FOSTERING A CULTURE OF INNOVATION IN THE AMERICAS

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Executive Summary

- Between 2003 and 2008, the region experienced the longest and strongest period of expansion since 1980, and only the second period since the late 1960s to have had such high growth rates of per capita gross domestic product (GDP). The combined effects of economic growth, higher earnings, more comprehensive transfer programs, and a decline in demographic dependency rates have resulted in considerable poverty reduction.

- Despite recent growth and progress on several fronts, some exceptions notwithstanding, the region has been slow to incorporate innovation into economic activities and production chains, or value added into exports, which are keys for strengthening competitiveness and sustainable growth.

- Scientific and technological capabilities in Latin America and the Caribbean (LAC) are mixed, with important asymmetries and lags. For example, investment in research and development (R&D) in Latin American countries, with the exception of Brazil, is lower than expected, given the level of per capita income. Most R&D in the region occurs in public laboratories and universities, while in other regions it is carried out chiefly by businesses.

- Even though the price of broadband has been halved over the past two years, broadband is still expensive, slow, of poor quality and out of reach for large segments of the population.

- While the region is among the world's most dynamic in terms of the increase in Internet users and information and communication technology (ICT) spending, this advantage has not been reflected in improved productivity. The use of ICT has had little effect on productivity because of gaps in access, poor broadband quality, and problems relating to the shortage or lack of complementary ICT assets.

- Today, science, technology and innovation occupy an important place in the agenda of several governments in the region. Innovation is an increasingly integrated process that takes place over networks and requires the interaction and cooperation of various agents in both the public and private sectors. Strengthening mechanisms to support regional cooperation on science, technology and innovation policies can prove key to generating synergies and complementarities.

- Aware of the need to address these issues, both at the national level and from a regional perspective, policymakers have been engaged on a number of fronts. Several initiatives in the science and technology field have been undertaken between LAC countries and the United States. Such efforts should be expanded further to spur innovation.

The Context

In the years leading up to the 2008 financial crisis, economic growth in Latin America and the Caribbean (LAC) had been at a historic high. Between 2003 and 2008, the

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region experienced the longest and strongest period of expansion since 1980, and only the second period since the late 1960s to have had such high growth rates of per capita gross domestic product (GDP). On balance, the countries weathered the global recession well, showing resilience both economically and socially, although Mexico and Central America were harder hit due to their closer integration with the United States. While growth is expected to slow to 3.7 percent in 2012, down from 4.3 percent in 2011, it will still be above the international average. The control of inflation (at 6.6 percent), sound fiscal policies, a lower and better-structured public debt (below 35 percent of GDP), and unprecedented high international reserves (in excess of $765 billion) continue to be major strengths.[1]

The combined effects of economic growth, higher earnings, more comprehensive transfer programs, and a decline in demographic dependency rates have resulted in considerable poverty reduction. While the incidence of poverty was 44 percent in the region as a whole in 2002, it declined to 30.4 percent in 2011; extreme poverty decreased from 19.4 percent to 12.9 percent in the same period. Unemployment now stands at 6.6 percent below the pre-crisis level. Moreover, there have been unprecedented improvements in income distribution thanks to a better apportionment of labor income and to redistribution policies. For the first time in history, inequality has been reduced and the Gini coefficient has improved in 18 countries, thus reversing the historical trend toward worsening distribution.

Overall, the past years have been characterized by economic prudence and progressive social policies.[2] Important changes have also taken place in the region's integration into international markets. Countries have achieved considerable export growth and improved access to major destination markets. Ties with Asia-Pacific, and with China in particular, have grown stronger, especially in South America. Also, foreign direct investment (FDI) to the region has been growing at an unprecedented rate. In 2011, FDI to LAC reached a record high $153 billion, representing 10 percent of global flows.[3]

Despite recent growth and progress on several fronts, significant challenges remain. Most importantly, growth performance during the past 50 years has not been dynamic. Countries have not been able to generate productivity growth, primarily because they have not kept pace with innovation. Today, productivity growth resulting from the emergence of new technologies (and faster change in existing ones) alters how production is organized across firms and sectors globally. More and more, sustainable growth depends on the ability to generate knowledge, to innovate, and to incorporate new technologies so as to foster greater competitiveness in international markets. New forms of industrial and geographic organization and business networks are evolving, with opportunities for participating in global supply chains and developing regional or sub-regional value chains—all with a view toward boosting the value added and technology and knowledge content of exports.

With some exceptions, the region has been slow to incorporate innovation into economic activities or production chains, or value added into exports, which are keys for strengthening competitiveness and sustainable growth. Achieving this will require creating dynamic innovation systems to speed up the accumulation of technological capacities. It will also require promoting the use of new information and communication technologies (ICT) in contemporary innovation systems, which are essential given their cross-cutting nature.

The real challenge in this regard resides in changing production patterns, with the goal of developing more knowledge-intensive societies, which can incorporate greater value and knowledge to diversify production of exported goods and services. Effectively upgrading value chains will depend on the ability to manage the absorption, dissemination and creation of innovation and knowledge—as well as progress in creating a skilled workforce and appropriate infrastructure and logistics.

This paper provides an overview of the main features of technological development and innovation in the LAC region. It will address trends, policy challenges and opportunities for cooperation in an effort to foster a culture of innovation. We acknowledge that there are often stark differences in economic performance among—and even within—countries, but such analysis goes beyond the scope of this paper. Please refer to the cited documents for a closer look at these issues. The paper draws from the most recent work on science and technology, innovation, and the information society undertaken by the Economic Commission for Latin America and Caribbean (ECLAC).[4]

Technology and Innovation

Innovation is one of the keys to diversifying production. Broadly defined, it includes not only radical changes but also small improvements in product design and quality, in the production process and its organization, and in marketing and logistics. This process, in turn, is a function of three things: capacities to create, learn and adapt knowledge and techniques to the productive and commercial domain; possibilities for capturing the greatest value added by those innovations; and the availability of the material, human and financial resources required.[5] The greater the generation of knowledge and linkages with the rest of the production structure, the greater the impact of innovation on productivity and growth.

As the experience of developed countries shows, the main driving force for innovation comes from the interaction between research and development (R&D) activities (both public and private) and the capacity of firms to generate, adopt and disseminate innovative processes and products. On the other hand, in developing economies, learning consists of increasing the adoption and adaptation of innovations in all activities related to production processes, product quality, and design and commercialization strategies. This develops the countries' technological capabilities and generates competitive advantages that redefine the export potential of businesses and the international position of each economy.

