1. Country and Sector Background

- In the last year, Colombia has been affected by the global economic downturn. In 2008, real GDP growth slowed to 2.5 per cent. GDP contracted by 0.1 per cent in 2009 and a modest rebound of economic activity is expected for 2010.

- In order to achieve and sustain long term growth, Colombian firms must increase their productivity. The low level of sophistication of Colombia’s product basket prevents firms from investing in R&D and innovation. Long-term investments in Science, Technology, and Innovation (ST&I) can contribute to the goal of diversifying production and increasing productivity. Theoretical and empirical evidence suggest that the realization of sustained productivity growth is contingent upon increasing knowledge generation and absorption.

- Colombia has intensified its support to ST&I in the past two decades, but still lags behind in the knowledge economy. Colombia ranks below other Latin American countries in investment in ST&I activities, and particularly in R&D. Investment in science, technology and innovation in 2006 accounted only for 0.4 per cent of GDP, with R&D reaching only 0.16 per cent, significantly lower than neighboring Brazil, which spent three and five times those amounts respectively. The issues that act as specific barriers to knowledge-based growth in Colombia are the following:

  a) Budget fluctuations, institutional fragmentation and weak sector leadership. Colombia’s National System of STI is constituted by a diverse set of institutions that have developed over the past four decades. During this period, changes in macroeconomic conditions and policy priorities have led to instability in budgetary allocations to the sector. Also, as budgets fluctuated, the agencies and ministries taking responsibility for the implementation of STI activities in specific sectors changed, which
hindered policy continuity. Currently, 16 ministries and governmental agencies have direct or indirect responsibilities in the implementation of STI policy, developing and funding separate and sometimes overlapping programs, while a number of important areas are disregarded. This issue has progressively been addressed by strengthening the role of its national agency for STI, Departamento Administrativo de Ciencia, Tecnología e Innovación (Colciencias), which still faces several challenges such as improving its management practices, upgrading its information technology systems, streamlining its core processes and increasing the policy-making capabilities of its human resources.

b) **Limited degree of development of scientific skills at the lower levels of the education system.** Compared to other middle income countries, Colombia’s performance on international assessments such as TIMMS and PISA roughly average in reading but falls behind in mathematics and science. According to TIMMS results, the average science performance of Colombian eighth-graders in the 2007 was lower than that of other middle income countries such as Jordan, Thailand, Malaysia and Indonesia. Furthermore, only 1 per cent of eighth-grade students reached the TIMSSS advanced international benchmark in science, compared to 5 per cent in Jordan and 3 per cent in Turkey, Ukraine, Thailand and Malaysia. This low level of attainment in science and mathematics at lower levels of the education system ultimately leads to low enrollment ratios in scientific, technical and technological degrees at the higher education level and to a low percentage of individuals that are able to perform innovation-related tasks in the labor market.

c) **Inadequate stock of advanced human capital.** Research shows that increasing the share of educated employees has a positive impact on introducing new products or processes within a firm. However, in Colombia, there is a lack of advanced human capital to promote innovation within the productive sector at the level required in a middle-income country aspiring to become a knowledge economy. Only 13.7 percent of the country’s labor force had reached higher education\(^1\) by 2005 and most higher education students during the period 2002-2008 were enrolled in university programs (71 per cent), compared to technical and technological programs (24 per cent). The number of engineers in strategic industries remains insufficient and, with less than 2,700 active researchers with doctoral degrees, Colombia lags significantly behind regional peers in the per capita number of doctoral graduates and researchers. This results in a low proportion of university professors with a doctoral degree (12 percent) and of PhDs contributing to innovation activities (only 2.5 per cent of doctoral graduates work in the private sector).\(^2\) There is also a very low share of employees with a doctoral degree in sectors of high economic relevance: for instance, only 0.06 per cent of those working in the manufacturing sector hold a PhD.

d) **Weak links between local researchers and the Colombian diaspora.** The experience of countries such as India or Scotland has shown that **diasporas** posses a high potential to facilitate access to knowledge to researchers and firms inside the country. Nevertheless, in spite of the fact that Colombian migrants to the United States have three more years of education than the average Colombian and that 46.2 per cent of them have tertiary education training, compared to only 14 per cent in the case of Mexican migrants,  

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\(^1\) Higher education refers to university and vocational and technical post-secondary programs.

