The digital economy for structural change and equality

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inclusion innovation development

Programme financed by the European Union

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@LIS2, which is carried out by ECLAC, is oriented towards promoting, improving and extending the dialogue and experiences on the information society in Latin America, as well as reinforcing the political, technical and social ties between the region and Europe in this area.

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Foreword

We have reached a turning point in the development of the digital economy in Latin America and the Caribbean, with both progress and standstills in a region that is moving at two vastly different technological speeds. One group of countries has been implementing strategies and policies to support the diffusion of information and communication technologies (ICTs) for decades, generating a positive impact on economic growth, technological investment, the production structure, business performance and consumer behaviour. A second group has yet to reach the minimum thresholds of access and use by their citizens and businesses; for these countries, progress is slower, and as a result of that lag, new technologies do not have the desired impacts on investment, growth and productivity or the subsequent positive repercussions on employment, wages and equality.

The effects in the first group of countries were felt in the widespread use of ICTs, in particular mobile telephones, Internet access and, to a lesser extent, broadband connection. The surpassing of the minimum thresholds of ICT development, access and use illustrates the progress of the digital economy in the region and shows that it is possible to appropriate the benefits of new technologies and use them in the pursuit of sustainable, equitable development. From this perspective, it is indispensable for our region to integrate broadband infrastructure, ICT access and use for all individuals and all businesses, and the development of a globally competitive regional software industry. All this is crucial for consolidating an integrated ICT market and including all countries, production sectors and social segments in the benefits of the digital economy.

The digital divide in terms of income, localization, ethnicity and gender, both among the countries in the region and between the region and the developed economies, has not closed significantly, especially with regard to access to high-speed mobile broadband. The distance is even greater if we consider not only these technologies, but also new platforms associated with mobility, cloud computing, social networks and the big data analytics for decision-making.

This book provides an overview and diagnosis of the digital economy in the region and shows its potential for achieving a new, higher economic stage. It proposes that the countries move towards a new industrial and technological policy strategy, centred on the digital economy. The windows of opportunity are real and they are open, but not forever: there is no time to lose.

The digital economy is a crucial force for driving structural change, reducing inequality and strengthening social inclusion—much needed processes in the countries of the region. Its role as a catalyst for change requires the participative construction of the complementarities indicated in the chapters of this book, especially those that have to do with organizational structures and institutional capacities that truly promote the development of SMEs, the formulation and implementation of industrial policies, and the necessary leaps in education, health and universal electronic government services demanded by society. These imperatives encompass all the countries of our region.

With vital support from the European Union over nearly a decade, ECLAC has undertaken research that has changed the region's reality. These efforts have combined political dialogue, technical assistance and research, resulting in more than 15 books delineating results and proposing lines of action to address the needs of the countries of Latin America and the Caribbean.

We hope that the concrete proposals laid out in each chapter of this book, produced by ECLAC, will help to drive economic and social development in this decade, which is so rich in opportunities for Latin America and the Caribbean. Only then can we advance fast enough towards structural change for equality.

Alicia Bárcena Ibarra
Executive Secretary of the Economic Commission
for Latin America and the Caribbean (ECLAC)

Introduction

The majority of the countries in Latin America are currently undergoing processes of economic growth and poverty reduction. As part of that development, it is critical that they address the challenge of articulating and consolidating their digital economy, as ECLAC puts forth in this book. This will require exploring how to identify and exploit the new opportunities that arise from technological convergence in order to foster economic development and equality.

First, new strategies are needed for maximizing the impact of the digital economy on growth, innovation, structural change and social inclusion. The main challenges are to ensure the minimum conditions necessary for investment in information and communication technologies (ICTs) to have a positive impact on economic growth; to promote and consolidate a broadband-based technological innovation and diffusion model, compatible with the objectives of social inclusion; and to foster a change in the production structure that, based on the specific economic and institutional characteristics of each country, articulates knowledge with production and strengthens the software sector.

Second, a consolidated policy framework needs to focus on the key factors for the deployment of the digital economy. The main deficiencies that need to be addressed are investment in telecommunications infrastructure, the demand for broadband and the development of the application software industry. Public policy is crucial for ensuring equality of access and use of ICTs that facilitate the provision of social services (public administration, health and education) and public goods.

Third, the region needs to move towards establishing an institutional framework for the digital economy that integrates policy initiatives on broadband, ICT industries and digital inclusion. In this area, the following chapters propose organized actions based on two pillars: ICT policies for structural change and ICTs for equality and social inclusion.

The book has three parts. The first section, comprising chapters I and II, defines the digital economy, describes its dynamics in Latin America and discusses its share of GDP for four countries in the region (Argentina, Brazil, Chile and Mexico). It also examines the environment in which the digital economy is developing, mainly in terms of the implementation of digital agendas and the diffusion of internet and broadband, and analyses the impact of ICTs on economic growth and productivity.

The second part (chapter III) lays out the vision held by ECLAC on structural change and equality and the role of ICTs as complementary assets that evolve in conjunction with the production structure. The interaction between ICTs, structural change and growth are analysed based on ICT diffusion indicators and an econometric exercise. In this chapter, the equality dimension is explored through an analysis of the relationship between ICTs and the distribution of income and between these and educational achievements.

The third part of the book (chapters IV and V) examines ICT policies for structural change and the use of these technologies for social inclusion. Chapter IV describes the Latin American telecommunications services market and analyses the opportunities for the region of the applications and software industries. It also proposes strategic objectives for broadband policy and action areas for achieving them. Finally, the chapter explores the industrial policy challenges with regard to digital economy and its priority objectives, describes the current situation and progress in the software industry and discusses the incorporation of ICTs in small and medium-sized enterprises (SMEs). Chapter V analyses the role of ICTs in social inclusion in three areas: education, health and electronic government. It provides an overview of ICT diffusion in each of these areas and suggests public policy guidelines for taking full advantage of the potential of ICTs.

Finally, the conclusion summarizes the book's findings and highlights the proposals that emerge from the different chapters.

I. The digital economy in Latin America

A. The dynamics of the digital economy

1. The digital economy ecosystem

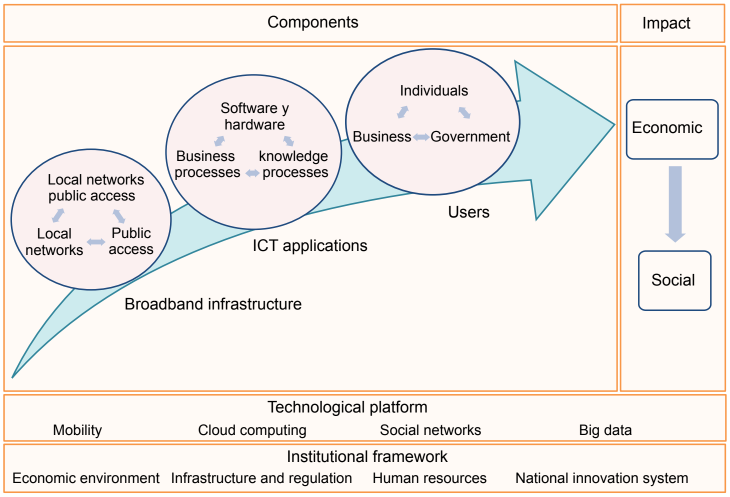
The digital economy is made up of the telecommunications infrastructure, the ICT industries (software, hardware and ICT services) and the many economic and social activities that are facilitated by the Internet, cloud computing and mobile, social and remote sensor networks. As described in the introduction, the digital economy is a facilitator whose development and deployment takes place in an environment characterized by the growth and accelerated convergence of diverse technologies, materializing in communications networks (networks and services, fixed-mobile networks), hardware (3G and 4G multimedia mobiles), processing services (cloud computing) and web technologies (Web 2.0).

The digital economy has three main components: the broadband network infrastructure, the ICT applications industry and the final users (see diagram I.1). Depending on their degree of development and complementarity, these components determine the digital economy's maturity in each country.

In this model, the broadband network infrastructure is the first component of the digital economy. The basic elements of that infrastructure are national and international connectivity, local access networks, points of public access and affordability.

A second key component for generating services and applications for users (individuals, businesses and government) is the hardware and software industry, including services facilitated by these technologies. The hardware and software industry encompasses the development and integration of software applications, network infrastructure management, the electronics industry and the equipment assembly industry. The other services facilitated by ICTs include business processes and analytic or knowledge processes. Business processes comprise horizontal applications, such as financial, accounting and human resources services, and vertical processes associated with specific activities like financing, the public sector, the manufacturing sector, retail, telecommunications, transportation and health. Knowledge processes are highly specialized and complex activities, including analytical services, design, engineering and technological research and development.

DIAGRAM I.1
THE DIGITAL ECONOMY ENVIRONMENT



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Ken J. Cochrane, From e-Government to the Digital Economy, KPMG, November 2012 and Soumitra Dutta and Benat Bilbao-Osorio (eds.), The Global Information Technology Report 2012: Living in a Hyperconnected World, The Business School of the World (INSEAD)/World Economic Forum.

The third component is the end user (individuals, businesses and government), who determines the degree of absorption of digital applications through their demand for services and applications. In businesses, ICTs improve the efficiency of production processes; in government, they increase transparency and raise the efficiency of the supply of public services; and for individuals, they improve the quality of life. It is critical for users to be able to use ICT services and applications productively and efficiently, for example in the various forms of electronic commerce (e-commerce), communications, government procurement and access to public services.

This model suggests that as the digital economy ecosystem develops and matures, it will generate impacts on the economic and social realms. In the former, the effects will be felt in productivity, economic growth and employment; in the latter, in education, health, access to information, public service, transparency and participation.

The facilitating platforms of the digital economy are mobility, cloud computing, social networks and big data analytics. Social networks generate an enormous quantity of data, which, when processed using online analytical tools, provide inputs for the design of marketing and production strategies. Big data analytics supports the development of more and better forecasts and improves decision-making based on complete, real-time information. It has wide-ranging applications, from product design to price definition and customer service, and it gives firms the flexibility to respond to changing demands and personal preferences. These tools are now being used for modelling consumer preferences and behavioural patterns, based on the analysis of complete observation universes, rather than statistical samples. This is achieved using mobile communications networks connected to cloud computing platforms, which allows the sharing of computing and storage resources and efficient on-demand access to hardware and software services (utility computing). The efficient use of cloud computing requires high connection speeds, using ultrafast networks on the order of 100 Mbps.

The institutional framework complements the digital economy ecosystem. Because ICTs are general technologies that cut across markets and activities, the development of complementarities is necessary for ICTs to reach a broad segment of society. The state must therefore consolidate economic and social sectors in order for spillover effects and complementarities to materialize in the economy as a whole. ICT investment will have a greater impact to the extent that it is accompanied by sufficient complementary factors, such as the economic environment, infrastructure, human capital and the national innovation system (ECLAC,2010a).