The difference between the speed of innovation in the leading countries and the speed with which the less-developed countries succeed in learning, imitating and adapting is crucial for the types of participation both have in the international economy. Falling behind may have long-term consequences for competitiveness and growth. As several studies show, there is a virtuous cycle in which R&D spending, innovation, productivity and per capita income mutually reinforce each other.[6]

Technology: A Few Highlights

As ECLAC has pointed out, scientific and technological capabilities in LAC countries are mixed, with important asymmetries and lags. As Table 1 indicates, investment in R&D in Latin American countries, with the exception of Brazil, is lower than expected, given the level of per capita income. Spending on R&D barely exceeds 0.5 percent of GDP in the region, which is one-quarter of the world average and below the figures for China, India and Malaysia. Most of the region's limited investments in R&D are governmental in origin, while the contribution of businesses is much lower. The opposite is true in more advanced countries: public resources are supplemented by a higher level of business investment in R&D.

The number of researchers per million inhabitants in the region is around one-tenth of the number observed in developed countries. However, the region does not fare too poorly when this indicator is compared with the results in some other developing countries such as China, India and Malaysia. Also, when comparing the number of patent applications with other emerging countries, the region still lags behind in terms of efforts to adopt and create new technologies. China in particular has successfully imitated and adapted new technologies to create its own technological capacity.

Innovation patterns are asymmetrical. Most R&D activities in LAC are geared toward science and basic research; in countries at the cutting edge of technology, R&D is focused on applied and experimental development. Also, R&D in the region occurs mainly in public laboratories and universities, while in other regions it is carried out chiefly by businesses.

As the experience of advanced countries shows, investment in R&D increases as the economy becomes specialized in more complex scientific and technological sectors and activities. A relatively small proportion of the increase comes from government. Public-sector participation is a fundamental component of the first innovation phase in countries that have successfully built their own technological capacity, allowing them to advance from adapting technology to creating it. Since most LAC countries are at this first stage, the most worrying aspect is not the limited participation of the private sector, but rather the low level of public investment and the lack of applied development. It is also interesting to note that there tends to be more public funding in developed countries where the production structure (especially in terms of exports) is linked to natural resources (Australia, New Zealand and Norway, for example).

Table 1: Indicators of Scientific Base and Innovation Efforts and Effectiveness

	Innovation efforts						Effectiveness of innovation efforts		
	Number of researchers per million inhabitants (average 2000–2004)		R&D spending as a percentage of GDP (average 2002–2004)	R&D spending by sector of financing (percentages of total, average 2000–2004)			Number of scientific and technical articles for every million inhabitants (2003)	Number of patents granted by USPTO [d] (cumulative, 2000–2006)	Patents granted by USPTO as a percentage of the total granted to non-residents (cumulative, 2000–2006)
				Government	Business	Other[c]			
Argentina	727		0.42	43	26	31	81	330	0.060
Bolivia	120		0.26	20	16	64	4	2	0.000
Brazil	434		0.94	58	40	2	48	738	0.135
Chile	682		0.68	47	42	11	94	88	0.016
Colombia	105		0.17	13	47	40	8	58	0.011
Costa Rica	...		0.37	...	...	...	20	27	0.005
Ecuador	47		0.07	...	...	...	2	15	0.003
Guatemala	...		0.08	...	...	...	1	7	0.001
Honduras	...		0.06	...	...	...	2	4	0.001
Mexico	321		0.43	55	35	10	37	568	0.104
Panama	97		0.31	29	0	71	12	8	0.001
Paraguay	80		0.09	63	0	37	1	1	0.000
Peru	...		0.12	...	...	...	5	23	0.004
Uruguay	366		0.22	17	47	36	57	10	0.002
Latin America and the Caribbean	298	[b]	0.55	55	37	8	27	1,879	0.34
G-8	3,412	[a b]	2.5	28	64	8	613	424,785	63.33
Australia	3,924		1.62	41	51	8	794	6,530	1.197
New Zealand	3,945		1.16	45	38	16	759	906	0.166
China	517		1.27	28	63	9	23	2,367	0.434
India	120	[a]	0.7	76	20	4	12	2,128	0.39
Malaysia	300	[a]	0.6	27	61	12	21	550	0.1
Republic of Korea	3,187	[a]	2.59	24	74	2	288	29,270	5.366
Singapore	4,699		2.14	41	52	7	743	2,558	0.469
Finland	7,749		3.47	26	70	4	1,000	5,612	1.029
Ireland	2,521		1.12	30	61	10	440	1,068	0.196
Norway	4,595		1.71	42	49	9	726	1,724	0.316
Spain	2,189		1.07	40	48	12	401	1,983	0.364
World	...		2.23	31	62	7	158	1,141,751	...

Source: ECLAC, *Structural Change and Productivity Growth—20 Years Later,* 2008

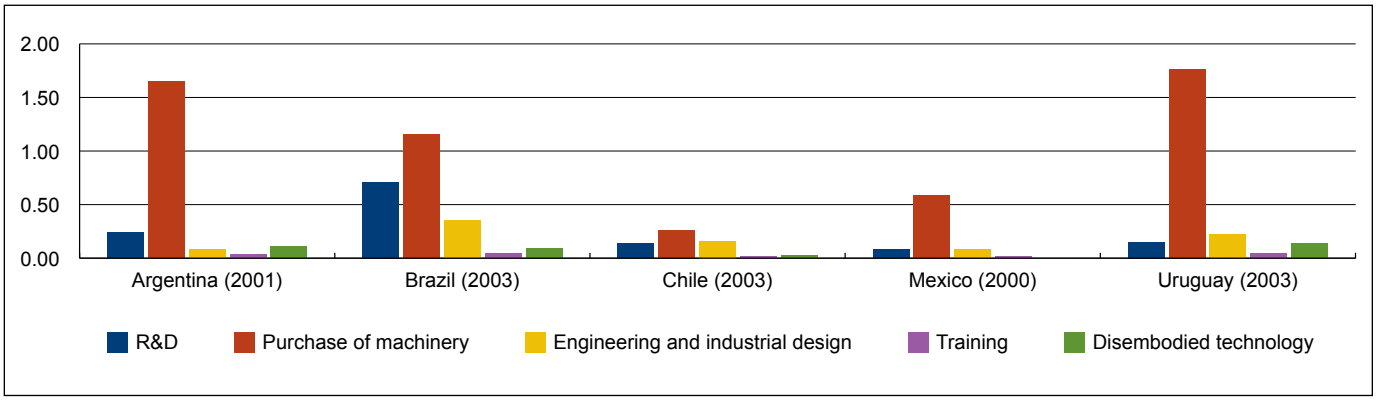
[a] Information corresponds to 2004

[b] Simple average

[c] Includes higher education and nonprofit institutions and external funds.

[d] United States Patent and Trademark Office.

