related to the Brazilian economy:

- *Chemistry and chemical engineering.* This is among the largest of Brazil's industries. More than 70 percent of chemistry graduates go to work for industry.
- *Geoscience/mineral technology.* Minerals are the largest export category. The country has large mineral reserves and a strong need for modern technology.
- *Biotechnology.* This is an emerging area in Brazil in which production is already growing rapidly. This sector will have a high demand for trained researchers.

- *New materials.* This is an interdisciplinary activity which made significant progress under the previous PADCT II project. The current project will benefit from the momentum created in this sector.
- *Environmental science.* This is an important area for protecting Brazil's natural resources. More than 1,000 groups are currently working in this sector, which was also supported by PADCT II.
- *Applied physics.* This subcomponent will work on applications involving physics and engineering groups in areas including optics and optical communications, electronic devices and systems, applied classical phenomenology systems and processes, sensors, and control systems.

While science research has a less direct and timely impact on the economy than does applied research, the work in these six areas is expected to improve the skills of researchers in subject areas that represent a major portion of Brazilian research activities now and in the future. The increase in human capital in critical areas, combined with the sectoral support activities discussed above are expected to increase the quality and efficiency of all research. The size of this impact is difficult to estimate. Science research and sectoral support will involve expenditures of about US$200 million over the four-year life of the project. As these researchers move throughout the S&T community, their increased skills will influence the return on all investments. Given the US$6 billion size of the sector, if the quality and efficiency of R&D&E activities is increase by only 0.5 to 2.5 percent, this will increase returns to R&D&E by US$30 million to about US$150 million annually.

Under these assumptions, Tables 5.3, 5.4, and 5.5 provide estimates of the potential effect of the project on the economy. Table 5.3 lists the major assumptions used in calculating the net benefits. Using the same 24 percent rate of return from innovation, the net present cost of the project is about US$211 million.

Table 5-3: Economic Analysis Calculations

			Cost of project		
Total return from innovation:	4.59		*Year*	*Cost*	*Discounted*
Time from investment to return:	7		0	30	30
Discount rate:	0.24		1	30	24.1935
			2	120	78.0437
Priv. RDE:	2,000		3	150	78.6731
Total RDE:	6,000		Total	330	210.91

Because of the uncertainty of predicting the rate of change, the analysis provides calculations for the range of values assumed earlier in this section. Conservative values of private sector investment growth from 0.5 to 3.5 percent and R&D&E efficiency improvements of 0.5 to 2.5 percent were used to calculate the NPV of the project under various levels of impact. These are shown in Table 5.4, and the IRR shown in Table 5.5.

The potential net benefit of the project is illustrated by the calculations shown in Table 5.4. Annual benefits of the project are calculated in two parts. Private sector growth is found by multiplying the current size of the private sector R&D&E by the assumed output value from the ANPEI data, and by the range of growth rates shown across the top of Table 5.4. At the current size of the sector, this would require an annual increase in private research of US$10 million – US$70 million, which is in the range of growth expected by the project matching grant component. Increase in the efficiency of R&D&E is found by estimating the potential change in the net rate of return, shown here limited at 0.5 to 2.5 percent. The present value of this annual flow of benefits is found by dividing the annual flow of benefits by the discount rate. Project costs are subtracted from this benefit estimation to obtain the net benefits shown in Table 5.4.

Table 5-4: Project Net Present Value

Change	*Growth in private R&D&E*						
in return	0.50%	1.00%	1.50%	2.00%	2.50%	3.00%	3.50%
0.50%	105	297	488	679	870	1062	1253
1.00%	230	422	613	804	995	1187	1378
1.50%	355	547	738	929	1120	1312	1503
2.00%	480	672	863	1054	1245	1437	1628
2.50%	605	797	988	1179	1370	1562	1753

Notes: Annual benefit = (growth rate of priv RDE) * (return from RDE) + (total RDE) * (rate of increase in return from RDE).
Total benefit = (annual benefit)/discount rate.
Net benefit = total benefit - total cost.
Rate of discount: 0.24.

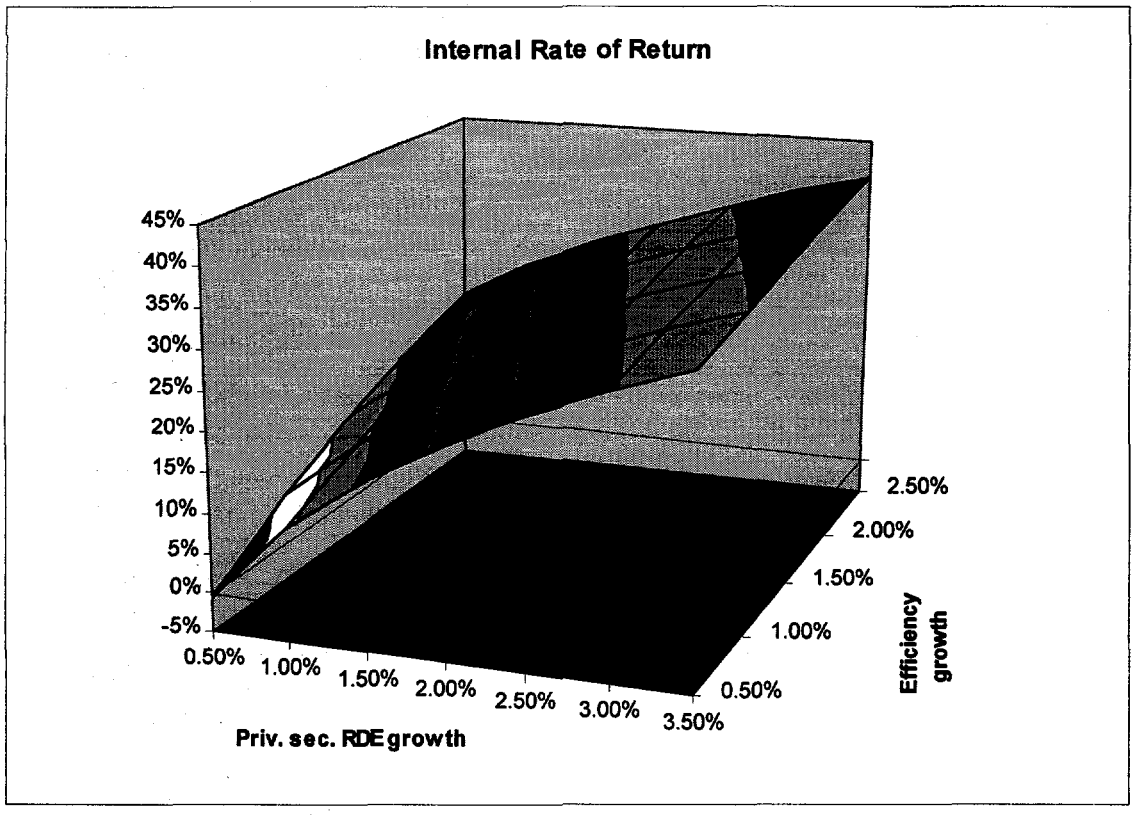
The project has a positive net value throughout the ranges of growth of private investment and R&D&E efficiency used in these calculations. In separate calculations, it was found that the project would break even with a 0.6 percent impact on the growth of private sector investment alone, or with a 0.9 percent impact on the rate of return for all R&D&E. At larger rates of growth, the project rapidly generates large returns for the economy, with Table 5.4 showing US$1.7 billion dollars in value for the most generous assumptions. Table 5.5 converts these flows into measures of the IRR. These rates are illustrated graphically in Figure 5.3. For the range of impacts expected, the project will generate an IRR as high as 40 percent.