\(^2\) According to the Network of Indicators of Science and Technology (RICYT), only 2.5 per cent of PhD graduates work in business, while 80.5 per cent work in higher education.
collaboration between researchers based in Colombia and Colombian citizens based abroad remains low.

e) **Low economic relevance and limited international linkages of existing public research.** Colombia produces significantly less scientific and technical journals than the Latin-American average. Furthermore, research is highly concentrated in humanities and social sciences, which account for almost half of the indexed publications, with limited attention given to the areas of natural sciences and technology. Universities and research centers remain the key actors in research production, and according to the Colombian manufacturing innovation survey, only 9 per cent of firms count with a R&D unit within their corporate structure. As a result of these dynamics, research only exceptionally provides knowledge inputs that can directly contribute to increasing the productivity of the economy. Translating the existing research foundation into economically productive commercial applications remains a missing link.

f) **Weak links between the private sector and knowledge institutions (universities, research centers, technology development centers).** A likely cause for the perceived lack of economic impact of Colombia’s research is the limited collaboration between the private sector and knowledge institutions. Like many other countries, Colombia has traditionally lacked a culture of cooperation between the private sector and universities and research centers. Lack of awareness of the benefits of such collaboration on both sides, mismatch of industry needs with academics’ knowledge and very limited incentives for faculty and students to engage with firms have all prevented effective collaboration.

g) **Low levels of awareness of Science, Technology and Innovation in society.** Recent surveys on the public perception of science show that, in Colombia, general access to content and information related to STI is relatively low, especially outside the most important urban areas. This reinforces some of the previous issues, such as the low enrollment ratios in scientific, technical and technological degrees and the lack of a corporate culture that values innovation. Furthermore, only 4.7 per cent of people interviewed in Bogota considered that public investments in Science and Technology should be a priority. In such a context, it becomes complicated to elicit support for increasing investments in STI activities.

h) **Limited diffusion of current public incentives.** While a number of financial instruments to promote STI have been in place for a long-time, many are not well-known to most firms. In the past, instruments were not successfully targeted and advertised to the private sector. A study commissioned by the National Planning Department (DNP) emphasized that the lack of an effective public communication strategy to promote the diffusion of the existing STI instruments prevented firms from more systematically undertaking publicly-funded commercial innovation. This is particularly the case for small and medium enterprises (SMEs), which do not typically have the specialized human resources in-house to effectively tap into these funding opportunities.

- **During the period 2006-2009 a series of political developments in Colombia highlighted the increased relevance of STI policy as a fundamental tool to promote productivity growth and increase welfare.** The beginning of the second Uribe administration was marked by the establishment of a long-term plan for social and economic policy (“Vision 2019”) that identified productivity growth through STI as a key strategy to achieve sustained economic growth and a
greater level of welfare. Furthermore, Colciencias, in coordination with the Departamento Nacional de Planeación (DNP), has been taking substantial steps towards developing a reform agenda for the STI sector the most important being the preparation of a policy document that served as a first proposal for a national STI policy. In this period, Colciencias has also been financially strengthened: in the last two years, its budget has increased by 46 and 59 per cent in real terms, respectively, and there are plans to continue increasing its funding (see Annex 1 for details about the recent budget evolution). In 2009, Law 1286 transformed Colciencias into the Administrative Department of Science, Technology, and Innovation reporting to the President and in charge of coordinating all actors in the STI sector. Law 1286 also created the National Fund for Financing of Science, Technology, and Innovation (Fondo Francisco José de Caldas) which is expected to significantly increase the resources available for STI activities and will alleviate some of the budgetary restrictions faced previously by Colciencias.

- **These legal developments were followed by the approval of a new STI Policy in 2009.** This policy, as presented in the CONPES 3582/2009, revolves around six leading objectives: (a) strengthening Colciencias and promoting the institutional consolidation of the National Science, Technology and Innovation System (SNCTI); (b) strengthening human resources for research and innovation; (c) promoting R&D and innovation in the productive sector; (d) promoting social dissemination of knowledge in specific audiences that can act as multipliers to increase social dialogue in scientific and technological issues; (e) focusing public action in strategic areas in order to complement the national competitiveness policy and (f) developing and strengthening STI capabilities regionally and promoting the internationalization of Colombian STI activities. The proposed Program would support continuity of National STI policy as established in CONPES 3582.