Figure 1: Latin America (5 Countries): Innovation-Related Spending, By Type of Activity



Source: ECLAC, *Structural Change and Productivity Growth—20 Years Later,* 2008

Innovation and Businesses

Evidence from national innovation surveys conducted in Argentina, Brazil, Chile, Colombia, Mexico and Uruguay sheds some light on firms' innovation behavior.[7] The results of the surveys point to similar sectoral patterns of innovation in the region as those observed in other parts of the world. Firms with above-average levels of innovation are found in chemicals and pharmaceuticals, machinery and equipment, and in the automotive, petroleum and metal sectors. Overall, an average of 38 percent of innovative firms are in the field of new product and process technologies.

Innovative firms outperform those that do not innovate. Results show a positive relationship among innovation, productivity and export capacity. Also, the effects of innovation on a firm's productivity are positive, irrespective of firm size and sector, with a slight tendency for the effect to be stronger in sectors that make more intensive use of engineering (for example, machinery and electrical appliances).

Firms in the region tend to "use" rather than "produce" knowledge, acquiring embodied technology developed in other countries. Firms invest little in in-house innovation activities. In this regard, innovation is biased toward acquisition of knowledge and limited internal learning efforts (see Figure 1). Also, when analyzing innovation surveys regarding cooperation among firms, universities and research or training centers, results indicated that for the most part, firms do not collaborate with other private and public actors.

Table 2: Effects of Broadband on Economic Growth and Social Inclusion

Economic growth	Social inclusion
Accelerated growth in productivity	Access to public goods: information and knowledge freely available on the Internet
Greater innovation in productive and organizational processes through the development of applications, based on the needs of different types of enterprises	Online access to public services: education, health, government, citizen participation, etc.
Job creation	Innovation in processes of social interaction through the development of new applications
Development of technological and productive capacities of individuals and enterprises	Increased well-being due to positive externalities in consumption
Increased environmental sustainability through the use of intelligent tools for managing energy and transportation resources	Impact on communication and on dealing with disasters

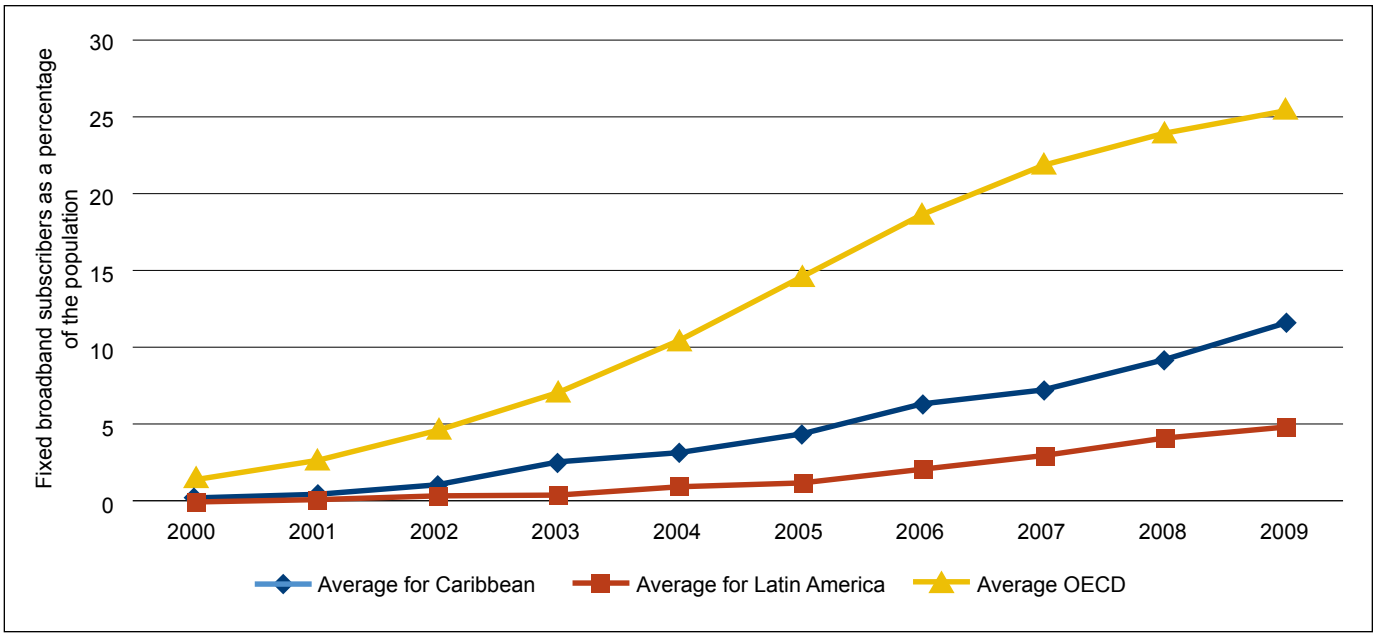
Source: ECLAC, *Broadband for Development and Inclusion*, 2011

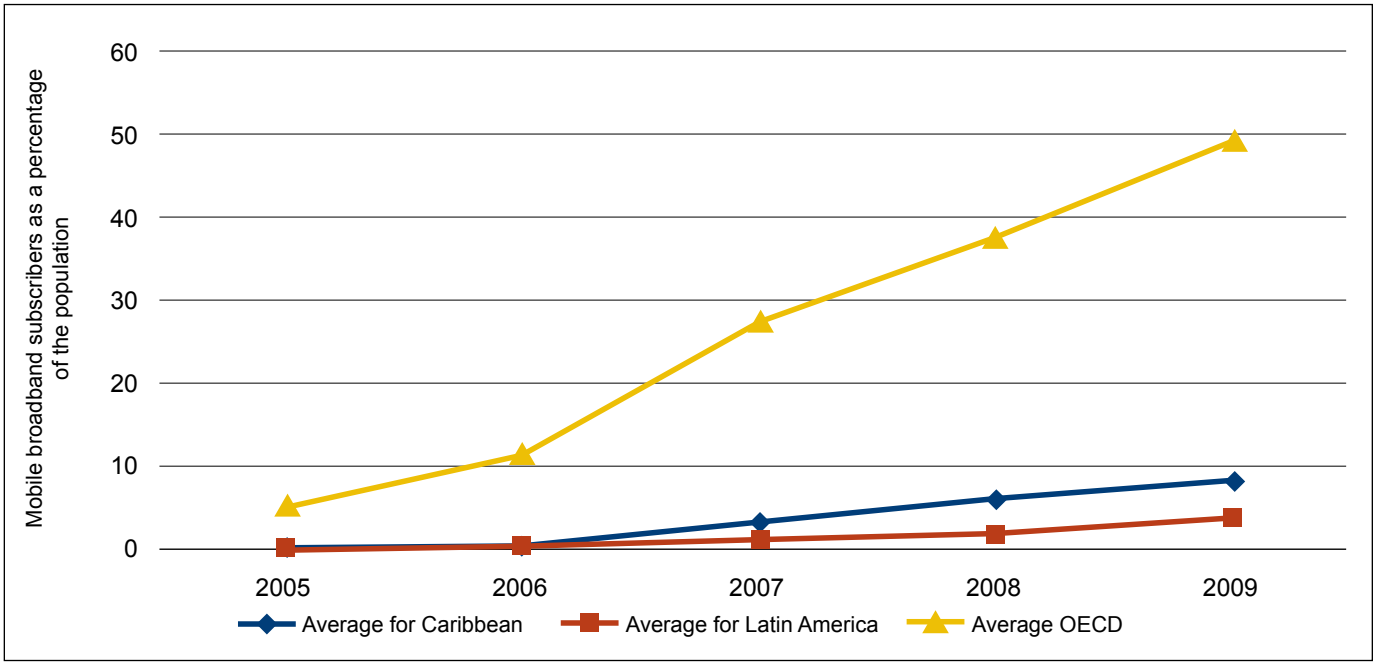
The surveys also shed light on some of the firms' obstacles to carrying out innovation. Though firms perceive a wide range of obstacles with striking differences among countries, major stumbling blocks include a lack of three things: a science and technology system capable of supporting innovation efforts, financing, and skilled human resources.