2. The digital economy in the region

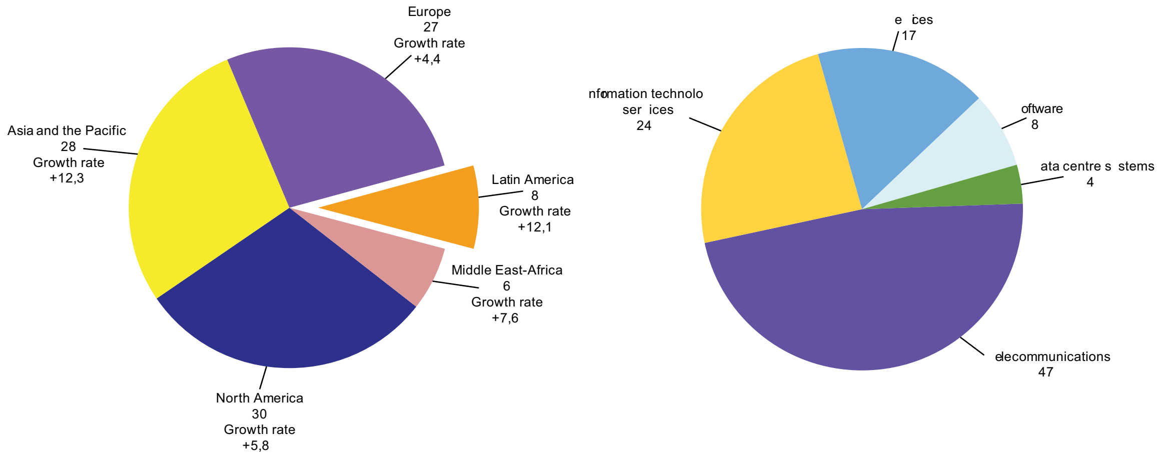
The region's digital economy has become increasingly important in the last decade, as measured through ICT spending, the number of Internet users and the diversification of uses. The region has become an emerging market in the use of ICT applications by businesses, government, and individuals, and spending in this area reached US$295 billion in 2011, or around 5.2% of GDP (Gartner, 2012). Figure I.1 shows the breakdown of world spending by region and industry segment. Spending in Latin America accounted for 8% of the world total, with a sustained growth rate of 12.1% in 2011, the second highest after Asia and the Pacific. By segment, world ICT spending can be disaggregated into telecommunications (47%), ICT services (24%), devices (17%), devices (8%) and data centres (4%).

The Internet market in Latin America has grown sharply in recent years, covering 133 million people in 2012 (ComScore, 2012). In 2008-2012, the region recorded the second-fastest growth rate of the population that uses the Internet (15% annual average), after the Middle East-Africa. The average annual growth rate for the world as a whole was 10% in the period, so the Latin American share increased from 7.3% to 9.0% (See figure I.2).

Figure I.1

COMPOSITION OF WORLD SPENDING ON ICTs, BY REGION AND SEGMENT, 2011

(Percentages)

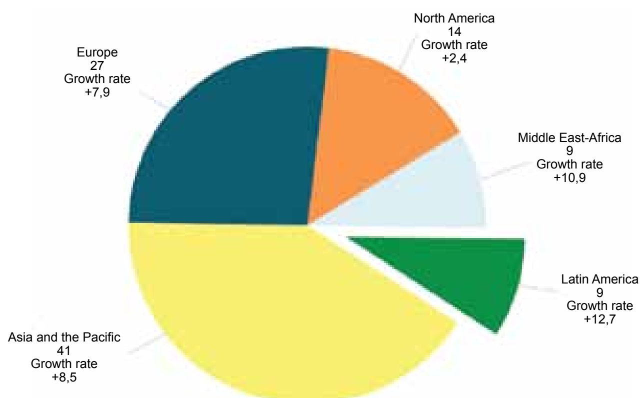


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Gartner Market Databook, 2012.
Note: The growth rate is for the 2010-2011 period.

Figure I.2

WORLD DISTRIBUTION OF INTERNET USERS, 2012

(Percentages)



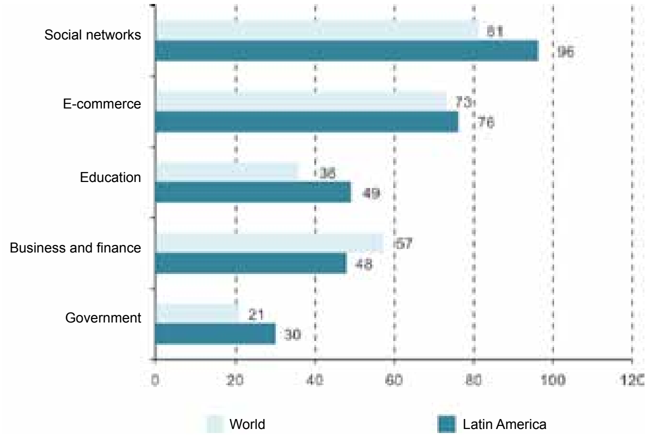
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of ComScore Inc., Futuro Digital – Chile, Webinar presentation [online] July 2012.
Note: Includes web users aged 15 years or older who connect from their home or workplace. The growth rate is for the 2010-2011 period.

The increase in Internet audience is associated with a diversification of its uses, in particular social networks, e-commerce, education, business, finance and government services (in that order). Figure I.3 shows that the regional use pattern has become more diversified, in line with international trends for the development of the digital economy. In Latin America, the use of social networks, education services, government services and e-commerce is more intensive than the international average, while use for business and finance is less intensive.

Figure I.3

MAIN INTERNET USE IN LATIN AMERICA AND THE WORLD, 2012

(Percentage of users)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of ComScore Inc., Futuro Digital – Chile 2012, Webinar presentation [online] July 2012.

With regard to the main uses of the Internet in the region, 96% of Internet users are involved in social networks, which exceeds the international average of 81%. Five countries in the region are among the top ten markets for social networks (measured by average monthly hours per visitor): Argentina (10.8 hours), Peru (8.9), Chile (8.9), Mexico (8.4) and Brazil (8.0).

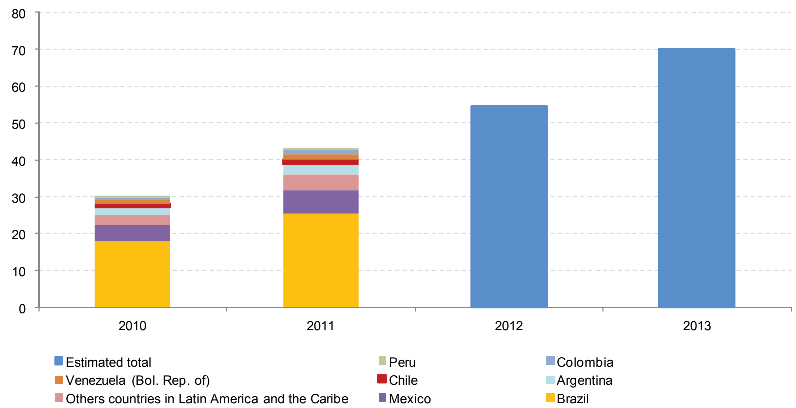
The use of government services and education also exceeds the world average. In 2012, 30% of the region's Internet users accessed government sites, versus a global average of 21%. The highest rates were found in the Bolivarian Republic of Venezuela (42%), and Brazil and Chile (40%). The share of users visiting educational sites was 49% for the region, while the world average was 36%; the highest rates for this type of use were in Peru (70%), Brazil (57%) and Chile (55%).

Business and finance accounted for 48% of site use in the region, and the highest rates were found in Brazil with 60%, Chile with 59% and Argentina with 47%. Regional use is below the international average of 57%. In this area, the most frequently used sites involve banking, personal finance, financial information and taxes.

The region has recorded significant growth of e-commerce in recent years, which is a key area for the development of the digital economy. Retail store websites were visited by 76% of total users, including 91% in Brazil, 80% in Argentina and 72% in Chile. This area merits particular attention from public policy, since its use has thus far been concentrated in only a few countries.

Recent data show that e-commerce has been very dynamic in the region, growing at exponential rates in a group of countries that have improved the conditions in this area. According to VISA and América Economía (América Economía, 2012), the value of e-commerce transactions doubled between 2009 and 2011, from US$21 billion to US$43 billion. This trend is largely explained by Brazil and Mexico, which accounted for over 70% of the region's spending in this area (see figure I.4). In 2011, e-commerce transactions represented 1.0% of GDP for Brazil; 0.6% for Argentina and Chile; 0.5% for Mexico and the Bolivarian Republic of Venezuela; and 0.3% for Colombia and Peru. Factors contributing to the rapid growth of e-commerce include the size of the domestic market, the expansion of access to banking services to larger segments of the population, consumer protection regulations, tax simplification and improvements in logistics and transportation systems.

Figure I.4
TOTAL E-COMMERCE SPENDING IN LATIN AMERICA, 2010-2013
(Billions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of VISA América Economía, "Los años del boom", Estudio de comercio electrónico en América Latina, May 2012.
[a] Projections.

One measure of the level of development of this activity is the e-commerce platform index, which takes into account variables such as online payment facilities, consumer protection for this type of business, distribution logistics and the Internet infrastructure (McKinsey & Company, 2012). Worldwide, Norway scores highest on this index (84 points); in the region, the countries with the highest index are Chile (49 points), Brazil (44), Mexico (36), the Bolivarian Republic of Venezuela (32), Argentina (30) and Colombia (29).

3. Share of GDP

Estimates of the digital economy's contribution to GDP are based on two methodologies; the first estimates final demand of the digital economy (private consumption, private investment, government spending and net exports), while the second estimates the added value of the digital economy, including the manufacturing and ICT services sectors. The second approach is used by countries in Asia, Europe and Latin America, as well as the United States.

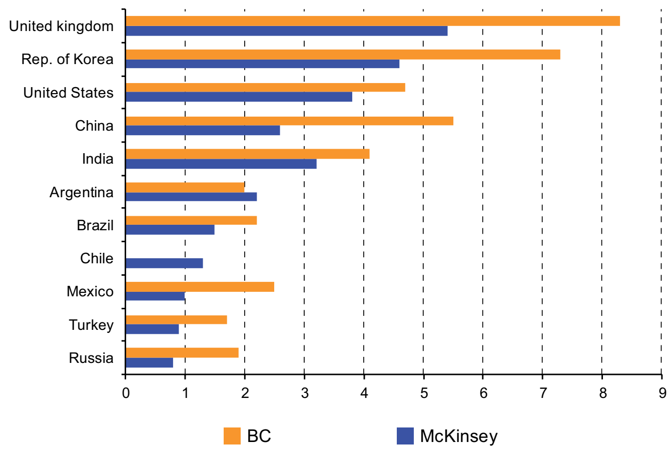
The main estimates of the digital economy using the final demand method come from studies conducted by McKinsey (2011) and the Boston Consulting Group (BCG, 2012a). These studies assess the value of the Internet economy,[1] a similar concept to that of the digital economy; they are based on the aggregate demand methodology, which includes amounts for private consumption, private investment, government consumption and net exports.[2]

Figure I.5 presents the estimates from these two consulting firms for a group of 11 countries in 2009-2010. Despite differences in the two sources, they are consistent in showing a strong contribution of the Internet economy in countries with strong digital development, such as the Republic of Korea, the United Kingdom and the United States. In emerging economies, such as China and India, the large share of the Internet economy is explained by the development of the hardware and software export sectors, respectively.

Figure I.5

GDP CONTRIBUTION OF THE INTERNET ECONOMY IN SELECTED COUNTRIES, 2009-2010

(Percentages of GDP)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of the Boston Consulting Group (2012b) and McKinsey (2012).