Table 5-5: Internal Rate of Return (percent)

Change	Growth in Private RDE						
in return	0.50	1.00	1.50	2.00	2.50	3.00	3.50
0.50	0	9	16	21	26	30	33
1.00	6	14	20	24	28	32	35
1.50	12	18	23	27	31	34	37
2.00	16	21	26	29	33	36	39
2.50	19	24	28	32	35	38	40

Table 5.5 also shows the sensitivity of the results to the various assumptions used. Because the range of major assumptions about the project impacts are arrayed along the rows and columns, it is possible to determine the sensitivity of the project to these variables. In addition, it should be recalled that background assumptions on the size of the R&D&E activity, and the average rate of return from individual projects, will greatly affect the size of the NPV and the IRR of the project. In most cases, the analysis provides a conservative set of assumptions, which increases the probability that the analysis does not overstate the value of the project.

Figure 5-3: Internal Rate of Return



The 'without project' scenario: It is difficult to project the status of Brazilian industry without this project for two major reasons. First, the economy is rapidly changing, making any projections problematic. Second, the analysis presented here examines the impact of the project over a wide range of assumptions, making it difficult to compare it to a baseline projection. Nevertheless, it seems clear that economic growth would be significantly slower without the project. Moreover, the inability of firms to adequately capture all the externalities generated by R&D&E would imply that the rate of innovation without the public intervention of this project would consistently be lower than optimal.

Sustainability: Many of the project activities can be considered initial investments to create an environment more conducive to increased innovation and growth. As these activities have the desired effect, the private sector is expected to increase its levels of investment in R&D&E, so that much of the project becomes self-sustaining. However, many areas of

cooperative research, where the benefits are shared throughout a sector, will continue to be appropriate areas for public investment. These "public good" innovations would be difficult to fund solely through the private sector; most countries continue to make these public investments. In addition, many of the programs from SMEs are likely to continue to use public expenditures for equity reasons.

Cost Effectiveness Analysis

A classic cost effectiveness analysis would compare various alternatives for achieving the same project outcome to find the lowest cost method. Because the alternatives are not precisely defined in this case, the analysis simply considers the economic logic of the project and whether the activities of the project generate the appropriate incentives.

Overall, the project uses a sound economic approach to spurring increased innovation. It intervenes only in ways that address problems with the market for innovation. There is an additional question of the absorptive capacity of the sector, but the preceding analysis indicates the project is quite compatible with the dimensions of the Brazilian S&T sector.

Because the project approaches the problem of increased innovation from several directions, with both supply and demand interventions, the question of separability of the components arises. Although each component appears as a discrete endeavor, the logic of the project is that all components of the "innovation marketplace" must be developed and in place for growth to take place. Thus, it requires simultaneous involvement in spurring demand, increasing supply, and creating appropriate levels of information flow and protecting intellectual property rights. In this sense, each component depends on the others.

Nevertheless, several questions of cost-effectiveness arise when considering any project of this type. Promoting innovation in the private sector is a difficult and delicate task, in which the public sector must tread carefully. In a paper promoting self-organizing industry investment boards,[18] Paul Romer argues that "even after admitting all of the deficiencies of economic markets, one must acknowledge what experience has so clearly demonstrated — that most of the familiar political alternatives are far less efficient mechanisms for allocating resources than the market is." He concludes that rather than trying to focus on "critical technologies," the public sector should work to ensure "the underlying processes that lead to effective institutional arrangements."

Just how any project can stay focused on efficient processes is the major question for cost effectiveness. Most of the common mechanisms for doing so are included in the structure of this project. For example, a study of the transfer of government technology[19] lists six approaches that government R&D managers have found promising: contracting R&D to industrial partners, working with industrial consortia, licensing to industry, influencing key decisionmakers, working with broker organizations, and generating end-user demand. The activities of this project are consistent with the approaches discussed in this study.

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[18] Paul Romer, "Implementing a National Technology Strategy with Self-Organizing Industry Investment Boards," Brookings Papers: Microeconomics 2, 1993.

[19] M. Brown, L. Berry, and R. Goel, "Guidelines for Successfully Transferring Government-Sponsored Innovations," *Research Policy*, V. 20, 1991.

The project also aims to effectively blend both applied and basic research in the most cost-efficient manner. A recent study[20] discusses a survey of 650 US industrial research executives who were asked to rank the relevance of basic research; respondents noted that it was important for efficient applied research, and that "Industrial scientists and engineers almost always need training in the basic scientific principles and research techniques of their field, and providing this training is a central function of universities."

Finally, the project will work with a number of decisionmakers in the research community and the private sector. For maximum effectiveness, these actors will be offered the proper incentives for high quality R&D&E, and have sufficient ability and information to act appropriately. The government agencies executing this project will also be given incentives to orient their funding toward commercial applications of research. To this end, it will be important to design the selection criteria for grants to favor commercial applications, and to have significant private sector representation on the selection boards. These considerations have influenced the suggested composition of such committees, increasing private sector participation vis-à-vis the experience of PADCT.

For private firms to use the services of the project and invest in R&D&E, the incentives must be consistent with the private sector goal to maximize profits. The value of such investments will depend on the expected cost, level of return, and the amount of risk involved. To encourage greater private sector commitment, the project will carefully consider the incentives of the private sector in structuring several components. For example:

- If platforms require sharing of information, firms may consider the cost high and the returns low (since they can get the information without participation). The project will carefully consider appropriate incentives that will encourage private sector firms to participate in the platform activities.
- Since R&D is somewhat speculative, it is likely that some projects will be known not to be commercially viable before the end of the grant-funded research. If firms are committed to complete their funding of the R&D regardless, they will consider the risk of participation much higher. As experience accumulates in the project, mechanisms for minimizing this risk will be developed.
- Researchers also have a choice of research opportunities. If their options include project funding for fundamental research or applied research with firms, there may be some danger of the two project components competing with each other. The fundamental research component will be carefully structured to minimize this competition.