Information and Communication Technology (ICT)

Given the cross-cutting nature of ICT, promoting its use is essential in contemporary innovation systems. The Internet in particular has changed the manner in which economic and social activities are undertaken by making more efficient the generation, management and exchange of information. And, as recent experience in the more advanced countries shows, the development and intensive use of ICT have significantly impacted productivity, promoting enterprise innovation and making public services more efficient and more inclusive. Table 2 summarizes some of the economic and social benefits associated with broadband.

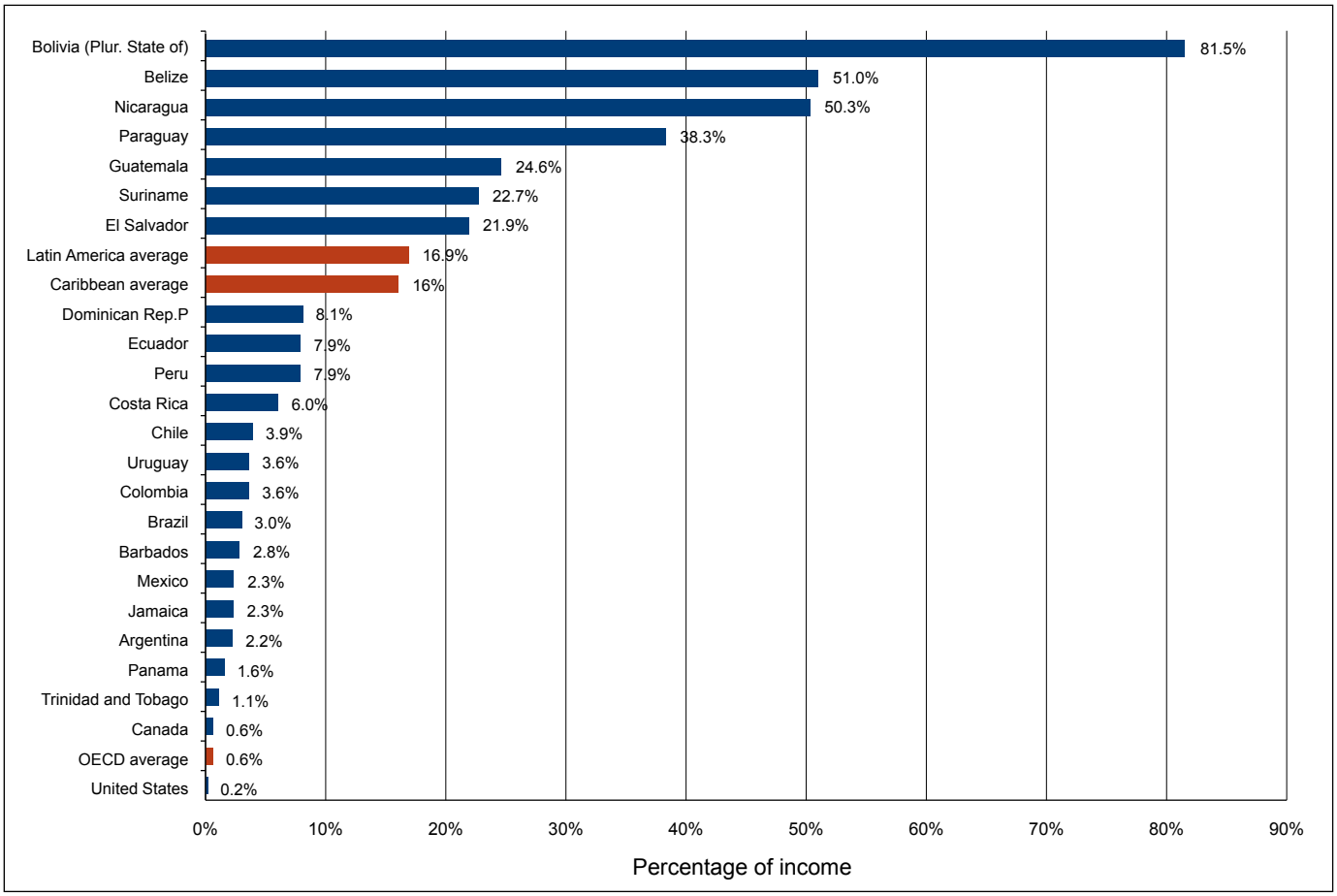
Figure 2: Penetration of Fixed[9] and Mobile[10] Broadband





Source: ECLAC, *Broadband for Development and Inclusion*, 2011

Figure 3: Affordability of Fixed Broadband[11]