2. **Objectives**

The Program (Calendar Year (CY) 2010-2019) would seek to enhance Colombia’s ability to generate, disseminate and apply knowledge to support its economic and social development.

The Project Development Objective (PDO) for Phase I of the APL (CY 2010-2013) would be to: (i) strengthen Colciencias’ capacity to promote human capital for the knowledge economy, R&D and innovation; (ii) raise awareness of science, technology and innovation in the Colombian society.

3. **Rationale for Bank Involvement**

The proposed operation builds on the World Bank Country Partnership Strategy (CPS). The 2008 Colombia CPS focuses WBG efforts on six main areas that are aligned with the pillars established in the National Development Plan 2006-2010. The operation would specifically support two of them: Sustained Equitable Growth and Governance. The former aims at improving Colombia’s competitiveness and private sector productivity to maintain high and sustainable GDP growth over the medium-term. Further increasing knowledge generation, absorption and utilization in Colombia are paramount to achieve the desired productivity leap. Improving governance across the public entities of the national STI system would allow them to
more effectively stimulate the supply and demand of knowledge, as well as link knowledge institutions and the private sector more efficiently.

The proposed operation will build on the existing cooperation in the STI and tertiary education sector between the World Bank and the Government of Colombia (GoC). Following the preparation of a World Bank policy note for the STI sector covering the period 2006-2010 under the title Colombia: A Window of Opportunity, the GoC increased its attention to the sector. A number of the recent institutional, legal and policy developments are aligned with the policy recommendations made to the GoC in this document. The proposed operation is also linked to the Bank’s current engagement with Colombia’s tertiary education system through loan 7155-CO, which closed on December 31, 2008 and whose main objective was to increase access, quality and coherence in the tertiary subsector. Colciencias was a co-implementing agency for this loan financing national doctoral scholarships, the acquisition of robust equipments and researchers’ mobility programs.

The Bank has accumulated relevant international experience in the development and implementation of STI strategies. The proposed operation would support policy areas where the Bank has gained broad expertise worldwide. In particular, since 2005, the Bank has financed STI interventions in a number of middle-income countries in the region (i.e. Argentina, Uruguay, Chile and Mexico) and outside the region (i.e. Turkey, Croatia, Armenia) focusing simultaneously on increasing the supply of knowledge and its demand by the enterprise sector to increase competitiveness and boost firms’ productivity. In addition to its operational experience, the Bank has also been involved extensively in knowledge activities related to STI globally.

4. Description

The Program (Calendar Year (CY) 2010-2019) would be financed by an Adaptable Program Loan (APL) structured in two phases to be implemented over a period of 9 years. The proposed Project (Phase I of the APL to be implemented in CY 2010-2013) would be financed through a loan of US$25 million. The second phase (CY 2014-2019) would be financed through a loan of US$225 million. The Program (Phases I and II) would be managed and implemented by Colciencias.

**Component 1: Strengthening Colciencias’ operational and policy-making capacity**

Institutional strengthening of Colciencias’ operational and policy-making capacity including: (a) Enhancing its organization, human resource capabilities and business processes, through the provision of staff training, technical assistance and operating costs; (b) Improving its strategic and sector planning and policy definition, through the creation of a specialized internal policy analysis unit, and provision of goods, services, operating costs and technical assistance; and (c) Improving its capacity to monitor, evaluate and manage the Project, through the provision of services, training, operating costs and technical assistance.

**Component 2: Strengthening Colciencias’ capacity to promote human capital**

Institutional strengthening of Colciencias’ capacity to promote the development of human capital for the knowledge economy through:
(a) The carrying out and financing of investment pilots to promote: (i) the labor market insertion of doctoral graduates, inter alia, by providing stipends to public and private knowledge institutions and firms to hire doctoral graduates, including Colombian and foreign researchers residing outside the Republic of Colombia; (ii) linkages between Colombian scientists and the Colombian diaspora, inter alia, by providing matching grants for collaborative subprojects, and training, forums and seminars; and (iii) the provision of technical assistance to develop and implement plans and carry out evaluations.