Monitoring and evaluation (M&E) of the project's inputs, processes, and outputs will be vitally important to keep the project on track. Coupled with the M&E, there is a need for appropriate feedback mechanisms that will indicate the incentives and decisions being made by all participants in the project activities. As such, it is significant that the M&E activities of this project are such a prominent component.

[20] Keith Pavitt, "What Makes Basic Research Economically Useful?" *Research Policy*, V. 20, 1991.

ANNEX 6: FINANCIAL SUMMARY

This project represents a substantial, but manageable, demand on Brazilian resources. Table 6.1 provides estimates of the annual expenditures of the project and its size relative to measures of the size of the economy.

By the final year of the project, expenditures are expected to reach as high as US$150 million, which is about 0.023 percent of the economy in that year. If total R&D spending in the economy is estimated to be only 0.88 percent of GDP, this project would add 2.6 percent to total R&D spending that year. If all project expenditures are considered additions to gross domestic investment, then in its final year the project will be shifting gross investment from 21 percent of the economy to about 21.02 percent. This is likely to be within the economy's absorptive capacity.

In terms of the project's fiscal impact on the government, total project expenditures are about 0.136 percent of the government consumption in the final year. Because this project replaces the PADCT II project, which ended in 1996, much of this spending does not represent new claims on government resources; instead it is a continuation of spending in this area. Moreover, by the end of the project period, it is expected the private sector will be covering an increasing portion of the project's expenditures, thereby reducing the burden on government resources.

Table 6-1: Project Expenditures and the Economy

		1998	1999	2000	2001	Total
Project expenditures		(millions)	(millions)	(millions)	(millions)	(millions)
S&T research		US$16	US$15	US$50	US$66	US$147
Technology development		US$12	US$14	US$49	US$72	US$147
Sectoral support		US$7	US$6	US$26	US$17	US$56
Unallocated		US$2.5	US$2.5	US$2.5	US$2.5	US$10
Annual total (US$ millions)		**US$37.5**	**US$37.5**	**US$127.5**	**US$157.5**	**US$360**
Project as percent of:						
General government consumption		3.2%	3.2%	12.1%	14.9%	
Gross domestic investment		2.6%	2.5%	1.0%	12.2%	
Brazil economy		(billions)	(billions)	(billions)	(billions)	(billions)
General government consumption	17%	US$103	US$105	US$107	US$110	US$425
Private consumption	62%	US$374	US$382	US$392	US$400	US$1,522
Gross domestic investment	21%	US$127	US$130	US$132	US$135	US$524

ANNEX 7: SUMMARY OF PROCUREMENT AND DISBURSEMENT ARRANGEMENTS

Procurement of Goods and Consulting Services

Procurement of all goods and services will be carried out in accordance with the Bank's Procurement Guidelines (*Guidelines: Procurement under IBRD Loans and IDA Credits*, version dated January 1995, revised January and August 1996). Specialized scientific equipment costing each US$100 thousand equivalent or more and obtainable from a limited number of suppliers may be procured through Limited International Bidding (LIB), up to an aggregate amount of US$13.9 million. For the execution of the LIB processes, purchasers will use the Bank's *Standard Bidding Documents*, which have been modified to exclude the provision on the margin of domestic preference, which will not be applicable. To the extent possible, other scientific equipment may be packaged, and contracts for such packages estimated to cost in excess of US$350,000 will be procured under International Competitive Bidding (ICB) procedures using the Bank's *Standard Bidding Documents*. Generic scientific equipment and other goods which have numerous local suppliers and cost each less than US$350,000 but more than US$100,000 may be procured under National Competitive Bidding (NCB) procedures using standard bidding documents acceptable to the World Bank. The aggregate ceiling for goods to be acquired via NCB has been set at US$59 million. International or local shopping procedures will be used for the purchase of goods estimated to cost less than US$100,000, up to an aggregate amount not to exceed US$24.2 million. Direct contracting procedures may be used for the purchase of spare parts and goods of a proprietary nature obtainable from a single source, up to an aggregate amount not to exceed US$24.6 million.

Consultant services will be procured in accordance with Quality- and Cost-Based Selection (QCBS) procedures. Complex or highly specialized assignments may be procured under Quality-Based Selection (QBS) procedures. Simple assignments not exceeding the equivalent of US$200,000 that can be precisely defined may be selected under a fixed budget. Assignments of a standard or routine nature not exceeding the equivalent of US$100,000 or less may be procured under least-cost selection procedures. Individual consultants will be selected on the basis of their qualifications. These procedures are described in the Bank's *Guidelines: Use of Consultants by World Bank Borrowers and by the World Bank as Executing Agency*, dated January 1997.

Major civil works are not contemplated in this project; minor renovation and refurbishing will be entirely financed with counterpart funding.

Tables 7.1, 7.2, and 7.3 summarize the above-described procurement arrangements agreed for the project, which are detailed in the project's *Manual Operativo*.

Table 7-1: Summary of Project Cost by Procurement Arrangements (US$ million)

Expenditure category	*Procurement method*				
	ICB	*NCB*	*Other*	*NBF*	*Total cost*
Goods	27.2 (27.2)	59.0 (41.3)	62.7 (43.2)		**148.9** **(111.7)**
Consultant services			44.5 (33.0)		**44.5** **(33.0)**
Training			43.8 (10.3)		**43.8** **(10.3)**
Operating costs				122.8	**122.8**
Total	**27.2** **(27.2)**	**59.0** **(41.3)**	**151** **(86.5)**	**122.8**	!Syntax Error, (**(155.0)**

Note: Figures in parenthesis are amounts financed by the World Bank.

Table 7-2: Detailed Project Cost Estimates by Procurement Arrangements (US$ million)

Expenditure category	*Procurement method (detailed)*							
	ICB	*LIB*	*NCB*	*IS/LS*	*DC*	*Other*	*NBF*	*Total cost*
Goods	27.2 (27.2)	13.9 (13.9)	59.0 (41.3)	24.2 (17.0)	24.6 (12.3)			**148.9** **(111.7)**
Consultant services						44.5 (33.0)		**44.5** **(33.0)**
Training						43.8 (10.3)		**43.8** **(10.3)**
Operating costs							122.8	**122.8**
Total	**27.2** **(27.2)**	**13.9** **(13.9)**	**59.0** **(41.3)**	**24.2** **(17.0)**	**24.6** **(12.3)**	**88.3** **(43.3)**	**122.8**	!Syntax Error, (**(155.0)**

Note: Figures in parenthesis are amounts financed by the World Bank.