Source: ECLAC, *Broadband for Development and Inclusion,* 2011

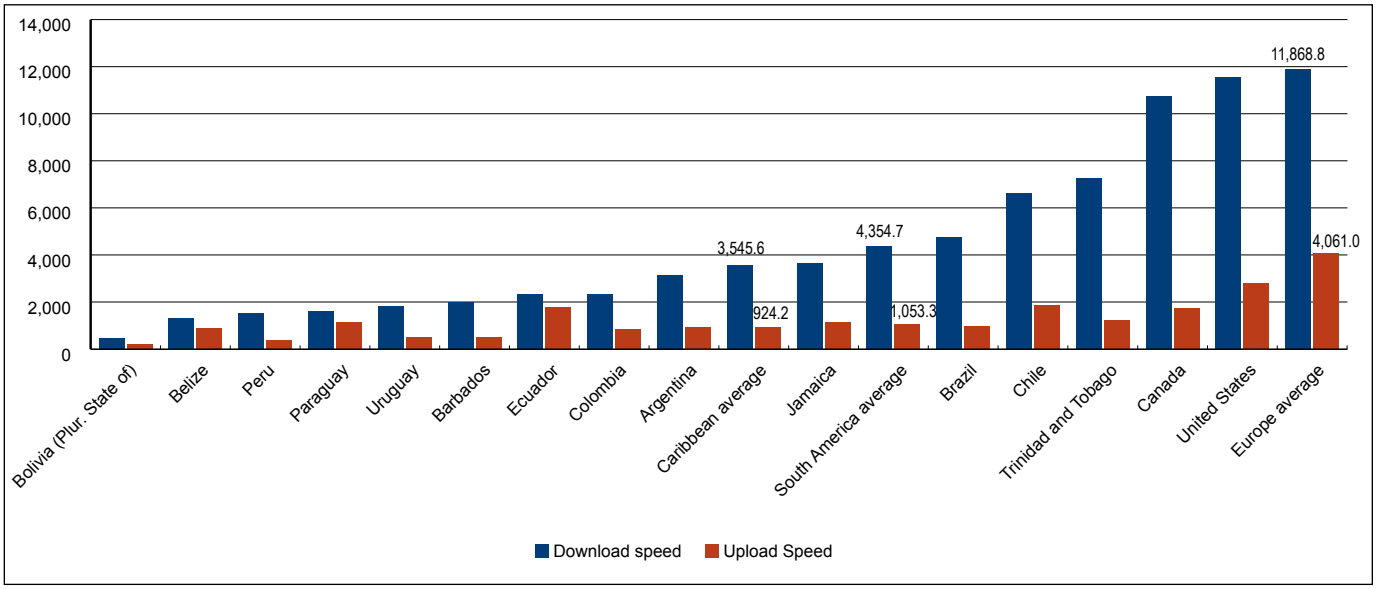
Broadband for Development and Inclusion[8]

Data on penetration, quality, price and affordability of broadband Internet service in LAC countries shows a mixed situation.

In the 2000s, LAC countries have steadily increased their share of Internet users, applications and spending on incorporating these technologies. Regarding infrastructure, the region has begun to converge with high-income Organisation of Economic Co-operation and Development (OECD) countries in terms of fixed and mobile telephone penetration, although most mobile phones in the region are pay-as-you-go and are used mainly for voice and messaging services. This is not the case with mobile broadband access, however, where countries are rapidly falling further behind the high-income OECD countries. So while the gap in telephone services has closed, a new gap (in broadband access) has opened. Low broadband penetration is even more critical in less developed countries, in lower-income households and in rural areas. Figure 2 shows the increasing differences in penetration, principally in the case of mobile broadband. This could be particularly worrisome for the region, since this form of access would be the most viable way to expand broadband service on a massive scale.

Other dimensions of the broadband gap relate to deficiencies in quality of access, measured in terms of transmission capacity, long latency times and high costs. The fact that the significant increase in the numbers of broadband users and subscribers has not been accompanied

Figure 4: Average Effective Upload and Download Speeds (Kbps)



Source: ECLAC, *Broadband for Development and Inclusion,* 2011

by improved quality of access is cause for concern. In 2000–2007 the region's share of the worldwide number of Internet users and subscribers rose from 4.4 percent to 8.2 percent, but at the same time its share of total transmission capacity fell significantly, from 2.9 percent to 1.1 percent. This had a negative impact on opportunities to use the most advanced applications.

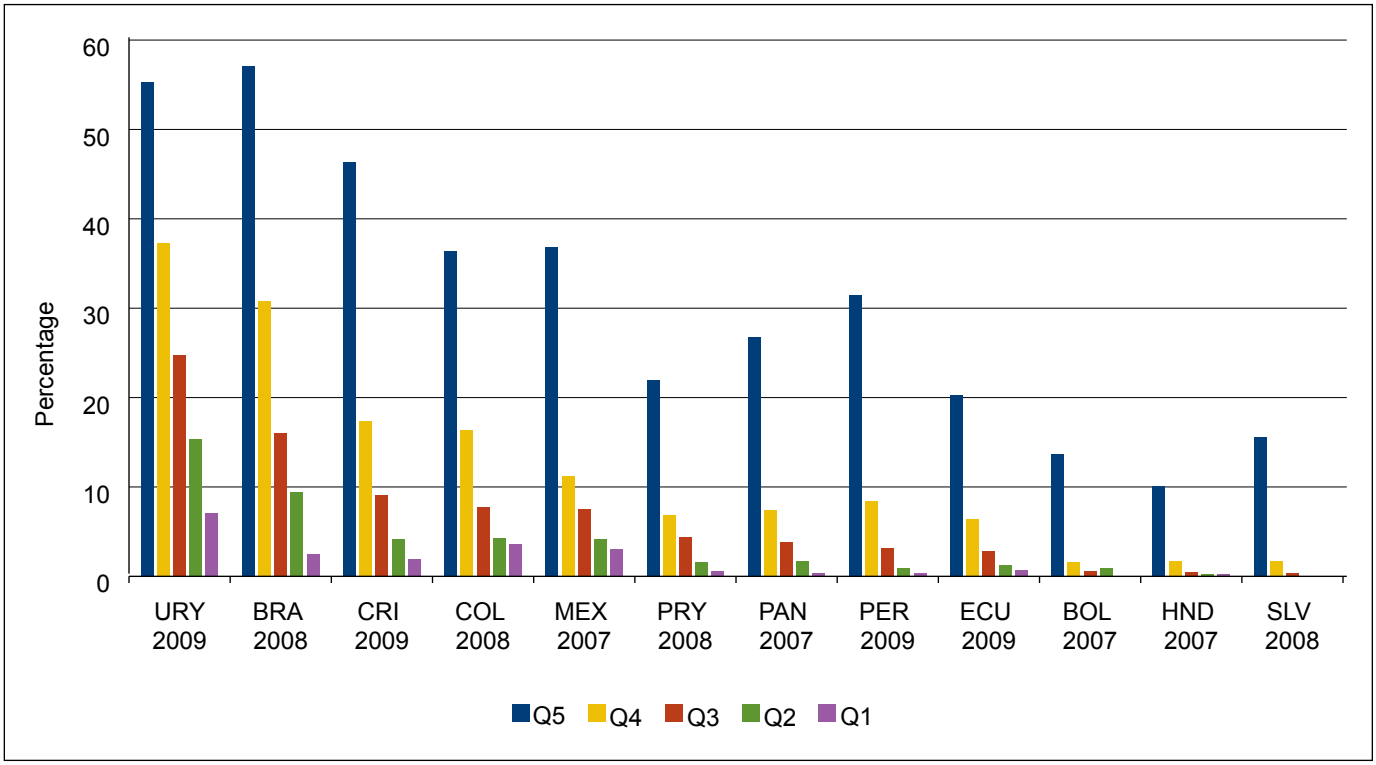
Throughout the region, broadband is still expensive, slow, of poor quality and out of reach for broad segments of the population. Only 5 percent of people have access to the Internet, at a cost of $25 per MBS, whereas in Europe, the cost is just $5. The data in Figure 3 show that there are large differences in terms of the relative price of broadband service, based on income. In LAC countries, the impact of prices on income is around 25 times greater than is the case in OECD countries, a differentiating factor that clearly affects the ability to adopt broadband service.