This chapter focuses on four Latin American countries: Argentina, Brazil, Chile and Mexico. The GDP share of the Internet economy is between 2.0% and 2.5% according to BCG and between 1.0% and 2.2% according to McKinsey. In Argentina, the GDP contribution is between 2.0% and 2.2%; in Brazil, between 1.5% and 2.2%; in Chile, 1.3%; and in Mexico, between 1.0% and 2.5%. According to BCG estimates, in the most developed countries, the Internet economy contributes 6.8% of GDP, on average; in emerging economies (China and India), 4.8%; in Latin America (Argentina, Brazil and Mexico), 2.2%; and in in Turkey and Russia, 1.8%. These forecasts suggest that the average GDP contribution in the three Latin American countries mentioned will be 3.3% by 2016.

1 The Internet economy is defined as activities associated with the creation and use of Internet services and networks, including all Internet activities and the web-related share of the ICT sector. It includes four categories: (i) activities that use the web as support (e-commerce, content creation and distribution and online publicity); (ii) telecommunications using Internet protocol (IP) or related to IP communications (Internet service providers, or ISP); (iii) software and services facilitated by the Internet (ICT consulting and software development); and (iv) hardware manufacturing and equipment maintenance (computers, smart phones, hardware and servers) (McKinsey & Company, 2012).

2 Private consumption includes the goods and services consumed via the Internet and the associated cotss. Private investment comprises Internet-related technologies. Government consumption is the sum of Internet-related spending by the central government and the public health and education sectors. Net exports includes Internet-related goods and services exports, plus el e-commerce, net of Internet-related goods and services imports (McKinsey & Company, 2012).

This chapter estimates the contribution of the digital economy in Argentina, Brazil, Chile and Mexico in 2008, using the value added national accounts methodology developed by LA-KLEMS.[3] The digital economy is calculated as the sum of the value added of the telecommunications, software, hardware and e-commerce sectors. The results are presented in figure I.6, which also includes the KLEMS estimates for other countries in 2007.

For the developed economies, the KLEMS estimates show that the digital economy's contribution to GDP in 2007 was 6.8% in Japan, 6.4% in the United States and 5.0%, on average, for the 27 countries in the European Union.

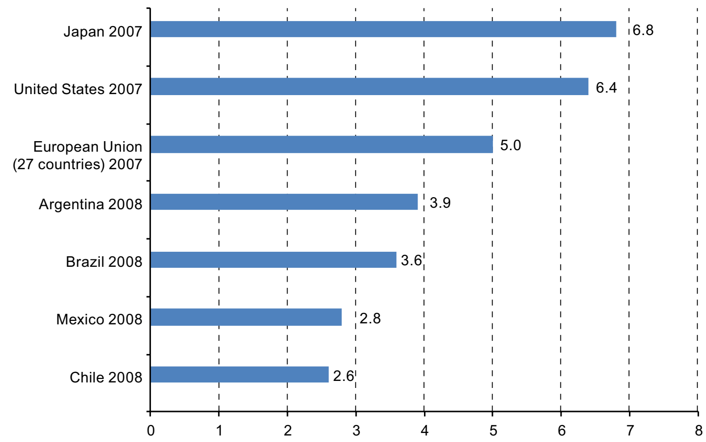
According to estimates based on the value added method, the GDP share of the digital economy was at least 3.9% in Argentina, 3.6% in Brazil, 2.8% in Mexico and 2.6% in Chile. These figures are higher than the final demand estimates, but they are more reliable because they use official national accounts series endorsed by the national statistics institutes and central banks of each country.

These figures represent the lower bound on the contribution of the digital economy, since they do not take into account the value added from related activities in other areas, such as the financial sector, the postal service and creative industries. According to these estimates, the contribution of the Internet economy in the four Latin American countries was 3.2% of GDP, on average. Thus, for the region as a whole the share would be over 2.0%.

Figure I.6

GDP CONTRIBUTION OF THE DIGITAL ECONOMY, SELECTED COUNTRIES, 2007-2008

(Percentages of GDP)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA-KLEMS project and UE-KLEMS.

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3 LA-KLEMS is part of the WORLD-KLEMS initiative and is a component of the ECLAC project, which aims to measure the impact of ICTs on economic growth and productivity. The LA-KLEMS initiative is coordinated by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) and financed by the ECLAC @LIS2 joint project of the European Commission and ECLAC. The objective is to build a set of comparable productivity statistics at the sectoral level for four countries in Latin America. The acronym comes from the use of a production function that includes capital (K), labour (L), energy (E), materials (M) and services (S).

B. Advances in ICT development

1. Digital agendas in the región

Although the majority of the countries in Latin America and the Caribbean are in an economic growth phase, the pace of ICT development in the region is very uneven. Some countries have made substantial progress through the steady implementation of policies and programmes over the last decade, with increasingly far-reaching effects that cut across many segments of the economy and society. Others lag further behind, and while they may have endorsed programme proposals, they have not managed to carry out pilot projects or execute national strategies in the area.

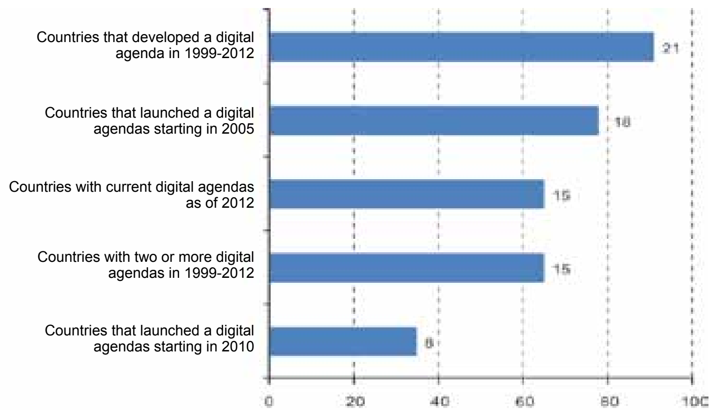
The countries in the region show a trend towards the formulation and implementation of increasingly integrated digital strategies. The first integrated ICT public policy initiatives emerged in the late 1990s and early 2000s. Countries like Chile and Colombia were pioneers in formulating national strategies or digital agendas. The creation of digital agendas was precipitated by international initiatives, such as the two World Summits on the Information Society (WSIS) in 2003 and 2005, the inclusion of ICTs in the United Nations Millennium Development Goals (MDGs) and the formulation of successive regional action plans on the information society in Latin America and the Caribbean (eLAC 2007, eLAC 2010 and eLAC 2015).

The region has been active in designing and launching digital strategies. In a sample of 23 countries, 21 have developed digital agendas starting in 2005, the year the eLAC process was set in motion. Currently, 15 of these countries continue to have an active digital agenda in force. Since 2010, several have developed or are in the process of developing new agendas (Argentina, Barbados, Chile, Uruguay, Ecuador, Colombia, Mexico, Panama, Paraguay and the Plurinational State of Bolivia) (see figure I.7).

Figure I.7

DIGITAL AGENDAS IN 23 COUNTRIES IN LATIN AMERICA AND THE CARIBBEAN, 2005-2012

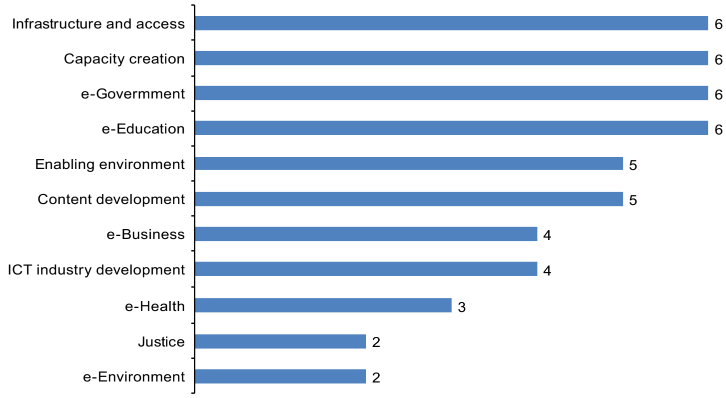
(Number of countries and percentages of total)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of digital agendas of Argentina, Barbados, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, the Plurinational State of Bolivia, Trinidad and Tobago and Uruguay.

Recent digital agendas have progressively incorporated new areas of intervention, as they become increasingly complex and integrated. In the sample of six countries featured in figure I.8, the policy focus is on infrastructure development and access. The most common and well-developed sectoral strategies are for e-education and e-government, followed by initiatives for ICT industry development. In other fields of application, such as e-health, justice and the environment, the initiatives are less frequent and not always tied to a national strategy for the sector.

Figure I.8
ITEMS ON THE DIGITAL AGENDAS OF SIX LATIN AMERICAN COUNTRIES



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of digital agendas of Argentina, Brazil, Chile, Colombia, Mexico and Uruguay.

Recent public initiatives include efforts to improve broadband connectivity in public institutions in the region, including initiatives to connect them to the general public, education and health institutions and local governments. Some important examples include Argentina's national telecommunications plan (called *Argentina Conectada*), Brazil's National Broadband Plan and its digital cities project, Chile's digital strategy, Colombia's broadband plan (*Vive Digital*), Mexico's digital agenda and Uruguay's CEIBAL plan (see table A.I.1 in appendix I).

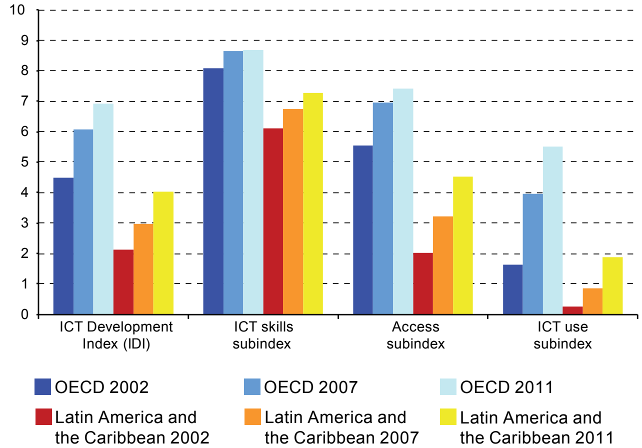
2. The region's preparation for the digital economy

The countries of Latin America and the Caribbean have made progress on the digital economy in several dimensions. The United Nations International Telecommunications Union (ITU) has developed an ICT development index that can be used to compare the evolution of ICTs in the region versus in member countries of the Organization for Economic Cooperation and Development (OECD). This comparison shows that, on average, the countries of the region have advanced moderately in the last decade, and the main achievements (infrastructure and access) and the largest gaps (use of ICTs) are consistent with the digital strategies implemented.

In the last decade, the regional rate of progress on the ICT development index was high (7.4% in average annual terms), but convergence with developed countries is still slow (see figure I.9). In 2002-2011, the region only increased its ICT development capacity relative to the OECD countries from 47% to 58%. This persistent gap can be largely explained by the very heterogeneous baseline situation of the countries in the region and the wide ranges in the scope, scale and budgets of their national digital strategies. Thus, only in 2013 will the region reach the level of ICT development that the OECD countries had in 2002, which implies a lag of over a decade.