Table 7-3: Consultant Selection Arrangements (in US$ million)

Category	*Selection method*						
	QCBS	*QBS*	*SFB*	*LCS*	*Other*	*NBF*	*Total cost*
A. Firms	10.8 (9.0)	9.2 (8.2)	6.0 (3.8)	4.0 (1.5)			**30.0** **(22.5)**
B. Individuals	n.a.	n.a.	n.a.	n.a.	14.5 (10.5)		**14.5** **(10.5)**
Total	10.8 (9.0)	9.2 (8.2)	6.0 (3.8)	4.0 (1.5)	14.5 (10.5)	(0.0)	**44.5** **(33.0)**

Note: Figures in parenthesis are the amounts financed by the Bank.

Prior Review by the Bank

Details of such review arrangements are in Table 7.4 below.

Table 7-4: Threshold for Procurement Methods and Prior Review

Expenditure category	*Type of procurement*	*Prior review*
1. Works	Not contemplated	Not contemplated
2. Goods		
< US$100,000	Shopping	None[1]
≥ US$100,000 < US$350,000	NCB or LIB	None[1]
≥ US$350,000	ICB or LIB	All
3. Consulting Services		
(a) Individuals		
< US$50,000	Qualification-based[2]	None[1]
≥ US$50,000	Qualification-based[2]	TOR, CV, draft contract
(b) Firms		
≥ US$200,000	QCBS or QBS	TOR, cost estimate, short list, LOI, technical evaluation report (QCBS), final evaluation report, draft contract
< US$200,000 and ≥ US$100,000	QCBS, QBS, or SFB	TOR, cost estimate, short list, LOI, final evaluation report, draft contract
< US$100,000	Variable[3]	None[1]

Notes: 1. Random ex post review.
2. As per Section V of the Consultant Guidelines for the selection of individual consultants.
3. To be determined on the basis of the nature of the task.

Disbursement

The proposed loan will disburse over a period of four years. It will finance 100 percent of foreign expenditures and 70% of local expenditures. The actual allocation of loan proceeds by category of disbursement is shown in Table 7.5.

Special Account

During negotiations, assurances were provided by the Borrower that it will open and maintain a Special Account in a commercial bank for disbursement of the loan proceeds. The authorized allocation will be US$20 million. The initial deposit will be limited to US$10 million until the aggregate amount of withdrawals from the loan account plus the total amount of outstanding special commitments shall be equal to or exceed US$35 million. After that point, the authorized allocation of the Special Account will be US$20 million. The Special Account will be operated by FINEP, the project's financial agent. FINEP operated the Special Accounts of PADCT I and II, both of which were also co-financed by the World Bank. The loan proceeds will be disbursed against full documentation for goods contracts above US$350,000, for consulting service contracts with firms above US$100,000, and consulting service contracts with individuals above US$50,000. All other expenditures, including disbursement for research grants, will be disbursed on the basis of Statements of Expenditures (SOEs).

Retroactive financing. Project expenditures made after June 1, 1997, or 12 months prior to loan signature, whichever occurs later, not to exceed US$15.0 million, will be eligible for retroactive financing from the loan.

Table 7-5: Allocation of Loan Proceeds by Expenditure Category

Project component	*Description*[1]	*Allocation (in US$ million)*
(A) Technology Development	Goods	40
	Consultant services (including studies and training)	18
	Subtotal	58
(B) Science and Technology Research	Goods	58
	Consultant services (including studies and training)	17
	Subtotal	75
(C) Sectoral Support	Goods	4
	Consultant services (including studies and training)	8
	Subtotal	12
Project management	Goods	1
	Consultant services (including studies and training)	4
	Subtotal	5
Unallocated		5
Total		155

Note: 1. Distribution of funds between goods and services is an estimation; given demand-driven nature of the project, actual breakdown cannot be known at this point. For this reason, for the purposes of the disbursement of the loan (Schedule 1 of Loan Agreement), no discrimination was made between goods and services.

Accounting, Financial Reporting, and Auditing

Project expenditures will be recorded in such a way that all related sources of funds and types of expenditures are clearly identified. Each implementing agency and the financial agent will supply financial information on project execution on a quarterly basis to the SCG for consolidation into annual reports due to the Bank. SCG has established a uniform and consistent financial accounting and reporting system for the project. Each implementing agency will maintain all required information and supporting documentation for the preparation of the Statements of Expenditures (SOEs). FINEP will be responsible for receiving disbursement information and documents from the implementing agencies; it will aggregate the data and prepare, sign, and submit to the Bank all withdrawal applications regarding expenditures to be financed with the loan proceeds.

Annual audits of the project accounts and the Special Account will be carried out by independent auditors acceptable to the Bank. As part of the audit, a separate opinion by the auditor on the proper use of SOEs will be required. The auditor's report will be forwarded to the Bank no later than six months after the end of each fiscal year of the Borrower.

ANNEX 8: PROJECT PROCESSING, BUDGET, AND SCHEDULE

A. Project Budget (US$131,000) **(LENP+LENA+LENN)**	Planned[21]	Actual
	US$361,400	US$381,755
B. Project Schedule		
	Planned[22]	Actual
Time taken to prepare the project	24 months	24 months
Strategic planning international workshop	May/95	May/95
Concept paper	Nov./95	Nov./95
Formal identification (in DC)	May/96	May/96
*Carta-Consulta a*pproval by COFIEX	June/96	June/96
Preparation mission	Sept./96	Sept./96
Technical meetings (in DC)	Nov./96	Nov./96
Initial preappraisal	Dec./96	Dec./96
Final preappraisal	Mar./97	Mar./97
Appraisal completion	June/97	June/97
Planned negotiations	Oct./97	Nov./97
Planned Board presentation	Nov./97	Dec./97
Planned effectiveness date	May/98	
Planned midterm review	Oct./2000	

C. Prepared by: The Brazilian Ministry of Science and Technology (MCT), with technical assistance from several national and international consultants, and in close coordination with the Brazil Science and Technology Assistance and Reform (S.T.A.R.) team, LCSHD.

[21] At draft PAD stage.

[22] At draft PAD stage.