In conducting any assessment of broadband Internet service, one factor that must be taken into account is the quality of the service. One of the parameters used to measure this quality is the connection speed for both uploads and downloads. According to the data, the region also lags in this regard, with both download and upload speeds significantly below those available in Europe. This variable is crucial, since it determines what applications can be used.

The gaps in broadband access involve differences not only among, but also within, countries. One of the main determinants in the use of broadband is income level, as reflected clearly in Figure 5, which shows the differences in Internet penetration in relation to income levels. For all of the countries in the sample, the result is the same: the higher the income level, the greater the penetration of service, with very significant differences between the segments at the extremes.

Overall, the performance of LAC has differed from that of more advanced economies, in that there is no significant narrowing of the gap with countries of the OECD as to the degree of readiness for the information society. In addition, the impact of ICT in LAC countries has been modest in comparison with international best practices, and the rise in spending on ICT as a proportion of GDP has not been matched by increases in productivity. This is telling, given that since the 1990s most of the countries have implemented digital policies and a variety of strategies and programs geared toward building information societies.

Figure 5: Percentage of Internet Penetration by Income Quintile[12]



Source: ECLAC, *Broadband for Development and Inclusion,* 2011

As ECLAC has pointed out, while the region is among the world's most dynamic in terms of the increase in Internet users and ICT spending, this has not been reflected in improved productivity. This is due to gaps in access, poor broadband quality and problems relating to the shortage or lack of complementary ICT assets. This access gap relates to the undersupply of complementary goods and services in the areas of human resources, business management, research and development and public sector reform—all of which are essential to ensuring appropriate ownership of technological advances and increasing the impact on productivity and social inclusion.

There are significant institutional gaps with the advanced countries with regard to ICT policies. Most of them relate to weaknesses in policy design and in the institutional structure of the bodies responsible for agendas and programs, lack of coordination between government bodies and the private sector, budgetary constraints, and low levels of leverage and support from key actors.

Progress in ICT will require expanding the high-speed Internet infrastructure to make broadband available to all. Progress is also needed in e-government, education and health based on the intensive use of digital technologies and networks and ICT-intensive innovation, especially the production of content and applications. This also involves stepping up the pace of ICT dissemination toward microenterprises and small and medium-sized enterprises (SMEs) to help make them more competitive.

Proposals for Addressing the Shortfalls

Policymakers have been engaged on a number of fronts as they seek to address these and other issues on both the national and regional levels. At the regional level, countries are advancing actions to maximize the impact of the region's information society initiatives (eLAC 2005–2007, eLAC 2008, eLAC 2015). The eLAC regional strategy encompasses all of the countries of Latin America and the Caribbean and is based on a long-term vision that is in keeping with the Millennium Development Goals (MDGs) and the

World Summit on the Information Society (WSIS). This vision is also being pursued through short-term action plans that have quantitative and qualitative targets. The figure below summarizes the key elements of the current strategy. [13]

While all of the issues detailed are important, with none a singular lynchpin for future success, the issue of access to and cost reduction of broadband is a high priority. Acting as technical secretariat, ECLAC has helped to promote the *Regional Dialogue on Broadband*, in which 10 countries in the region have been participating actively. And there have been concrete achievements: in just two years, the cost of public broadband has been halved. The focus now is on obtaining better quality service and lowering costs by reducing the use of international links, which account for between 20 percent and 40 percent of these costs.

Institutions to Support Technological Development

The history of today's developed countries shows the importance of public policies in promoting basic and applied research and in building research-oriented institutions. Notwithstanding the importance of factors such as a stable macroeconomic environment, well-functioning financial, labor and product markets, and effective tax, trade and regulatory policies—all of which affect innovation—policies such as promotion of R&D do so more directly. As experience has shown, public investment in R&D has proven to be crucial since, without government intervention, the market would undersupply certain types of research.

As is well documented, in the United States, for example, government support has been key in fostering new technologies in a variety of fields including agriculture, chemicals, information technology and health care. Overall, governmental support to R&D has provided many benefits and has generally been successful in spurring technological developments in the United States.[14]

In Latin America and the Caribbean, policies to support science and technology and innovation have evolved over time.[15] During the import substitution industrialization period, the public sector played an important role supporting the generation of technological capabilities and building institutional infrastructure for science and technology. Though significant progress was made in increasing the supply of technological capabilities, the system was not linked to

Table 3: eLAC2015 Plan Of Action

The eLAC2015 Plan of Action has 8 thematic areas, 10 lines of action, 6 priorities and 26 goals. The areas, lines of action and priorities are the following ones:	
Access to broadband	• Line of action: achieving access for all • Priority: achieve a leap toward universal broadband access
e-Government	• Line of action: treating e-government as an obligation of governments toward their citizens • Priority: achieve transactional and participatory e-government
Environment	• Line of action: promoting the use of ICT to mitigate the impact of climate change and broadening the use of technologies for natural disaster and emergency prevention, mitigation and response
Social security	• Line of action: promoting the use of ICT for inclusive social security • Priority: use ICT to ensure access, security and continuity of health care for users of health services
Productive development and innovation	• First line of action: driving research, technological development and innovation in the region • Second line of action: helping to close the digital divide between large enterprises and micro-, small and medium-sized enterprises (SMEs) • Priority: achieve access to ICT for all microenterprises and SMEs and promote innovation
Enabling environment	• First line of action: crafting a legal environment that facilitates the development of the information and knowledge society • Second line of action: moving toward the implementation of policies that facilitate the development of the information and knowledge society • Priority: promote the use of ICT for regional integration
Education	• Line of action: developing and implementing ICT for an inclusive education • Priority: provide universal access to ICT for education and expand their use in this field
Institutional structure for a policy of state	• Line of action: promoting coordination at the national level

Source: ECLAC, *Broadband for Development and Inclusion*, 2011

the demand for innovation. Policies were designed without participation from the main stakeholders and based on the assumption that research would follow a "linear path" from universities or research centers to adoption in production methods. This top-down policy approach changed in the 1990s when emphasis was placed on demand factors, and the intent was a "hands-off science and technology policy." Public intervention was limited to correcting market failures and allowing private-sector demand to guide knowledge and technology activities. On balance, however, the model is considered to have been more successful in dismantling the previous top-down approach rather than in designing the needed incentives to increase demand for innovation and technology.