Figure I.9

LATIN AMERICA AND THE CARIBBEAN: SIMPLE AVERAGE RATE OF PROGRESS ON THE ICT DEVELOPMENT INDEX RELATIVE TO THE OECD COUNTRIES



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), Measuring the Information Society 2012.

The ICT development index is made up of 11 indicators organized into three categories: access, use and skills. The biggest improvement was in the access subindex, due to advances in mobile telephony, Internet access and international bandwidth. Relative to OECD members, the region's access subindex increased substantially in 2002-2011, from 36% to 61%.

The ICT skills subindex is calculated on the basis of adult literacy, gross secondary enrolment and gross tertiary enrolment. This factor has not been critical in the region, as the social policies of the last decade have contributed to steadily closing the gap, in particular in education. The skills subindex relative to the OECD was 84% in 2011.

The region's weakest performance was in ICT use. This subindex captures the intensity of ICT use, measured as the percentage of the population that uses the Internet and has access to fixed and mobile broadband services. In 2002-2011, the countries more than doubled their use subindex relative to the OECD, from 16% to 34%, but that level is still not sufficient to drive the development of the digital economy. It implies that, on average, the region had only a third of the ICT use capacity of the developed countries in 2011.

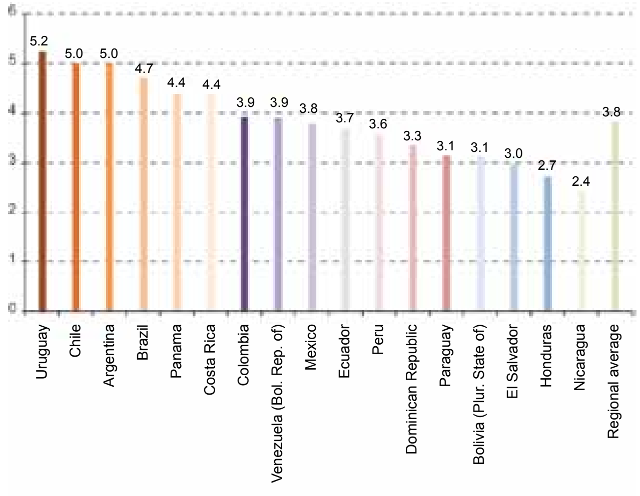
3. Regional heterogeneity

One of the factors hindering ICT development in the region is the digital divide between countries. This degree of cross-country diversity is reflected in differences in the ICT development index of over 100% (see figure I.10). As indicated earlier, the three best-performing countries have an index equivalent to 75% of the OECD index, versus 38% for the countries with the poorest performance. The highest cross-country variation in the region is in the ICT use subindex, where the difference between the three best performers and the three worst performers exceeds 300%.

Figure I.10

LATIN AMERICA AND THE CARIBBEAN: ICT DEVELOPMENT INDEX, 2011

(Index from 0 to 10)



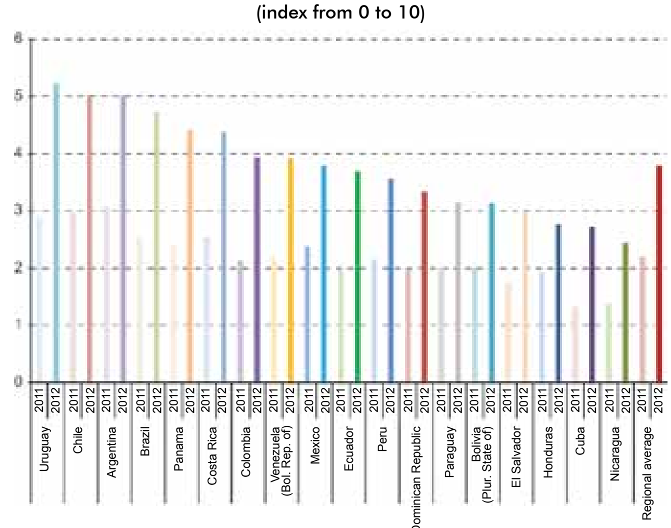
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), *Measuring the Information Society 2012*.

While some countries in the region have reduced the digital divide vis-à-vis more developed economies, others have seen it grow. Not only are the countries advancing at different rates, but the rate is fastest among the countries with the highest level of digital development. Between 2002 and 2011, the greatest progress was recorded by Uruguay, Brazil and Chile, followed by Panama, Argentina, Costa Rica, Colombia, the Bolivarian Republic of Venezuela and Ecuador (see figure I.11).

Figure I.11

LATIN AMERICA AND THE CARIBBEAN: IMPROVEMENT IN THE ICT DEVELOPMENT INDEX, 2002 AND 2011

(index from 0 to 10)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), *Measuring the Information Society 2009*, for data from 2002 and *Measuring the Information Society 2012* for data from 2011.

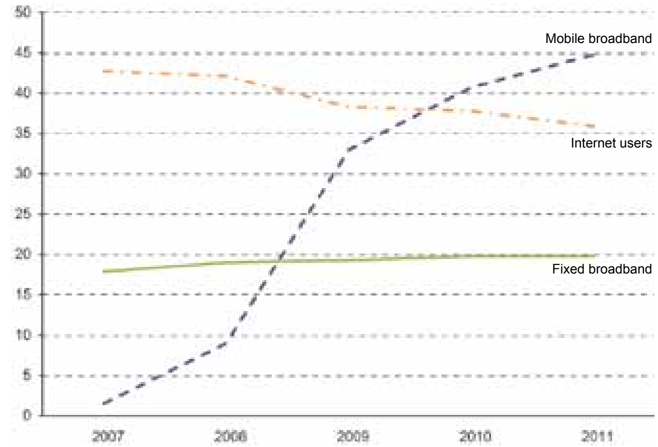
C. Internet and broadband diffusion

The evolution of the digital divide, measured as the difference in penetration rates in the region and in the OECD countries, has been mixed. The region's Internet use converged between 2007 and 2011, whereas the gap stabilized in fixed (wired) broadband penetration and grew exponentially in mobile broadband (see figure I.12). These results regarding Internet diffusion and broadband penetration in Latin America and the Caribbean are shaped by both supply and demand factors.

Figure I.12

THE DIGITAL DIVIDE BETWEEN LATIN AMERICA AND THE CARIBBEAN AND THE OECD

(Percentage points)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), *World Telecommunications Indicators Database,* 2012.

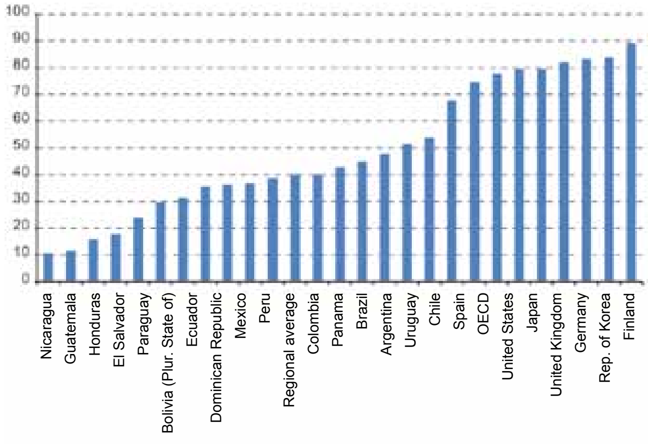
Although the region converged with more developed countries in terms of Internet penetration, the gap is still very large (36% of the OECD level). Policies are therefore needed to stimulate demand. In the more advanced economies, Internet uptake depends on individual preferences, interests or generational limits and, to a lesser extent, the expansion of infrastructure. A similar situation is found in Latin America and the Caribbean, where demand factors restrict consumption possibilities and the capacity for technology use. While the majority of the countries are facing supply restrictions in terms of infrastructure, the Internet divide is increasingly driven by demand-side factors, including structural factors associated with socioeconomic variables (such as education level, geographic location and income level) and market factors (such as the affordability of broadband services, measured as the ratio between service rates and per capita income).

Just as mobile telephony was instrumental in closing the gap in voice services, it may also help achieve universal broadband in Latin America and the Caribbean, via mobile broadband. The countries of the region are facing a set of challenges in this area, which require national and regional public policies for an integrated, synchronized approach to solving them. The rate of mobile broadband penetration depends on several factors, including the maturity of the next-generation networks (3G and 4G), the evolution of socioeconomic factors that favour Internet use, the cost and affordability of services and the regulatory framework.

1. Internet diffusion in the region

Internet diffusion in Latin America and the Caribbean in recent years has narrowed the gap between the region and the developed countries in this respect, while at the same time generating greater heterogeneity within the region. Figure I.13 shows Internet users as a share of total population in OECD countries and in Latin America. In 2011, the most advanced countries recorded a penetration rate of 80% of the population, whereas the region's penetration rate was 40% (see Barrantes, Jordán and Rojas, 2013). The latter figure is the average for a highly heterogeneous region in which penetration ranges from around 10% to 50%. In relative terms, the three countries with the highest penetration rates (Chile, Uruguay and Argentina) have 68% of the coverage found in the OECD countries, on average, while the three with the lowest rates (Nicaragua, Guatemala and Honduras) average 17% of the OECD level. Internet penetration in the OECD countries is double that of Latin America. Furthermore, the penetration rate of the three countries with the greatest regional coverage is four times the rate for the three countries with the lowest coverage.

Figure I.13
INTERNET PENETRATION IN 2011
(Percentages)



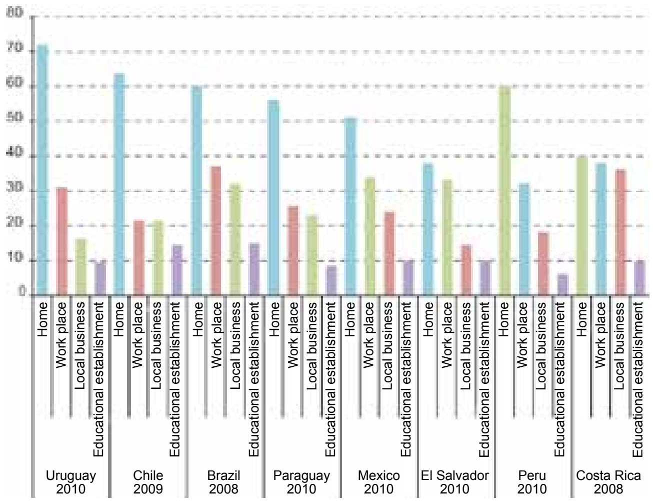
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), *World Telecommunications Indicators Database*, 2012.

The deep inequalities in income and access to education and public services in the region determine the pattern of Internet access and use. It is therefore important for Internet access to be available not only in the home and work place, but also in local businesses and educational establishments, especially for lower-income segments of the population. Figure I.14 shows the importance of each type of access point; in Peru, El Salvador and Mexico, the main alternative to home access is local businesses, while educational establishments are less important.