(b) (i) The carrying out and financing of investments to promote the development of scientific skills in basic and secondary education, inter alia, by providing grants for research activities of students and their teachers; and (ii) the provision of technical assistance to establish and implement a monitoring and evaluation framework.

Component 3: Strengthening Colciencias’ capacity to promote research and innovation

Institutional strengthening of Colciencias’ capacity to promote Research and Development (R&D) and innovation through the carrying out and financing, including matching grants, of investment pilots to promote and support: (a) the development of innovation-management capabilities in firms; (b) R&D and innovation subprojects in strategic knowledge areas; (c) subprojects under revisions of existing Colciencias’ instruments for recuperación contingente and cofinanciación; and (d) the provision of technical assistance to develop and implement plans and carry out evaluations.

Component 4: Promoting Social Dissemination of Science, Technology and Innovation (STI)

Carrying out and financing of investments to: (a) Increase awareness and disseminate knowledge of science, technology and innovation among the Borrower’s public and private sectors, including provision of (i) goods, including the rental, acquisition and operation of vehicles for mobile classrooms; (ii) training, forums and seminars, including training of mediators and facilitators; and (iii) technical assistance for the development and implementation of a monitoring and evaluation framework; and (b) Increase Colciencias’ visibility in Colombian society, including, plans, seminars and mass media investments, and provision of goods, services, operating costs and technical assistance.

5. Financing

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6. Implementation

The IDB and the World Bank would finance two independent operations in the STI sector in Colombia, under the umbrella of CONPES 3582. A special effort has been made during Project preparation to ensure coordination. In particular, the IDB would be financing activities in the areas of institutional strengthening, R&D and innovation and social dissemination of knowledge.
that will be complementary to those financed by the World Bank under Components 1, 3 and 4 of the proposed Project (Phase I).

Colciencias would have primary responsibility for implementation of the three components under the operation, including procurement and financial management. The internal capacity of Colciencias has been assessed during preparation. Recommendations are being addressed through a non-reimbursable technical cooperation currently under implementation and will continue to be addressed under Component 1, in particular during Phase I of the APL.

7. **Sustainability**

The proposed Program is expected to have a catalytic effect on increasing the private sector contribution to STI through the provision of specific incentives. It might also leverage additional public resources. CONPES 3582/2009 policy document establishes the target of increasing private sector contributions to STI activities to 2 per cent of GDP by 2019. Since the combined financial contribution of the IDB and the World Bank over the proposed programs’ nine-year term would be US$500 million, the impact of the operations in directly increasing financing for the sector would be relevant, but limited. Combined IDB-World Bank resources would represent around 5.7 per cent of the additional budgetary effort that Colombia would have to make in the 2010-19 period in order to increase STI funding to 2 per cent of GDP. It is expected that, as Colciencias improves its internal and policy-making capacity and *instruments*, it would be able to increase leverage of additional public and private resources. Colciencias currently leverages around 1.5 pesos for every peso it grants to research and innovation subprojects. If Colciencias manages to at least maintain this ratio with the resources provided by the multilateral loans, the sum of these resources would represent approximately 5.4 per cent of the additional combined public-private effort necessary to increase STI funding to 2 per cent of GDP by 2019.

8. **Lessons Learned from Past Operations in the Country/Sector**

The proposed Project has been designed taking into account the lessons learned from previous World Bank operations and analytical work in the STI sector. Based on these lessons learned, the proposed Project would incorporate the following features:

(a) **An integrated supply and demand approach**: A review of World Bank lending for Science and Technology from 1980-2004 emphasized the importance of strengthening the demand for knowledge and technology in the private sector to be able to accommodate and reap the most benefits from investments aimed at increasing the supply of knowledge. Implementation Completion Reports (ICRs) for projects that focused exclusively on increasing the supply or the demand of knowledge in a number of countries found that these projects could have yielded better results if a more integrated approach had been taken. As a result, the instruments to be piloted through the proposed Project are a combination of supply and demand-side public incentives.