Technology policy has gradually evolved. Nowadays, the prevailing approach is based on a recognition of complementarity between the public and private sectors in generating and disseminating knowledge. This systemic approach privileges interaction between supply and demand. Incentives for innovation have a sectoral focus and are designed with involvement of the private sector.[16]

Over the past decade, several countries of the region have undertaken institutional reforms geared toward strengthening science and technology and innovation processes. Institutions responsible for designing innovation policy have grown stronger in several countries. The creation of ministries and agencies dedicated to innovation strategies illustrates the growing interest in the design and implementation of more efficient and effective policies. To name but a few, Argentina created the Ministry of Science, Technology and Productive Innovation (2007); Chile established the National Innovation Council for Competitiveness (2005) and the Governmental (ministerial) Committee for Innovation for Competitiveness (2007), among others. Since 2008, Brazil has implemented a productive development policy with strong participation from the Brazilian Development Bank (BNDES).

The new strategic vision and institutional framework has been accompanied by new and diversified policy instruments geared toward mobilizing resources for technological advance. No doubt, as the experience of countries that have been successful in invention and innovation shows, the production of new technological knowledge increases as more resources are committed to it. However, as Lamoreaux and Sokoloff maintain in their study of innovation in the U.S. economy, it appears that there is no globally superior way to organize the mobilization of resources for invention. They also show that the way in which financing takes place has consequences for the direction of technological developments and the competitiveness of the economy.[17]

In Latin America, new policy instruments have included technology funds, sector-specific funds, venture capital incentives, and initiatives to promote university-enterprise cooperation, among others. Funds are one of the most widely used tools for encouraging enterprise knowledge generation. There are basically two fund models in use in the region. They differ in terms of how they work, where the funding comes from, how the beneficiaries can tap them, who is eligible, and how the funds are managed and monitored. The Brazilian model takes an integrated approach, mixing elements of supply and demand and thus setting itself apart from the model that is more widely used in the region, which stresses demand.

However, policies focused on national innovation systems and adequate financial support for implementing innovation strategies still need further strengthening. It remains necessary to improve planning capacity, overcome the tendency of assigning resources based on short-term assessments, and design more results-oriented policies.

Increasing Cooperation on Innovation

Today, science, technology and innovation occupy an important place in the agenda of several governments in the region. Innovation is an increasingly integrated process that takes place over networks and requires the interaction and cooperation of various agents in both the public and private sectors. Strengthening mechanisms to support regional cooperation on science, technology and innovation policies can prove key to generating synergies and complementarities. The scope of these tasks tends to exceed national capacities; international cooperation is an important alternative that can enable countries to combine their efforts to attain the levels of quality, scale and productivity required in the global economy.

The countries of Latin America and the Caribbean have accumulated experiences and capacities in managing policies to support scientific and technological development and in-

Table 4: Latin America: Science and Technology Support Fund Models

Type of Fund	Features	Weakness
Funds based on demand-side subsidies (Argentina, Chile, Colombia, Costa Rica and Mexico)	• Funding from governments and international agencies • Horizontality • Direct allocation to beneficiaries via competitive selection and evaluation	• Can exacerbate differences between actors: the most proactive actors with the greatest technological capacity are selected, leaving out those most in need of developing this capacity • There is no way to keep the funds from indirectly financing non-S&T related activities • Awareness policies are needed to promote knowledge and use of the funds
Funds based on coordinating S&T supply (schools and research centers) and demand (productive sector) (Brazil)	• Resources from higher-revenue productive sectors • Allocated with a shared strategic vision (scientific community, entrepreneurs, ministries) • Sector-based selectivity • Promote S&T research via cooperation between universities and businesses	• Coordination is complex, and there are conflicts of interest among ministries • Management conflicts arise because of the high amount of funding

Source: ECLAC, *Innovating, Gaining Market Ahare and Fostering Social Inclusion: Success Stories in SME Development* (Santiago, Chile: United Nations, 2011).

novation; they should use these openings for collaboration. In recent years, the countries of the region have made some progress in expanding their coordination in science, technology and innovation—but not enough to generate synergies that impact decisions relating to trade, investment and international partnerships involving technology businesses and innovation.

Toward the end of 2008, several countries signed the *Mechanism for Regional Dialogue on Science, Technology and Innovation Policies*, which should continue to be promoted. Its purpose is to address challenges in managing and implementing science, technology and innovation policies. The dialogue would help to increase the available critical mass both at the human resources and financial levels for conducting large-scale projects. Doing so would bring together fragmented research efforts in order to generate synergies among the various scientific and technological development efforts. This open, informal forum would allow discussion on substantive topics relating to science, technology and innovation policies of regional interest.

Also, the private sector—especially in the information technology industry in countries such as Colombia, Mexico and several Central American countries—has been signing cooperation agreements to create synergies through initiatives, strategic partnerships and joint activities. These efforts are aimed at encouraging the opening of new markets, designing and executing training and technology transfer programs, coordinating and supporting events to disseminate knowledge on software and ICT, and promoting experience-sharing among countries.

In the context of the knowledge economy, innovation and competitiveness cannot be properly fostered without trained human resources, especially in fields in which the region has (or might acquire) competitive advantages. The linkages between the educational system and the productive system must be strengthened to allow the former to provide the skills needed by the latter. Much could be gained from sharing innovative, successful experiences on curricula, management, the adoption of new technologies, teacher training and refresher courses, online classrooms and distance education.

ECLAC has advanced several proposals for further strengthening cooperation on innovation and competitiveness in LAC countries.[18] Examples include: creating or establishing regional forums, funds or foundations to promote, study and fund innovation programs/projects; preparing annual reports on regional innovation initiatives; identifying programs to encourage socially excluded young people and women to enter the ICT field; developing regional capacities in effective ICT (e.g., e-government, ICT-related industries such as creative and cultural industries and those involved in software production); expanding high-speed networks; strengthening health; and improving education.