Figure I.14

INTERNET USE BY PLACE OF ACCESS IN SELECTED COUNTRIES, MOST RECENT YEAR AVAILABLE

(Percentages)



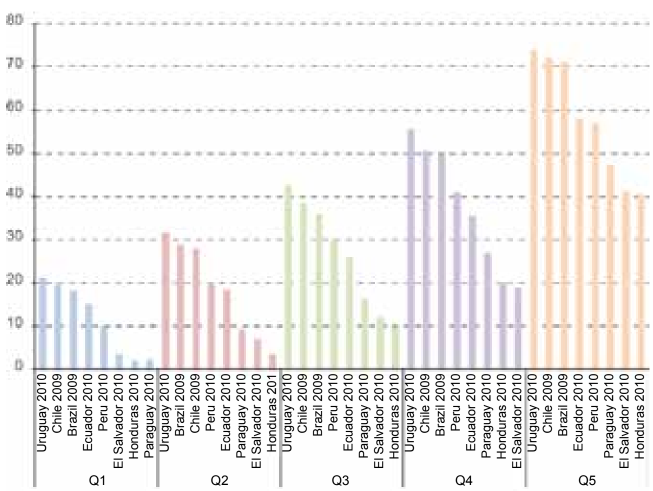
Source: Economic Commission for Latin America and the Caribbean (ECLAC), Observatory for the Information Society in Latin America and the Caribbean (OSILAC), on the basis of information from the household surveys of national statistical offices.

Internet access varies sharply by socioeconomic segment: the usage rate of the highest income quintile (the fifth quintile) is five times that of the lowest income quintile (the first quintile). Figure I.15 shows that for the eight countries for which data are available, the usage rate of the highest income segment is 58%, versus just 11% for the lowest income segment. The countries with the highest usage rate in the lowest income segments are Uruguay, Chile and Brazil, with an average rate of 20%.

Figure I.15

INTERNET USE BY INCOME QUINTILE IN SELECTED COUNTRIES

(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Observatory for the Information Society in Latin America and the Caribbean (OSILAC), on the basis of information from the household surveys of national statistical offices.

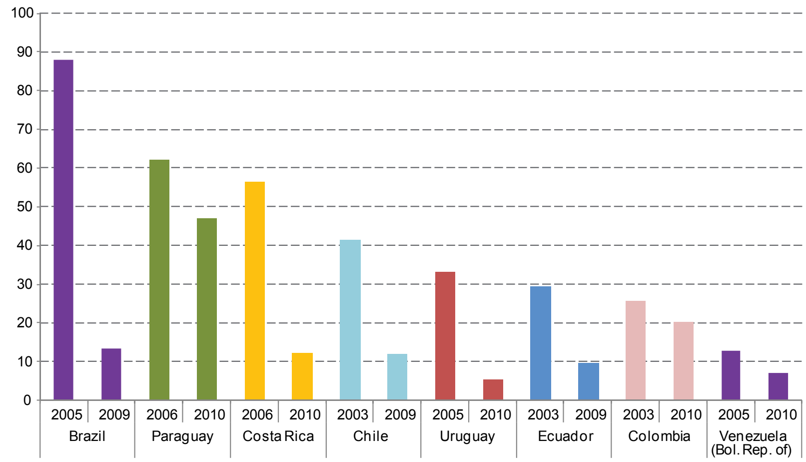
Alternately heterogeneity by socioeconomic segment is even more pronounced at the household level. The inequality in Internet access between the highest income quintile and the lowest reaches 14 times in 11 Latin American countries. Households in the fifth quintile have an average penetration rate of 47%, versus 3.4% for households in the first quintile. The country with the highest access for the poorest households is Uruguay with 11%, followed by Brazil, Chile, Costa Rica and the Bolivarian Republic of Venezuela, which, on average, have an access rate of 5% (see figure A.II-1 in appendix II).

Although sharp inequalities persist, Internet access in low-income households has increased in recent years as a result of public policies. Figure I.16 compares the relative access of the poorest and richest quintiles in 2005-2010. Significant progress is seen in Brazil, Costa Rica, Chile, Uruguay, Ecuador and the Bolivarian Republic of Venezuela. In Brazil, the access ratio between the richest and poorest households fell from 88 times to 13 times in 2005-2009.

Figure I.16

INTERNET ACCESS RATIO FOR HOUSEHOLDS IN HIGHEST AND LOWEST INCOME QUINTILES

(Number of times)



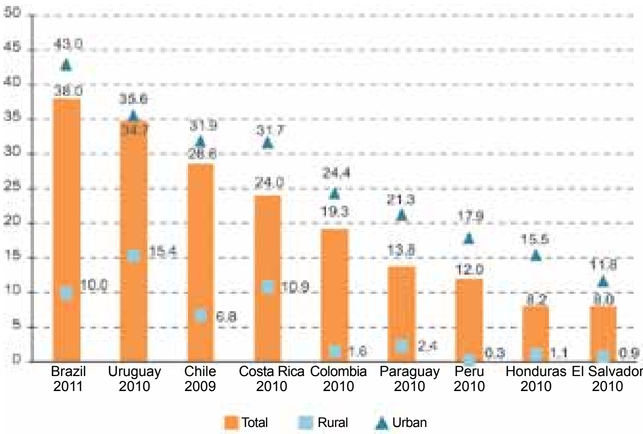
Source: Economic Commission for Latin America and the Caribbean (ECLAC), Observatory for the Information Society in Latin America and the Caribbean (OSILAC), on the basis of information from the household surveys of national statistical offices.

Another factor determining unequal Internet access for households is urban versus rural location. Figure I.17 shows the percentage of households with access by geographic location. In this case, the strongest performance is in Uruguay, Brazil and Costa Rica, where between 10 and 15% of rural households had access in 2010-2011.

Figure I.17

HOUSEHOLDS WITH INTERNET ACCESS IN URBAN AND RURAL AREAS AND AT THE NATIONAL LEVEL

(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Observatory for the Information Society in Latin America and the Caribbean (OSILAC), on the basis of information from the household surveys of national statistical offices. Most recent year available.

2. Determinants of Internet use

This section analyses the determinants of the probability of using the Internet at the individual level in nine Latin American countries, based on microdata from official household surveys with national coverage in Brazil, Chile, Costa Rica, Ecuador, Honduras, Paraguay, Peru, El Salvador and Uruguay in 2009-2010. A Probit econometric model was used to determine how a set of explanatory variables —including socioeconomic factors, occupational status and labour market insertion— affects the probability that an individual uses the Internet. The factors used to analyse the effect of the socioeconomic profile were per capita household income, age, education level, gender and area of residence (urban or rural); for occupational status, the categories considered were employed, unemployed, student or retired; for labour market insertion, the basis of analysis was the skill level (Navarro, 2012).

The probability of using the Internet from any location was modelled as a function of a set of continuous independent variables (income, age and years of study) and dummy variables (which take a value of 0 or 1) (woman, unemployed, student, retired and urban area). The dependent variable, P(use=1), is a binary variable that takes the value of 1 if the individual reports using the Internet from any point of access, and 0 otherwise. Appendix III provides a detailed description of the model.

To interpret the results, the marginal effects of each variable are compared between countries, identifying the most affected in each case, and then the variables with the greatest marginal effect on the probability of using the Internet are identified for each country. The statistical factors for the Probit model are presented in table A.III-1 in appendix III.

The main results are the identification of the variables with the greatest impact on the probability of using the Internet. Table I.1 presents, for each country, the three variables with the greatest marginal effect on the increase in the probability of using the Internet. Interestingly, the magnitude of the effect of a given variable varies markedly between countries. For example, an increase in income has a stronger impact in countries with a higher per capita income; a student in Costa Rica has a higher probability of using the Internet than a student in Honduras or El Salvador; a skilled worker in Brazil has a higher probability of using the Internet than a skilled worker in Peru.

Being a skilled worker and being a student are among the three most important variables in seven of the nine countries considered, followed by living in an urban area (seven countries) and per capita income (four countries). Surprisingly, an increase in per capita income is not always the most important factor.

Table I.1

DETERMINANTS OF THE PROBABILITY OF USING THE INTERNET

(Percentage probability)

Country	Variable	Change P(*use*=1) (%)	Country	Variable	Change P(*use*=1) (%)	Country	Variable	Change P(*use*=1) (%)
Brazil	Skilled work	43.8	Chile	Student	39.2	Costa Rica	Student	55.5
	Urban area	21.9		Skilled work	22.6		Skilled work	29.0
	log(*income*)	19.4		Urban area	20.2		Unemployed	17.4
	Unemployed	3.2		log(*income*)	14.6		log(*income*)	11.1
	Female	0.7		Unemployed	9.8		Urban area	10.7
	Years of education	0.3		Years of education	5.5		Retired	6.5
	Age	-1.1		Retired	4.7		Female	-3.2
	Student	n.d.		Female	-3.0		Years of education	1.4
	Retired	n.d.		Age	-1.0		Age	-0.7
	No. observations	355 450		No. observations	222 291		No. observations	11 367
Ecuador	Student	22.9	Honduras	Student	3.6	Paraguay	Skilled work	23.6
	Skilled work	18.4		Urban area	2.3		Student	20.8
	Urban area	9.4		Unemployed	1.7		Unemployed	12.4
	log(*income*)	7.9		log(*income*)	1.6		Urban area	8.9
	Unemployed	7.0		Retired	-1.2		log(*income*)	7.6
	Retired	5.2		Years of education	0.8		Female	-0.9
	Years of education	3.6		Skilled work	0.5		Years of education	0.6
	Female	-1.3		Female	-0.3		Retired	-0.2
	Age	-0.9		Age	-0.1		Age	-0.2
	No. observations	75 912		No. observations	29 259		No. observations	18 460
Peru	Skilled work	15.2	El Salvador	Student	9.7	Uruguay	Skilled work	24.8
	Urban area	11.9		log(*income*)	1.8		log(*income*)	23.3
	log(*income*)	8.6		Urban area	1.7		Student	18.9
	Unemployed	7.3		Skilled work	1.6		Years of education	5.1
	Female	-6.5		Unemployed	1.0		Retired	4.2
	Years of education	3.3		Years of education	0.9		Unemployed	-2.5
	Age	-1.1		Retired	0.7		Age	-2.0
	Student	n.d.		Female	-0.5		Female	-1.5
	Retired	n.d.		Age	-0.1		Urban area	n.d.
	No. observations	80 133		No. observations	77 611		No. observations	12 3631

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT.

3. Deployment of mobile broadband

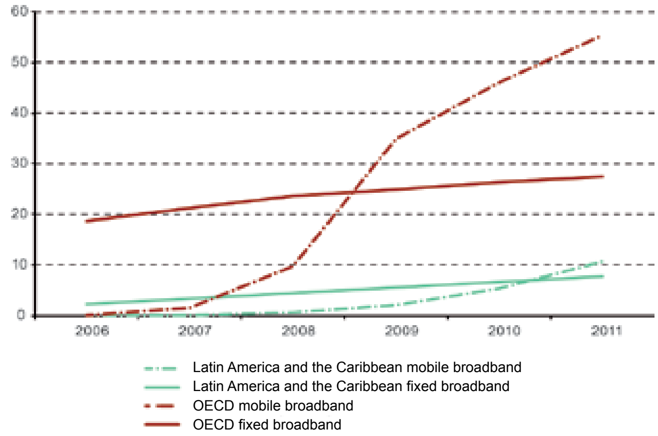
Access to broadband networks, services and applications is an essential prerequisite for economic and social development. The world trend shows a fast expansion of mobile broadband, which has become the predominant means of access due to the greater diversity and affordability of the access devices and the wider coverage of mobile networks. Mobile broadband could thus become a tool for economic development to the extent that it contributes to universalizing broadband in lesser developed countries (Bold and Davidson, 2012).