(b) **Strong project ownership and commitment**: Previous Bank experience has demonstrated that the probability of success for programs seeking to strengthen STI capacities is higher when they support a coherent, pre-existing government STI policy. In addition, given the long-term horizon of most STI interventions, program continuity was found to be critical for a successful implementation. Ensuring continuity typically requires a wide
consultation process that encompasses the most important public and private stakeholders, including current government officials and representatives from opposition parties, to ensure continuity even in the face of changes in the political scene. Finally, projects have been found to be more successful when implemented by an agency that has the experience, capacity and commitment to leverage broad support. The proposed Project integrates these findings into its design as it is meant to support the goals of Colombia’s Vision 2019, the National Development Plan (NDP), Colciencias’ policy document Construye y Siembra Futuro, Law 1286/2009 and CONPES 3582/2009. In particular, the latter document has been the result of a wide consultation process among the stakeholders within the national innovation system (NIS).

(c) **Addressing institutional bottlenecks that might hinder successful implementation**: As emphasized by a study on the Knowledge Economy in the Europe and Central Asia region, in order to implement successful STI projects, interventions should be logically sequenced to address institutional bottlenecks that may pose implementation risks. The proposed Project has been designed to include initial components focused on Colciencias’ institutional strengthening to ensure that the implementing agency would be able to address any potential shortcomings in time to manage the future stream of resources successfully.

(d) **Competitive financing**: Allocating funding for universities, research centers and firms through competitive processes increases efficiency and has a positive effect on outputs and outcomes. Competitive funding also favors quality institutions and channels resources towards entities with the highest potential. In light of the advantages of using competitive processes to allocate public funds, the proposed operation would channel resources for labor market insertion and research and innovation subprojects through competitive funds. At the same time, there would be a strong focus on ensuring that current allocation procedures are aligned with international best practices for competitive financing.

(e) **Balancing neutrality and selectivity**: A review of Bank operations suggests that specific policies should be designed to immunize the Project from potential selectivity biases that could result in negative outcomes. Notwithstanding the desirability of designing neutral instruments to avoid capture of funding by special interest groups, clusters, political actors or implementing agencies, Bank’s recent experience in STI projects suggests that designing instruments selectively and focusing financing on specific knowledge areas defined in a broad form up-front can help develop a critical mass of knowledge with high potential for growth and spillovers. Therefore, the Project would implement a combination of neutral and selective competitive funding mechanisms and include a coherent monitoring and evaluation framework that ensures objectivity in the selection process.

(f) **Special support for SMEs, regionally-based research groups and students in isolated regions**: SMEs, students living in isolated regions and research groups located outside the traditional decision-making networks often face a similar problem that hinders their access to conventional instruments such as PhD and research grants or matching grants for commercial innovation and technology adoption. This results in high concentration of STI activities in urban areas, universities and large companies, although the returns in other areas could be higher. To address this challenge while ensuring that a merit-based approach prevails and quotas are avoided, Colciencias’ traditional funding instruments
would be complemented with a new instrument aimed at promoting innovation-management capacities in firms, as it is described in Component 3.

(g) Ensure adequate sequencing in the design of instruments: In the innovation field, adequate instrument sequencing that matches the steps in the innovation process can contribute to programs’ long-term success. Given the current low levels of innovation-related activities in Colombia, Phase I of the APL would finance instruments to support the first two stages of the innovation process: matching grants to create capacity and develop technology and innovation management skills in firms and matching grants for R&D and the initial development of new products and processes. Phase II of the APL could potentially move into the provision of support for the commercialization stage, through venture capital funding, patent services and credit guarantee schemes.

9. Safeguard Policies (including public consultation)

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10. List of Factual Technical Documents

4. Arbeláez and Parra Torrado, Innovation, R&D Investment and Productivity in Colombia, Unpublished (2009), carried out in collaboration with IDB

*By supporting the proposed project, the Bank does not intend to prejudice the final determination of the parties' claims on the disputed areas*


35. ---. World Economic Outlook, October 2009.

44. MESEP. "Resultados Fase 1: Empalme De Las Series De Mercado Laboral, Pobreza Y Desigualdad." Bogotá, Colombia: DANE and DNP, 2009.
51. ---. Pharmaceuticals Industry in Colombia, 2008.
64. ---. Economic Prospects for Colombia, October 2009.
66. ---. Knowledge Assessment Methodology, 2008.

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