ANNEX 9: SELECTED DOCUMENTS IN THE PROJECT FILE

BRAZIL

Science and Technology Reform Support Project

(See project file for additional documents and references)

A. Basic documents for project implementation
- MCT: Project Implementation Plan, dated November 1997
- MCT: Draft Manual Operativo, dated November 1997

B. PADCT I & II documents
- WB: PADCT I: SAR, January 1985; and PCR, July 1994
- WB: PADCT II: SAR & MOP, October 1990; and ICR, draft of August 1997

- MCT: PADCT I: Documento Básico and Manual Operativo
- MCT: FINEP/PADCT II "Loan Agreement," February 1991

C. Related Projects
- Indonesia: Higher Education Support Project — Development of Undergraduate Education: Project Implementation Plan, April 1996 and SAR
- Argentina: Higher Education Reform: SAR plus Operational Manual and Guide for the Presentation of Project Proposals (Spanish)

D. Federal Science and Technology Agencies and Institutions
- MCT: Relatórios de Atividades, 1995 and 1996
- MCT: Relatório Estatístico 1985 – 1995

- CNPq: Relatórios de Atividades 1995 and 1996
- CNPq: Relatório Estatístico 1993

- FINEP: Relatórios de Atividades 1995 and 1996
- FINEP: A Experiência da FINEP 1967 – 92 (Interbusiness, January 1993)

- EMBRAPA: Gestão em Ciência e Tecnologia: Pesquisa Agropecuária (Goedert: EMBRAPA reorganization plan: 1994)
- EMBRAPA: II Plano Diretor da EMBRAPA 1994 – 1998 (Brasília, 1994)
- FIOCRUZ: Relatório de Atividades 1993/94
- FIOCRUZ: Política Nacional de Ciência e Tecnologia em Saúde (Synopsis of 10/94 conference proceedings)
- INPI: Panorama da Tecnologia "Nova lei prevê patentes farmacêuticas" (Various articles; 12/93)

- INMETRO: Plano do Modernização do INMETRO 1995/96
- INMETRO: Brasil e a Certificação ISO-9000 (INMETRO; 1996)

- INMETRO: Special Programs: PACTI, PBQP, National Quality Award, Science and Technology Policy Studies Program

E. State Systems
- Orçamento dos Estados para Ciência e Tecnologia (CNPq, 1994)
- "Participação das FAP's na Gestão dos Recursos do PADCT e na Operação de seus Subprogramas" (A. Carvalho da Silva, 1995: Brasília)
- FIRJAN: Investments in RJ (15 pp.) / Cadastro Industrial de RJ
- Fundação Bio Rio: Relatório de Atividades & other information

F. Background: Brazil Research and Development Incentive Laws
- *O Mecanismo de Renúncia Fiscal no Processo de Estímulo ao Investimento Privado em Desenvolvimento Tecnológico* (E. Stal, Subprograma PGCT /PADCT, São Paulo, Oct. 1995)
- *Manual de Orientação Para o Preenchimento de Formulários de PDTI/PDTA* (A FINEP and Instituto UNI/EMP Publication)

G. Background: Brazil University/Industry Cooperation
- *Dossiê Universidade-Empresa* (Several authors, Revista USP, No. 25, March, April, May 1995)
- *Análise e propostas de mecanismos que possibilitem a interação adequada entre o setor acadêmico e a indústria de bens e serviços* (J. de Souza Neto, Preparado para o PADCT, Ministério da Ciência e Tecnologia, Oct. 1995)

H. Firm-Level Research and Development/ Intellectual Property Issues

In Brazil
- National Systems Supporting Technical Advance in Industry: The Brazilian Experience (Frischtak & Dahlman, in Nelson)
- Estudo da Competitividade da Indústria Brasileira (Coutinho & Ferraz, 1994)
- *Senado Federal: Projeto de Lei da Câmara no. 115 de 1993* (De iniciativa do Presidente da República, Centro Gráfico do Senado Federal, Brasília DF)

In General
- *Intellectual Property Protection, Foreign Direct Investment, and Technology Transfer* (E. Mansfield, IFC Discussion Paper #19, 1994)
- *Intellectual Property, Trade and Economic Development: A Road Map for the FTAA Negotiations* (Sherwood and Braga, 1996)

I. Technology and Research Institutes
- *Memória Anual, Fundación Chile* (Published by Fundación Chile in Dec. 1994, Ivan Lavados, President)
- *Anais do Seminário Internacional – The Role of Industrial Technology Research Institutes* (Multiple authors, collection of essays, printed by IPT, Instituto de Pesquisas Tecnológicas, May 1995)
- *Relatório da Comissão de Supervisão de Avaliação dos Institutos do MCT* (Bevilacqua, Dias, Taralli, Krieger, Silva, Marcovich, Ferreira, Leal, Nussenzveig, Dec. 1994)

J. Sectoral Policy and Measuring Returns to R&D/S&T (Brazil)

- Simpósio Sobre Engenharia de Materiais: 23 – 25 Aug. 1995:
- Departamento de Engenharia de Materiais, Universidade Federal de São Carlos
- Science & Technology in Brazil: A New Policy for a Global World (Schwartzmann, ed., 1995)

K. Science Research, Advanced Training, and Higher Education

- Brazil Higher Education Reform (October 1993)
- Reforming Higher Education Systems: Some Lessons to Guide Policy Implementation (Eisemon & Holm-Nielsen, ESP Discussion Paper # 60, 4/95)

L. Methodology

- *How to Communicate with the LogFrame* (M. Thompson with Team Technologies Inc. May 1996)
- *TeamUP Marco Lógico: Melhores Times, Melhores Projetos* (Team Technologies, Inc. 1996)