Opportunities for Cooperation in Innovation with the United States

Fruitful initiatives and important collaboration are already taking place between the United States and several countries (United States and Brazil, United States and Chile, Canada and Brazil, to name a few). Most recently the United States and Brazil reaffirmed their commitment to "recognize the importance of science, technology and innovation." In March 2012, the U.S.-Brazil Joint Commission Meeting on Science and Technology (originally created in 1984) agreed to expand initiatives in a wide range of areas to include: strengthened ecosystem, ocean science and space weather research; collaboration on nanotechnology development; managing and monitoring of natural disasters; and improved measurement standards for biofuels. They also agreed to expand academic and research partnerships in health science, with particular focus on influenza, HIV/AIDS and the prevention of noncommunicable diseases. In each of these areas, existing ministries, national institutes and working groups and the private sectors (as feasible) will work together to develop and encourage information sharing, shared access to user facilities, exchange of students, scientists and scholars, and joint research projects. Aspects of this arrangement can be found in other science and technology agreements into which the United States has entered, including with Chile (1992), Colombia (2010) and Uruguay (2008).

Thus is appears likely that an expanded agenda that seeks to foster mutually advantageous cooperation in innovation in the Americas could be developed in the following areas, among others:

- Strengthening cooperation on science, technology, and education. It would desirable to deepen and expand joint initiatives on research and development projects in areas such as ICT, agriculture, green technologies and nanotechnology, to name a few.
- Encouraging cooperation among universities focused on innovation and technology. These efforts should be geared toward promoting two-way work internships and higher education exchanges, particularly between research and higher education institutions in the fields of science, technology, environmental studies and math.
- Improving collaboration and technical assistance directed toward strengthening the competitiveness of small and medium enterprises, including their technological upgrading and use of ICT to increase productivity.
- Fostering the competitiveness and internationalization of firms, particularly small and medium-sized enterprises (SME), by promoting alliances between firms from the LAC countries and the United States, paying particular attention to the accession of SMEs to regional value chains.

Endnotes

[1] Economic Commission for Latin America and the Caribbean (ECLAC), *Preliminary Overview of the Economies of Latin America and the Caribbean, 2011* (Santiago, Chile: United Nations, 2011).

[2] ECLAC, *Social Panorama of Latin America and the Caribbean, 2011* (Santiago, Chile: United Nations, 2011). See also ECLAC, *Time for Equality: Closing gaps, Opening Trails* (Santiago, Chile: United Nations, 2010).

[3] ECLAC, *Foreign Direct Investment in Latin America and the Caribbean*, *2011* (Santiago, Chile: United Nations, 2012).

[4] ECLAC, *Broadband for Development and Inclusion*, document prepared for the Sixth Summit of the Americas, Cartagena, Colombia (Santiago, Chile: United Nations, 2011); ECLAC, *ICT for Growth and Equality: Renewing Strategies for the Information Society*, Third Ministerial Conference on the Information Society in Latin America and the Caribbean, Lima, Peru (Santiago, Chile: United Nations, 2010); ECLAC and Secretaría General Iberoamericana (SEGIB), *Espacios Iberoamericanos: La economía del Conocimiento* (Santiago, Chile: United Nations, 2008).

[5] ECLAC, *Structural Change and Productivity Growth—20 Years Later: Old Problems, New Opportunities* (Santiago, Chile: United Nations, 2008); ECLAC, *Globalization and Development* (Santiago, Chile: United Nations, 2002).

[6] ECLAC, *Structural Change and Productivity Growth – 20 Years Later*, 2008.

[7] For more information regarding innovations surveys throughout the region, please see: ECLAC, *Structural Change and Productivity Growth 20 Years Later*, 2008.

[8] In preparation for the Sixth Summit of the Americas, the Government of Colombia requested that ECLAC prepare inputs on access and use of technologies, with particular concern with broadband use. See ECLAC, *Broadband for Development and Inclusion*, 2011.

[9] The average for the Caribbean countries includes the Bahamas, Barbados, Belize, Guyana, Jamaica, Suriname, Trinidad and Tobago and the Eastern Caribbean Currency Union (Antigua and Barbuda, Dominica, Grenada, Saint Lucia, Saint Kitts and Nevis, and Saint Vincent and the Grenadines). The average for Latin America takes into account 18 countries (excluding Honduras), while the average for the OECD includes 31 countries.

[10] The average for the Caribbean countries includes the Bahamas, Belize, Jamaica, Suriname, and Trinidad and Tobago. The average for Latin America takes into account 15 countries (excluding Colombia, El Salvador, Honduras and Panama), and the average for the OECD includes 31 countries.

[11] Rates for service are as of April 2011 in the case of the Latin American countries, the United States and Canada, and as of May 2011 for the Caribbean countries.

[12] The figure does not include the Caribbean countries, since the relevant information was not available from the national statistics offices of those countries.

[13] ECLAC acts as the technical secretariat of this regional action plan, monitoring advances, publishing information bulletins and exchanging information among the stakeholders.

[14] Address by Ben Bernanke, "Promoting Research and Development: The Government's Role," delivered at the conference *New Building Blocks for Jobs and Economic Growth*, Washington, D.C., May 16, 2011.

[15] ECLAC, *Globalization and Development* (Santiago, Chile: United Nations, 2002); ECLAC, *Time for Equality: Closing Gaps, Opening Trails*, 2010.

[16] Organisation for Economic Co-operation and Development (OECD) and ECLAC, *Latin American Economic Outlook 2012: Transforming the State for Development* (OECD Publishing, 2011).

[17] Naomi Lamoreaux and Kenneth Sokoloff (eds.), *Financing Innovation in the United States, 1870 to the Present (*Cambridge, MA: MIT Press, 2007).

[18] ECLAC, *Opportunities for Convergence and Regional Cooperation*, Unity Summit of Latin America and the Caribbean, Riviera Maya, Mexico (Santiago, Chile: United Nations, 2010).

COMMENTARY BY CAROL GRAHAM

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Dr. Bustillo provides a very good review of the state of technology and innovation in the region—issues that are critical to the economic future of Latin America and the Caribbean. The paper is an enlightening contribution to the usual discussion of economics in the region, and highlights one of the key economic factors that countries in the region must grapple with if they are going to attain competitive and sustainable growth.

One caution regarding this topic—which is also a shortcoming of many discussions of the economics of the region—is that it tends to treat the region as a homogenous entity. Yet there are large differences in economic performance both across and within countries. These differences are particularly important factors determining the ability of different countries to adopt and take up new technologies. Not only are there huge differences in progress across countries, but distributional issues within countries also vary in terms of access to the Internet and education, for example, which will significantly impact overall development outcomes.

In the end, the region's high levels of inequality, both across and within countries, serve as an obstacle to its economic competitiveness. While progress has been made in recent years in reducing inequality in many key countries, the differences across countries—both in terms of their macroeconomic management and in terms of the general access that their citizens have to technology and innovation—are likely to increase rather than decrease in the future, not least due to the nature of technology-driven growth.