Although advanced telecommunications networks have expanded in most of the countries of Latin America and the Caribbean, mobile broadband has a limited reach compared with more developed economies. Figure I.18 shows the evolution of broadband penetration in the region in 2006-2011 and compares it with the trend for OECD countries. The gap widens sharply beginning in 2008 as a result of the strong growth of expansion mobile broadband in the more advanced economies.

Figure I.18

FIXED AND MOVILE BROADBAND PENETRATION IN LATIN AMERICA AND THE CARIBBEAN AND THE OECD, 2006-2011

(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), *World Telecommunications Indicators Database*, 2012.

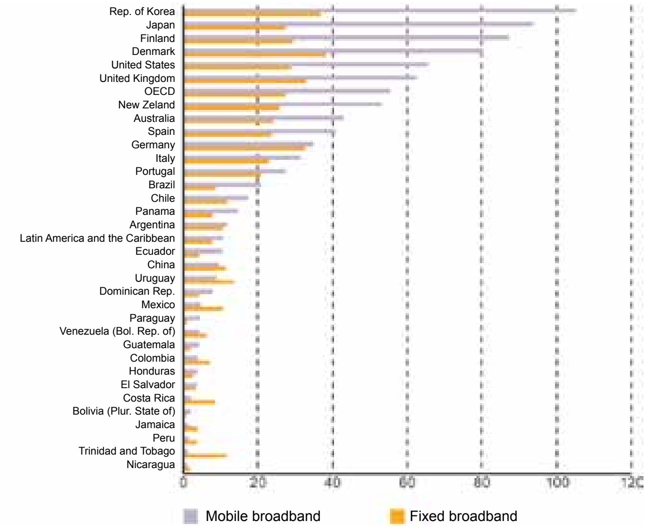
Figure I.19 presents the levels of fixed and mobile broadband penetration for selected countries in 2011, together with the averages for the countries of Latin America and the Caribbean and the OECD, excluding Chile and Mexico. The countries with lower Internet usage rates in the region have wider diffusion of mobile broadband, which is explained by lower service prices (Barrantes, Jordán and Rojas, 2013).

Latin America and the Caribbean displays not only a marked lag in mobile broadband penetration, but also substantial heterogeneity. In 2011, the mobile broadband penetration rate was five times higher in the OECD countries than in the countries of Latin America and the Caribbean and three times higher than in the three countries in the region with the highest mobile broadband penetration (Brazil, Chile and Panama). Within the region, the difference between the three countries with the highest and lowest penetration rates was 15 times. The main factors driving the growth of mobile networks are the early deployment and maturity of next-generation networks, whereas per capita income has a lower impact (Flores-Roux, 2013).

Figure I.19

FIXED AND MOBILE BROADBAND PENETRATIONS IN 2011

(Percentages)



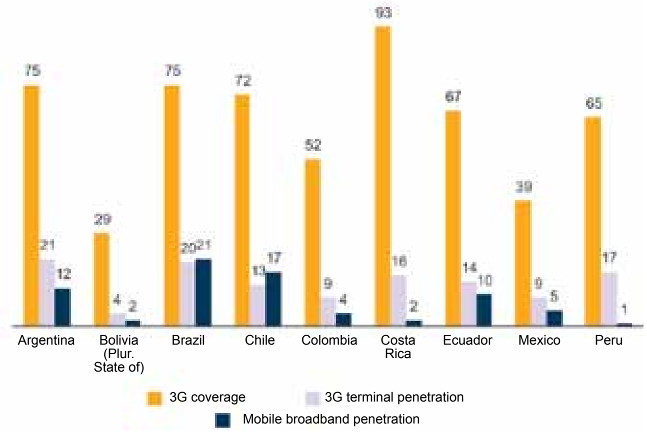
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Telecommunication Union (ITU), *World Telecommunications Indicators Database*, 2012.

Figure I.20 presents the 3G network coverage, 3G terminal penetration and mobile broadband penetration for nine Latin American countries in 2010. The disparities that persist in the region are substantial: 3G coverage ranges from 29% to 93%, 3G terminal penetration from 9% to 21% and mobile broadband penetration from 1% to 21%. The diffusion of smart terminals in the region, while incipient, has grown from 1% in 2007 to 11% in 2012 (www.statista.com); this compares with a rate of around 30% for the advanced economies of Europe (www.ourmobileplanet.com).

Figure I.20

3G COVERAGE, 3G TERMINAL PENETRATION AND MOBILE BROADBAND PENETRATION AS A SHARE OF TOTAL POPULATION, 2010

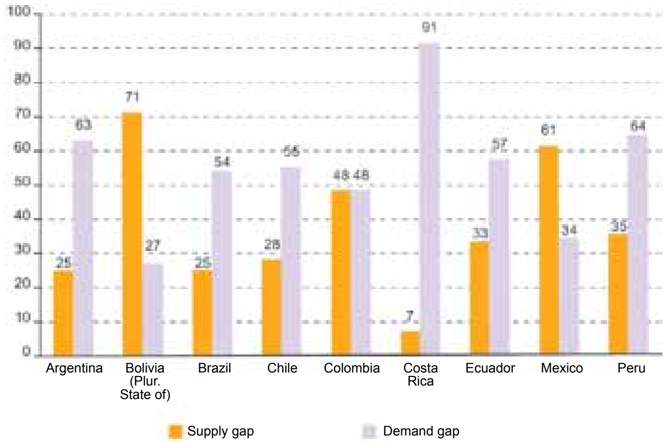
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of GSM Association (GSMA), Latin American Mobile Observatory: Driving Economic and Social Development through Mobile Broadband, London, 2012 and International Telecommunication Union (ITU), *World Telecommunications Indicators Database*, 2012.

Figure I.21 shows estimates of the supply and demand gaps in nine Latin American countries. In Argentina, Brazil, Chile, Costa Rica, Ecuador and Peru, the main obstacle to the diffusion of mobile broadband is the demand gap, defined as households that do not subscribe to mobile broadband service despite the availability of supply. In the Plurinational State of Bolivia and Mexico, the most important factor is the supply gap, that is, the lack of investment in 3G networks. In Colombia, both supply and demand gaps have hindered the development of mobile broadband.

Figure I.21
SUPPLY AND DEMAND GAPS IN MOBILE BROADBAND IN 2010
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of GSM Association (GSMA), *Latin American Mobile Observatory*, 2011 and 2012 and International Telecommunication Union (ITU), *World Telecommunications Indicators Database*, 2012.

The coverage of 3G networks is just one aspect of the broadband infrastructure. In Latin America, particularly South America, structural factors impede economies of scale that would justify large investments, which limits regional connectivity to Internet. This could result in network saturation in the near future.

The supply of high speed services lags behind, particularly in the area of international connectivity, due to the large concentration of interconnection capacity at specific points in the United States (85% of the international connectivity capacity) and the scarce intraregional connection routes (14% of capacity). The difficulties for local content storage and the low competition in international connectivity affect the supply problems. These variables have a negative impact on broadband tariffs, affordability and service quality.

Public policies to promote supply should focus on the infrastructure and regulation variables that have a direct impact on costs: promotion of a new regional and international connectivity infrastructure, through increased competition and greater fibre-optic capacity; increase in the number of Internet exchange points (IXP); and the promotion of content storage in countries in the region (de León, 2013).

The demand gap will become increasingly important as countries up their investment in broadband infrastructure and improve regional connectivity. The explanatory factors include structural elements, associated with socioeconomic variables, and market structure, mainly the level of competition among service providers (Katz and Galperin, 2013).

Among the structural factors, the determinants of Internet use can also explain broadband use. As discussed earlier, the set of explanatory variables that affect the probability that an individual uses the Internet include socioeconomic variables, occupational status and labour market insertion. The results for nine Latin American countries show that the variables with the biggest impact on the probability of Internet use are skill level, being a student, living in urban areas and per capita income.

Among the market factors, the most important obstacle is the affordability gap, that is, the perception that broadband service is expensive for their income level, which causes them to forgo subscribing despite the availability of supply. Given the high cost and low quality of broadband in the majority of the countries in Latin America, reducing the affordability gap should be a public policy objective based not only on regulatory policies to increase competition, but also on the promotion of investment in broadband service provision.

Data on mobile broadband tariffs and affordability in Latin America (tariffs relative to per capita income) indicate that the affordability gap is, in fact, one of the biggest obstacles to mass diffusion. Figure I.22 shows the high mobile access tariffs, expressed as a percentage of GDP per capita, in comparison with more developed countries. The average access cost of 17 Latin American countries is 5.7 times the average for the six more developed countries included in the figure.[4] The difference between the three best and worst performers in the region is 6.8 times. This large price dispersion is due to factors such as market size, the degree of competition in the access and submarine cable markets, economies of scale and public policies on broadband regulation and promotion (de León, 2013).Si se considera que un nivel de gasto razonable en banda ancha móvil podría ser de 2% de los ingresos individuales, en la actualidad solo dos países de la región (Uruguay y Panamá) estarían por debajo de esa cota. Esto les permitiría estar en condiciones de universalizar la banda ancha móvil si, al mismo tiempo, lograran superar las brechas de demanda derivadas de obstáculos socioculturales, principalmente la calificación de la fuerza laboral, y realizar las inversiones necesarias para alcanzar una alta cobertura de redes de 3G y aumentar la velocidad de conexión.

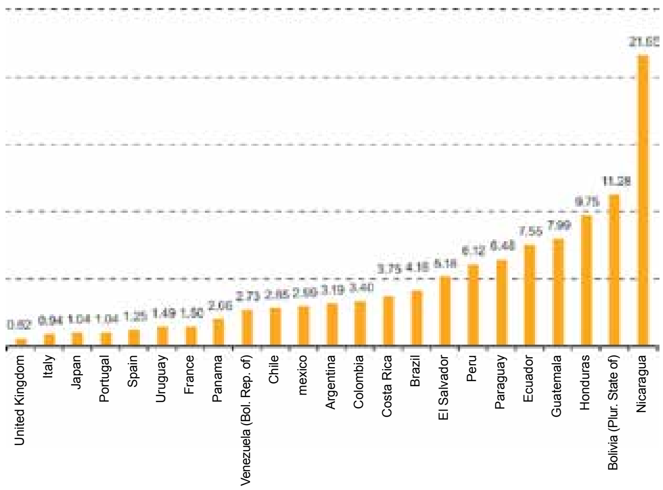
If a reasonable cost for mobile broadband is, 2% of individual income, then only two countries in the region, —Uruguay and Panama— are currently below that level. This would put them in a position to universalize mobile broadband if they can simultaneously overcome the demand gaps deriving from sociocultural obstacles, mainly the skill level of the labour force, and undertake the necessary investment to expand 3G network coverage and increase connection speed.

In addition to the high cost of broadband, connection quality is insufficient, based on upload and download speeds (see figure A.II-1 in appendix II). Most broadband connections in

4 The price of access devices is another obstacle to the diffusion of broadband in the region: in Latin America, an average notebook costs between 3% and 10% of annual per capita income, versus 1% in France, Spain, the United Kingdom and the United States.

the region have download speeds of between 4 and 10 Mbps. While this is adequate for the main activities currently offered by the Internet, it limits the use of advanced applications that require higher speed and lower latency.