ANNEX 10: STATUS OF WORLD BANK GROUP OPERATIONS IN BRAZIL

IBRD Loans and IDA Credits in the Operations Portfolio

Project ID	Loan or Credit No.	Fiscal Year	Borrower	Purpose	Original Amount in US$ Millions				Difference Between expected and actual disbursements a/	
					IBRD	IDA	Cancellations	Undisbursed	Orig	Frm Rev'd
Number of Closed Loans/credits: 192										
Active Loans										
BR-PE-35728	IBRD42320	1998	STATE OF BAHIA	BAHIA WTR RESOURCES	51.00	0.00	0.00	51.00	0.00	0.00
BR-PE-39197	IBRD42110	1998	STATE OF RIO DE JANEIRO	RJ ST.PRIV.	250.00	0.00	0.00	250.00	250.00	0.00
BR-PE-6474	IBRD42380	1998	STATE OF SAO PAULO	LAND MGT 3(SP)	55.00	0.00	0.00	55.00	0.00	0.00
BR-PE-34578	IBRD41650	1997	RIO GRANDE DO SUL	RGS HWY MGT	70.00	0.00	0.00	70.00	70.00	0.00
BR-PE-38896	IBRD41200	1997	STATE OF RGN	R.POVERTY(RGN)	24.00	0.00	0.00	22.80	22.80	0.00
BR-PE-39196	IBRD41390	1997	STATE OF RIO GRANDE DO SU	RGS ST.REFORM	125.00	0.00	0.00	75.00	75.00	0.00
BR-PE-42566	IBRD41220	1997	STATE OF PERNAMBUCO	R.POVERTY(PE)	39.00	0.00	0.00	36.35	36.35	0.00
BR-PE-43868	IBRD41480	1997	STATE OF RGS	RGS LAND MGT/POVERTY	100.00	0.00	0.00	100.00	100.00	0.00
BR-PE-43871	IBRD41210	1997	STATE OF PIAUI	(PIAUI)R.POVERTY	30.00	0.00	0.00	28.50	28.50	0.00
BR-PE-43873	IBRD41690	1997	FED.REP.OF BRAZIL	AG TECH DEV.	60.00	0.00	0.00	56.01	56.01	0.00
BR-PE-46052	IBRD41900	1997		CEARA WTR PILOT	9.60	0.00	0.00	9.60	0.00	0.00
BR-PE-48870	IBRD41890	1997	THE STATE OF MATO GROSSO	MT STATE PRIV.	45.00	0.00	0.00	45.00	45.00	0.00
BR-PE-6475	IBRD41470	1997	FED. REP. OF BRAZIL	LAND RFM PILOT	90.00	0.00	0.00	75.05	75.05	0.00
BR-PE-6532	IBRD41880	1997	FEDERAL GOVERNMENT	FED HWY DECENTR	300.00	0.00	0.00	300.00	300.00	0.00
BR-PE-6562	IBRD41400	1997	STATE OF BAHIA	BAHIA MUN.DV	100.00	0.00	0.00	94.98	94.98	0.00

Project ID	Loan or Credit No.	Fiscal Year	Borrower	Purpose	Original Amount in US$ Millions				Difference Between expected and actual disbursements a/	
					IBRD	IDA	Cancellations	Undisbursed	Orig	Frm Rev'd
BR-PE-37828	IBRD40600	1996	STATE OF PARANA	(PR)R.POVERTY	175.00	0.00	0.00	175.00	175.00	0.00
BR-PE-40028	IBRD40460	1996	FEDERATIVE REPUBLIC OF BR	RAILWAYS RESTRUCTURG	350.00	0.00	0.00	159.53	159.53	0.00
BR-PE-6512	IBRD39240	1996	CVRD	ENV/CONS(CVRD)	50.00	0.00	0.00	35.87	35.87	0.00
BR-PE-6554	IBRD40470	1996	FED. REP. OF BRAZIL	HLTH SCTR REFORM	300.00	0.00	0.00	261.09	261.09	0.00
BR-PE-35717	IBRD39170	1995	GOVT OF BRAZIL	RURAL POV. (BAHIA)	105.00	0.00	0.00	69.52	69.52	0.00
BR-PE-38882	IBRD39150	1995	FED REPUBLIC OF BRAZIL	RECIFE M.TSP	102.00	0.00	0.00	98.72	98.72	0.00
BR-PE-38884	IBRD39180	1995	GOVT OF BRAZIL	RURAL POV.- CEARA	70.00	0.00	0.00	54.55	54.55	0.00
BR-PE-38885	IBRD39190	1995	GOVT OF BRAZIL	RURAL POV.-SERGIPE	36.00	0.00	0.00	24.27	24.27	0.00
BR-PE-6436	IBRD37890	1995	STATE OF CEARA ZIL	CEARA UR.DV/WATER CO	140.00	0.00	0.00	115.65	115.65	0.00
BR-PE-6564	IBRD39160	1995	FED REPUBLIC/BRAZIL	BELO H M.TSP	99.00	0.00	0.00	83.69	83.69	0.00
BR-PE-6452	IBRD36630	1994	MINISTRY OF EDUCATION	NE BASIC EDUC III	206.60	0.00	0.00	88.21	88.21	0.00
BR-PE-6522	IBRD37670	1994	ST.OF ESPIRITO SANTO	ESP.SANTO WATER	154.00	0.00	0.00	94.65	94.65	0.00
BR-PE-6524	IBRD36390	1994	ST.OF MINAS GERAIS	MINAS MNC.DEVELOPMT	150.00	0.00	5.00	43.82	48.82	0.00
BR-PE-6543	IBRD37330	1994	GOVERNMENT	M. GERAIS BASIC EDUC	150.00	0.00	0.00	83.06	83.06	0.00
BR-PE-6546	IBRD36590	1994	GOVERNMENT	AIDS CONTROL	160.00	0.00	0.00	22.33	22.33	0.00
BR-PE-6555	IBRD37130	1994	STATE GOVTS	STE HWY MGT II	54.00	0.00	18.00	20.10	204.10	42.96
BR-PE-6555	IBRD37140	1994	STATE GOVTS	STE HWY MGT II	87.00	0.00	0.00	4.43	137.43	42.96
BR-PE-6555	IBRD37150	1994	STATE GOVTS	STE HWY MGT II	79.00	0.00	18.00	18.43	177.43	42.96
BR-PE-6558	IBRD37660	1994	REPUBLIC OF BRAZIL	PARANA BASIC EDUC	96.00	0.00	0.00	38.03	38.03	0.00
BR-PE-6378	IBRD35470	1993	STATE GOVERNMENTS	STATE HWY MGMT	50.00	0.00	0.00	5.58	43.58	14.09
BR-PE-6378	IBRD35480	1993	STATE GOVERNMENTS	STATE HWY MGMT	38.00	0.00	18.00	8.53	76.53	14.09
BR-PE-6427	IBRD36040	1993	MIN. OF EDUCATION N	NE BASIC EDUC II	212.00	0.00	0.00	64.00	64.00	0.00
BR-PE-6540	IBRD35540	1993	MINAS GERAIS ST.	WTR Q/PLN(MINAS GERA	145.00	0.00	5.00	33.35	38.35	33.34

Project ID	Loan or Credit No.	Fiscal Year	Borrower	Purpose	Original Amount in US$ Millions				Difference Between expected and actual disbursements a/	
					IBRD	IDA	Cancellations	Undisbursed	Orig	Frm Rev'd
BR-PE-6541	IBRD35030	1993	S.PAULO/PARANA STS.	WTR Q/PLN(SP/PARANA)	9.00	0.00	0.00	6.25	242.25	0.00
BR-PE-6541	IBRD35040	1993	S.PAULO/PARANA STS.	WTR Q/PLN(SP/PARANA)	119.00	0.00	0.00	39.93	165.93	0.00
BR-PE-6541	IBRD35050	1993	S.PAULO/PARANA STS.	WTR Q/PLN(SP/PARANA)	117.00	0.00	0.00	50.75	178.75	0.00
BR-PE-6547	IBRD36330	1993	FED.REP.OF BRAZIL	METRO TRANSP. RIO	128.50	0.00	0.00	47.83	47.83	0.00
BR-PE-6368	IBRD34420	1992	GOVERNMENT	WATER SECTOR MODERNI	250.00	0.00	0.00	76.61	76.61	0.00
BR-PE-6379	IBRD34570	1992	GOB BRAZI	METRO TRANSP.SPAULO	126.00	0.00	0.00	5.20	5.20	0.00
BR-PE-6505	IBRD34920	1992	GOVERNMENT OF BRAZIL	MATO GROSSO NAT RES	205.00	0.00	0.00	95.38	95.38	0.00
BR-PE-6364	IBRD33750	1991	STATE OF SAO PAULO	INNOV BASIC ED	245.00	0.00	0.00	58.24	58.24	0.00
BR-PE-6492	IBRD33760	1991	PETROBRAS BRAZI	HYDROCARBN TRNSP/PRO	260.00	0.00	0.00	16.66	16.66	0.00
BR-PE-6403	IBRD31350	1990	FEDERATIVE REPUBLIC OF BR	NE BASIC HLTH SRV II	267.00	0.00	50.00	11.93	61.93	12.31
BR-PE-6442	IBRD28831	1990	ELETROBRAS	ITAPARICA	100.00	0.00	0.00	1.68	33.68	1.86
BR-PE-6446	IBRD31730	1990	FEDERATIVE REPUBLIC OF BR	NAT ENVIRONMT	117.00	0.00	0.00	29.61	29.61	0.00
BR-PE-6453	IBRD31700	1990	FEDERATIVE REPUBLIC OF BR	NE IRRIG I	210.00	0.00	69.00	41.00	110.00	39.49
BR-PE-6473	IBRD31600	1990	STATE OF SANTA CATARINA	LND MGMT II-S. CATAR	33.00	0.00	0.00	7.84	7.84	0.00
BR-PE-6370	IBRD30130	1989	FEDERATIVE REPUBLIC OF BR	NE IRRI JAIBA	71.00	0.00	0.00	5.91	5.91	0.00
BR-PE-6414	IBRD30430	1989	COMGAS, SAO PAULO	NTRL GAS DIST	94.00	0.00	0.00	7.55	7.55	0.00
BR-PE-6360	IBRD29500	1988	GOVERNMENT OF BRAZIL	IRR SUB-SECTOR	195.00	0.00	26.00	.46	26.46	.44
BR-PE-6431	IBRD28100	1987	FEDERAL REPUBLIC OF BRAZI	SKILLS FORMATION	74.50	0.00	58.90	.11	59.01	-1.99
Total					6,978.20	0.00	267.90	3,374.64	4,576.94	242.51

	Active Loans	Closed Loans	Total
Total Disbursed (IBRD and IDA):	3,335.67	14,962.96	18,298.63
of which has been repaid:	399.40	11,942.37	12,341.77

Project ID	Loan or Credit No.	Fiscal Year	Borrower	Purpose	Original Amount in US$ Millions				Difference Between expected and actual disbursements a/	
					IBRD	IDA	Cancellations	Undisbursed	Orig	Frm Rev'd
Total now held by IBRD and IDA:			6,310.89	3,087.65	9,398.54					
Amount sold	:		0.00	45.83	45.83					
Of which repaid	:		0.00	45.83	45.83					
Total Undisbursed	:		3,374.64	67.09	3,441.73					

a. Intended disbursements to date minus actual disbursements to date as projected at appraisal.

b. Rating of 1-4: see OD 13.05. Annex D2. Preparation of Implementation Summary (Form 590). Following the FY94 Annual Review of Portfolio performance (ARPP), a letter based system will be used (HS = highly Satisfactory, S = satisfactory, U = unsatisfactory, HU = highly unsatisfactory): see proposed Improvements in Project and Portfolio Performance Rating Methodology (SecM94-901), August 23, 1994.

Note:

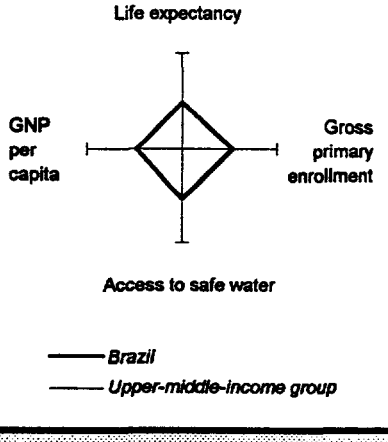
Disbursement data is updated at the end of the first week of the month.

ANNEX 11: BRAZIL AT A GLANCE

8/28/97

POVERTY and SOCIAL	Brazil	Latin America & Carib.	Upper-middle-income
Population mid-1996 *(millions)*	161.2	485	479
GNP per capita 1996 *(US$)*	4,360	3,710	4,540
GNP 1996 *(billions US$)*	702.9	1,799	2,173
Average annual growth, 1990-96			
Population *(%)*	1.4	1.7	1.5
Labor force *(%)*	1.6	2.3	1.8
Most recent estimate *(latest year available since 1989)*			
Poverty: headcount index *(% of population)*	17	..	..
Urban population *(% of total population)*	78	74	73
Life expectancy at birth *(years)*	67	69	69
Infant mortality *(per 1,000 live births)*	44	37	35
Child malnutrition *(% of children under 5)*	18	..	..
Access to safe water *(% of population)*	92	80	86
Illiteracy *(% of population age 15+)*	17	13	13
Gross primary enrollment *(% of school-age population)*	114	110	107
Male	..	..	..
Female	..	..	..

Development diamond*

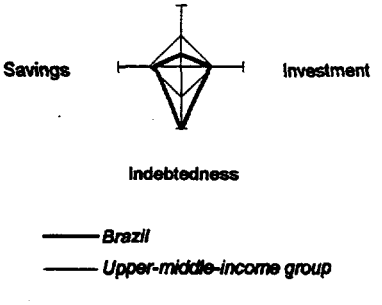


KEY ECONOMIC RATIOS and LONG-TERM TRENDS

	1975	1985	1995	1996
GDP *(billions US$)*	121.8	222.9	716.9	748.7
Gross domestic investment/GDP	26.8	19.2	20.1	19.5
Exports of goods and services/GDP	7.5	12.2	6.7	6.6
Gross domestic savings/GDP	22.9	24.4	19.2	18.2
Gross national savings/GDP	21.1	19.3	17.6	16.3
Current account balance/GDP	-5.8	-0.2	-2.5	-3.2
Interest payments/GDP	1.7	3.3	1.2	1.7
Total debt/GDP	22.4	46.5	22.2	23.8
Total debt service/exports	43.5	39.1	43.1	46.7
Present value of debt/GDP	..	..	22.1	..
Present value of debt/exports	..	..	270.7	..