Figure I.22
AFFORDABILITY: MOBILE BROADBAND TARIFFS TO GDP PER CAPITA, 2012
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional Broadband Observatory (ORBA), on the basis of published rates by the operators to September 2012.

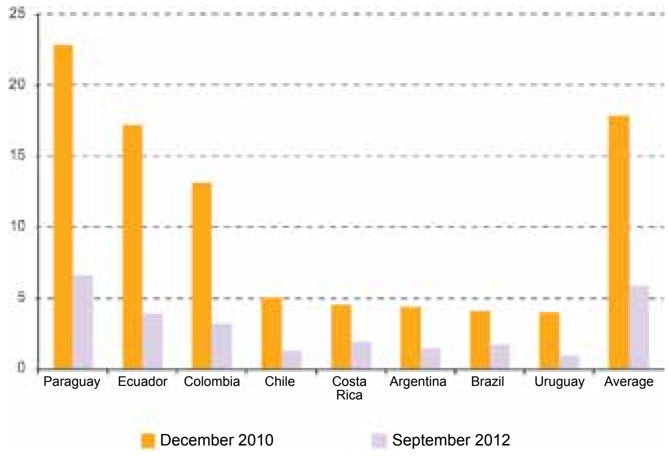
Broadband services in the region are more expensive and lower quality than in developed countries, although there has been progress in recent years due to regional coordination initiatives and regulatory measures to promote competition. Since the creation of the Regional Broadband Dialogue in 2010,[5] there has been a reduction in fixed broadband tariffs measured in dollars per 1 Mbps and an increase in connection speed. In the nine countries participating in the Regional Dialogue, fixed broadband fees fell 67% between December 2010 and September 2012, while download speeds increased 150% and upload speeds increased 195%. Consequently, the affordability of fixed-line broadband fell from 17.8% to 5.8% (see figure I.23 and figure A.II-2 in appendix II). Affordability thus improved in nine countries, in particular in Ecuador (77%), Colombia (76%), Uruguay (75%) and Chile (75%).

5 The Regional Broadband Dialogue is a space for exchanging experiences, approaches and proposals on the costs of international connectivity. ECLAC acts as technical secretariat, through the project ECLAC @LIS2. In early 2013, there were 10 participating countries in the region: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Paraguay, Peru, the Plurinational State of Bolivia and Uruguay.

Figure I.23

EVOLUTION OF AFFORDABILITY: FIXED BROADBAND TARIFFS PER 1 MBPS TO GDP PER CAPITA, DECEMBER 2010 TO SEPTEMBER 2012

(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional Broadband Observatory (ORBA), on the basis of published rates by the operators to September and December 2012.

Note: For the Plurinational State of Bolivia, fixed broadband tariffs to GDP per capita was 84.8% in December 2010 and 31.4% in September 2012.

II. The economic impact of ICTs

A. Aggregate impacts

1. Evolution of ICT investment

The broad potential of ICT diffusion has motivated research on how its production and use affect economic growth and productivity. Investment in general technologies has an impact on aggregate economic growth. For the United States, the acceleration of growth after 1995 can mainly be explained by a more intensive use of ICTs in the economy. In the European Union and Japan, ICT investment has also contributed significantly to growth and productivity in recent decades (Jorgenson, 2005; Timmer and others, 2007). This section describes a methodology for estimating the economic growth contribution of capital by asset class, with an emphasis on ICT assets, taking into account the contribution of labour inputs.[6]

The model of growth determinants was developed by Jorgenson and Griliches (1967) to empirically analyse economic growth. It uses capital services by asset class and labour inputs to identify the growth contributions of the different factors. The model starts from a standard production function in which output is obtained from the combination of technology, capital and labour (see appendix IV). That is, the growth of output can be decomposed into the sum of changes in technology and the production factors, weighted by their marginal productivity. Assuming complete and efficient factor markets and constant returns to scale, the return to production factors is equal to their marginal productivity.

In this context, multifactor productivity is an indicator of an economy's efficiency in combining labour and capital to generate value added. Authors like Prescott (1998) and Easterly and Levine (2002) argue that differences in productivity explain most of the cross-country

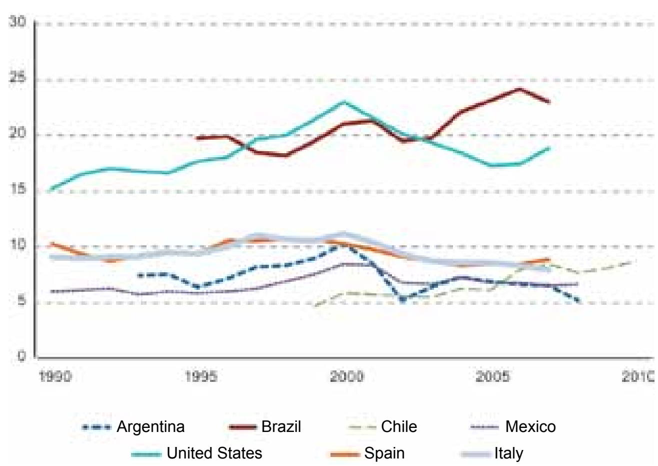
[6] The next section focuses on the complementarity between ICTs and structural change, with an emphasis on sectoral growth.

variation in income. However, the fact that the contribution of productivity is estimated as a residual implies that any bias introduced through errors or omissions in the estimation of the production function will contaminate the estimate of multifactor productivity. The main results from growth accounting exercises for countries in Latin America are associated with the evolution of ICT investment and the contribution of ICTs to economic growth. One of the contributions of this chapter is the construction of a gross fixed capital formation time series for ICTs, covering three assets (hardware equipment, telecommunications and software) for Argentina, Brazil, Chile and Mexico. The results are compared against Spain and Italy (developed countries with a per capita GDP that is close to the regional level) and the United States (an economy with a higher level of ICT development and production).

The results show that ICTs account for a significant share of the investment process. Figure II.1 presents the evolution of ICT capital as a share of total gross fixed capital formation (GFCF), which supports the following conclusions:

- ICTs are part of the long-term investment process in the countries analysed, and their share in total investment is comparable to the share in more developed economies.
- In Brazil, ICTs account for a significant share of total investment, comparable to the United States.
- Argentina, Mexico and Chile also have a high share of ICT investment, in line with Spain and Italy.
- In Brazil and Chile, the share of ICTs in total investment has been growing for over a decade, building a substantial stock of ICT capital.
- In Argentina and Mexico, the ICT share of investment has paralleled the economic cycle, with periods of growth and contraction.

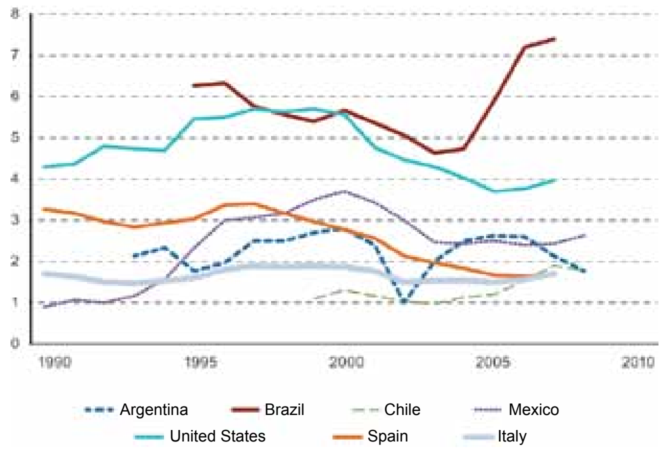
Figure II.1
SHARE OF ICT INVESTMENT IN TOTAL GFCF, 1990-2010
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project.

The components of ICT investment have behaved differently in each country. Investment in hardware equipment (see figure II.2) has been particularly strong in Brazil and Mexico, where the share has been larger than in the United States and Spain, respectively, since the mid-2000s, when Spain and Italy recorded a downward trend. The performance in Argentina has been sharply cyclical, with a downward trend in the early 2000s and a strong recovery thereafter. In Chile, the share is smaller, but with a steady upward trend.

Figure II.2
INVESTMENT IN HARDWARE EQUIPMENT AS A SHARE OF TOTAL GFCF, 1990-2010
(Percentages)



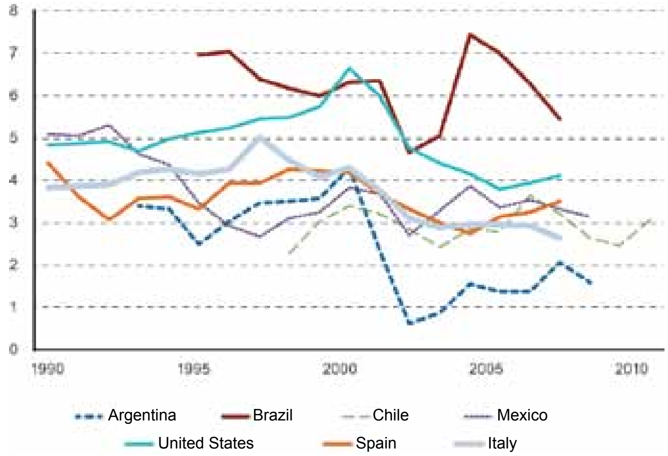
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project.

Figure II.3 shows the evolution of telecommunications assets. In this case, investment is led by Brazil, which has a larger share of telecommunications investment than the other countries in Latin America. The most recent period recorded a sharp cyclical adjustment, however, which was also seen in the United States. Investment has been growing in Argentina, Chile and Mexico, which are in line with the levels in Spain and Italy. In Argentina, telecommunications investment slowed markedly after the 2001 economic crisis, but it has been steadily recovering in recent years. The dynamic growth in Mexico has positioned the country above Spain and Italy. Chile also shows an upward trend, but it is less dynamic than the other countries.

Figure II.3

INVESTMENT IN TELECOMMUNICATIONS EQUIPMENT AS A SHARE OF TOTAL GFCF, 1990-2010

(Percentages)



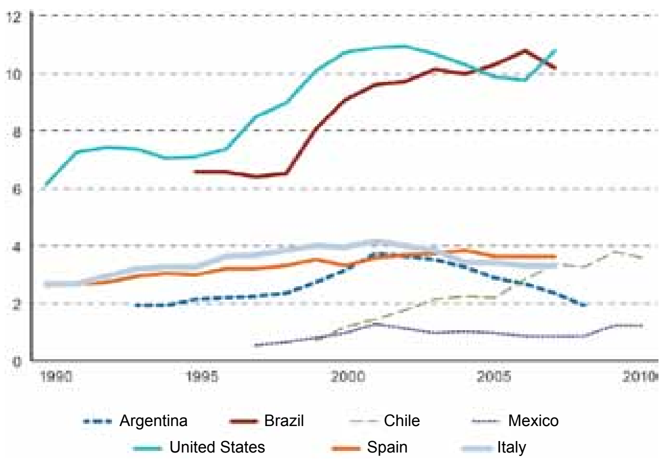
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project.

Investment in software has been more stable (see figure II.4). The weight of software in total investment is largest in Brazil, which has exceeded the United States since 2005. Argentina and Chile have been in line with Spain and Italy since 2000 and 2007, respectively. The positive trend recorded in Chile since 2005 contrasts with the slowdown of investment Argentina and stagnation in Mexico.