	1975-85	1986-96	1995	1996	1997-05
(average annual growth)					
GDP	3.1	*1.2*	4.1	2.9	4.8
GNP per capita	0.2	*-0.4*	2.8	1.6	4.0
Exports of goods and services	10.5	*6.5*	-1.4	6.1	7.0

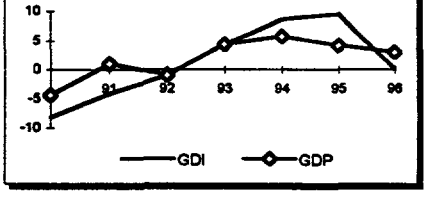
Economic ratios*



STRUCTURE of the ECONOMY

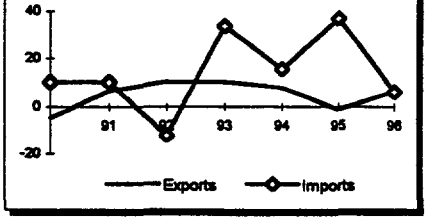
	1975	1985	1995	1996
(% of GDP)				
Agriculture	12.1	11.5	14.4	14.4
Industry	40.2	45.3	36.5	36.4
Manufacturing	30.3	33.7	23.8	..
Services	47.7	43.1	49.1	49.2
Private consumption	66.5	65.8	64.9	65.7
General government consumption	10.6	9.9	15.9	16.1
Imports of goods and services	11.5	7.1	7.6	7.9

Growth rates of output and investment (%)



	1975-85	1986-96	1995	1996
(average annual growth)				
Agriculture	4.3	*2.6*	4.9	3.1
Industry	3.0	*-1.1*	2.1	2.3
Manufacturing	2.6	*-1.5*	2.1	..
Services	2.9	*2.8*	5.3	3.3
Private consumption	3.0	*1.8*	11.0	4.1
General government consumption	1.2	*0.7*	2.4	0.8
Gross domestic investment	-2.9	*-0.6*	9.4	0.0
Imports of goods and services	-4.0	*8.9*	36.8	5.9
Gross national product	2.5	1.1	4.2	2.9

Growth rates of exports and imports (%)

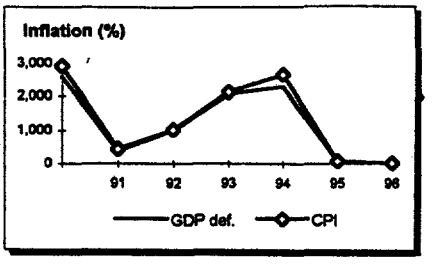


Note: 1996 data are preliminary estimates. Figures in italics are for years other than those specified.

* The diamonds show four key indicators in the country (in bold) compared with its income-group average. If data are missing, the diamond will be incomplete.

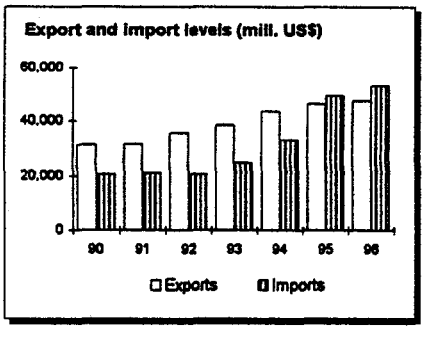
PRICES and GOVERNMENT FINANCE

	1975	1985	1995	1996
Domestic prices				
(% change)				
Consumer prices	25.0	226.9	67.0	15.5
Implicit GDP deflator	33.9	231.7	74.9	11.1
Government finance				
(% of GDP)				
Current revenue	..	..	31.5	32.4
Primary surplus/deficit	..	..	0.4	-0.1
Operational surplus/deficit	..	..	-4.8	-3.9



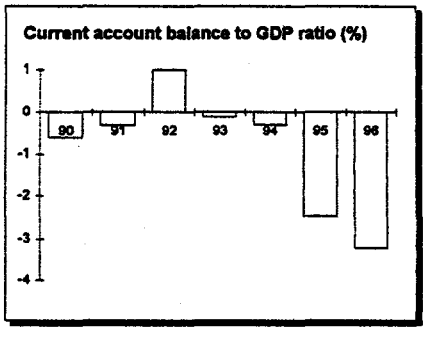
TRADE

	1975	1985	1995	1996
(millions US$)				
Total exports (fob)	..	25,638	46,508	47,746
Coffee	..	2,607	1,970	2,059
Other food	..	2,545	3,896	4,665
Manufactures	..	13,356	25,568	26,247
Total imports (cif)	..	13,153	49,663	53,286
Food	..	..	3,535	6,044
Fuel and energy	..	6,176	4,649	5,752
Capital goods	..	2,480	19,688	19,804
Export price index *(1987=100)*	..	97	128	126
Import price index *(1987=100)*	..	79	124	125
Terms of trade *(1987=100)*	..	123	103	101



BALANCE of PAYMENTS

	1975	1985	1995	1996
(millions US$)				
Exports of goods and services	9,418	27,713	47,960	49,558
Imports of goods and services	14,323	16,928	54,306	59,355
Resource balance	-4,905	10,785	-6,346	-9,797
Net income	-2,106	-11,213	-15,419	-17,402
Net current transfers	-10	16	3,973	2,899
Current account balance, before official capital transfers	-7,021	-412	-17,792	-24,300
Financing items (net)	5,956	1,826	30,779	32,935
Changes in net reserves	1,065	-1,414	-12,987	-8,635
Memo:				
Reserves including gold *(mill. US$)*	4,166	11,613	51,469	59,663
Conversion rate *(local/US$)*	3.0E-12	2.3E-09	0.9	1.0



EXTERNAL DEBT and RESOURCE FLOWS

	1975	1985	1995	1996
(millions US$)				
Total debt outstanding and disbursed	27,329	103,601	159,130	178,131
IBRD	1,045	5,274	6,038	5,876
IDA	0	0	0	0
Total debt service	4,320	11,470	22,328	..
IBRD	98	796	1,868	1,638
IDA	0	0	0	0
Composition of net resource flows				
Official grants	9	34	64	..
Official creditors	1,059	935	-1,378	..
Private creditors	4,213	149	9,827	..
Foreign direct investment	1,302	1,348	4,859	..
Portfolio equity	0	0	4,411	..
World Bank program				
Commitments	538	1,525	404	858
Disbursements	249	765	838	1,500
Principal repayments	26	406	1,377	1,222
Net flows	224	359	-539	278
Interest payments	72	391	491	416
Net transfers	152	-32	-1,031	-138