Figure II.4

INVESTMENT IN SOFTWARE AS A SHARE OF TOTAL GFCF, 1990-2010

(Percentages)



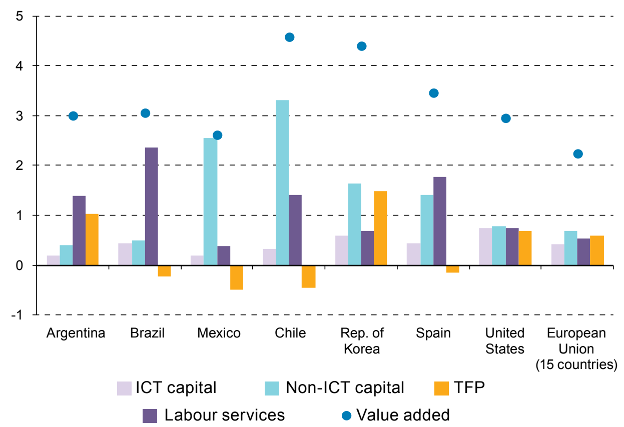
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project.

2. Growth contribution of ICT capital

This section presents the results of a growth accounting exercise using original measures of ICT and non-ICT capital and the stock of labour for four countries. Figures II.5, II.6 and II.7 show the results for the full sample period (1995-2008) and for two subperiods (1995-2001 and 2002-2008). The sample period was chosen to reflect the fact that ICTs have had a larger impact on growth in the United States since 1995, while the subperiods mark the dot-com crisis of 2001. To evaluate the performance of the four countries in the international context, the exercise includes the Republic of Korea, Spain, the United States and a group of 15 members of the European Union (UE15).

The results show that ICT investment is an explanatory factor for long-term economic growth in the four countries, although to a lesser degree than in the more developed countries. In 1995-2008, ICT capital explained 14% of the growth of value added in Brazil, 7% in Chile and Mexico and 5% in Argentina. For the developed countries in the same period, ICT capital explained between 13% and 25% of GDP growth, with the lowest share in Spain and the largest share in the United States.

Figure II.5
SOURCES OF GROWTH, 1995-2008
(Percentages)



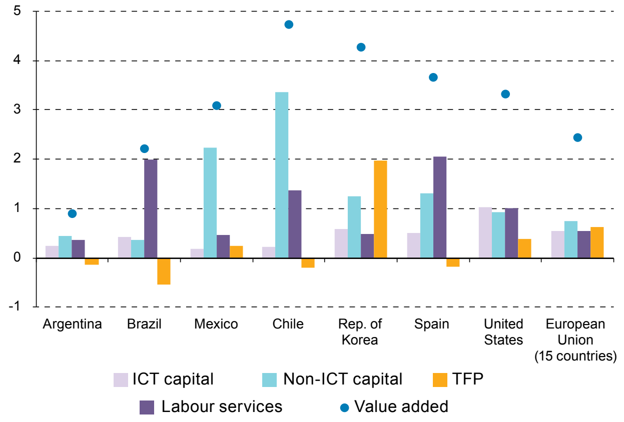
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project.

A comparison of the 1995-2001 and 2002-2008 subperiods reveals that the growth contribution of ICT capital doubled in Chile, whereas it did not change significantly in the other three countries. The more developed economies recorded steep drops in the contribution of ICT capital on the order of 40%, with the exception of the Republic of Korea, where the share was stable.

Figure II.6

SOURCES OF GROWTH, 1995-2001

(Percentage points)



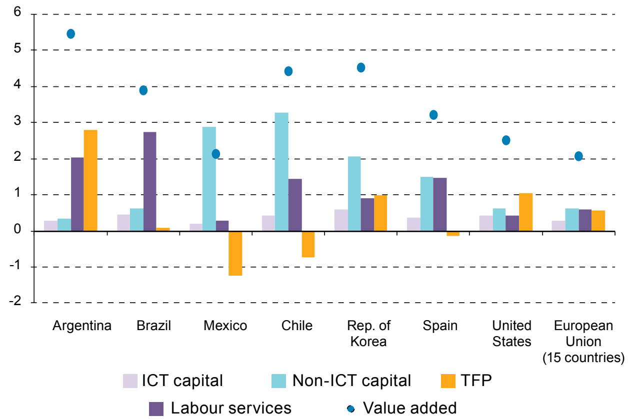
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project.

In the 2002-2008 subperiod, the contribution of ICT capital in Brazil and Chile was similar to the developed countries, with a slight increase in the former and strong growth in the latter (see figure II.7). In contrast, the share of ICT capital in the growth of the developed countries fell, except in the Republic of Korea.

Figure II.7

SOURCES OF GROWTH, 2002-2008

(Percentage points)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project.

The contribution of other types of capital to GDP growth follows two patterns (see table II.1). In Argentina and Brazil, the contribution of traditional, non-ICT capital is slightly greater than that of ICT capital. In Chile and Mexico, over 70% of GDP growth is based on the accumulation of traditional, non-ICT capital.

Table II.1
CONTRIBUTION TO OUTPUT GROWTH, 1995-2008
(Average annual growth, in percentage points)

		Argentina	Brazil	Mexico	Chile	Republic of Korea	Spain	United States	European Union (15 countries)
1.	Value added (2)+(3)+(6)	3.0	3.1	2.6	4.6	4.4	3.5	3.0	2.2
	Contributions of:								
2.	Labour services	1.4	2.4	0.4	1.4	0.7	1.8	0.7	0.5
3.	Capital services (4) + (5)	0.6	0.9	2.8	3.6	2.2	1.8	1.5	1.1
4.	ICT capital	0.2	0.4	0.2	0.3	0.6	0.4	0.8	0.4
5.	Non-ICT capital	0.4	0.5	2.6	3.3	1.7	1.4	0.8	0.7
6.	Total factor productivity	1.0	-0.2	-0.5	-0.5	1.5	-0.2	0.7	0.6

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project.

B. ICTs and productivity

The impact of ICTs on productivity in the developed economies has been widely analysed in the relevant literature.[7] As mentioned earlier, beginning in the mid-1990s, the United States benefited from an unprecedented increase in productivity due to efficiency gains in the ICT sectors, which had a large weight in the economy, and to a capital effect associated with a high investment rate in ICT assets in various sectors. These changes were induced by a dynamic innovation process in the ICT sectors, which was reinforced by a steady reduction in the prices of semiconductors and related products. The United States differed from the European Union in that the increase in productivity spread to other sectors of the economy, particularly to services in areas such as trade and business and financial services (van Ark, O'Mahony and Timmer, 2008).

According to conventional economic theory, the process of ICT diffusion and the reduction of prices should be similar in different parts of the world. In reality, however, the increases in productivity are mainly concentrated in the United States, which suggests that there are barriers to the exploitation of ICTs as a source of increased productivity and growth in other developed economies. This occurs because, as discussed in the next chapter, cross-country differences in productivity are explained not only by the development and diffusion of new technologies, but also by complementary factors at the level of the firm, the industry and the institutional framework, which interact with the development of ICTs to generate positive externalities, technological spillovers towards other sectors and productivity increases throughout the economy as a whole.

7 A number of key works use the EU KLEMS Growth and Productivity database, constructed by a consortium of 16 European research institutions in collaboration with national statistics institutes. The database contains harmonized information on economic growth, productivity, employment and capital formation at the industry level for the member states of the European Union, the United States and Japan from 1980 to 2004.

At the firm level, these factors include organizational change in the form of best practices in management and more decentralized management structures; at the institutional level, they involve human resources formation, the modernization of the productive infrastructure, state reform and investment in technological research and development. Because these complementarities are necessary for addressing market and coordination failures, the state must intervene through public policies to drive the processes of knowledge generation and learning in the information society (Cimoli, Dosi and Stiglitz, 2009; Cimoli, Hofman and Mulder, 2010).

The EU KLEMS growth accounting model was used to asses the relative growth contribution of labour, capital and intermediate inputs and to measure total factor productivity. The methodology considers measured changes in hours worked, as well as changes in the composition of the labour factor in terms of age, gender and education level. Physical capital is decomposed into six asset classes, three of which are directly associated with ICTs (hardware, telecommunications equipment and software) and three of which are not (machinery and equipment, transportation equipment and non-residential structures). This provided the basis, for the first time in the region, for comparing and analysing the impacts of high-skilled labour and ICT capital on the growth of productivity at the industry and country levels.

A comparative analysis of the factors contributing to output growth in 10 countries in the European Union, the United States and three countries in Latin America (Argentina, Brazil and Chile) show large changes in the patterns of productivity growth in 1995-2004 (see table II.2).[8]

Table II.2

CONTRIBUTIONS TO OUTPUT GROWTH, 1995-2004

(Average annual growth in percentage points)

	European Union (10 countries) 1995-2004	United States 1995-2004	Argentina 1995-2008	Brazil 1997-2009	Chile 1995-2009
1. Output (2) + (3)	2.2	3.7	3.4	2.8	4.2
2. Hours worked	0.7	0.6	1.0	1.3	0.5
3. Labour productivity (4)+(5)+(8)	1.5	3.0	2.4	1.5	3.7
Contribution of::					
4. Labour composition	0.2	0.3	0.3	1.2	0.8
5. Capital services per hour (6) + (7)	1.0	1.3	0.7	1.0	3.5
6. ICT capital per hour	0.5	0.8	0.3	0.5	0.3
7. Non-ICT capital per hour	0.5	0.4	0.4	0.5	3.2
8. Multifactor productivity	0.3	1.4	1.3	-0.7	-0.6
Contribution of the knowledge economy to labour productivity (4)+(6)+(8)	1.1	2.6	1.9	1.0	0.5

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project; for Europe and the United States, B. Van Ark, M. O'Mahony and M. Timmer, "The productivity gap between Europe and the United States: Trends and causes", *Journal of Economic Perspectives*, vol. 22, No. 1, 2008.

Note: Output comprises the market economy, excluding the health, education, public administration and defence sectors.

[8] In the United States, the average annual growth rate of labour productivity accelerated from 1.2% in 1973-1995 to 2.3% in 1995-2006. In the 10 countries of the European Union, the average annual growth rate of labour productivity in the same subperiods fell from 2.4% to 1.5%. (van Ark, O'Mahony y Timmer, 2008).

[9] The contribution of hours work to output growth in the 1980-1995 period was -0.6% in the European Union and 1.4% in the United States (van Ark, O'Mahony and Timmer, 2008).

The contribution of hours worked to output growth was similar for the European Union, the United States and Chile (0.7, 0.6 and 0.5 percentage points, respectively) and higher in Brazil and Argentina (1.3 and 1.0 percentage points, respectively). It was the most important factor in Brazil and the second most important in Argentina. When these data are compared with the output growth contribution in the more developed countries in the previous period (1980-1995),[9] we find that the share of hours worked has increased in the European Union and decreased in the United States.

The growth contribution of the knowledge economy is key for explaining why the growth rate of labour productivity in the United States was double that of the European Union in 1995-2004. A large share of the difference can be attributed to ICTs, to the extent that the European ICT sector recorded a lower investment rate and lower efficiency than the ICT sector in the United States. In Argentina and Brazil, the contribution of the knowledge economy was also substantial, although less than in the United States and in line with the European Union. In Chile, however, the contribution of non-ICT capital had the largest impact on labour productivity.

The main results of the comparative analysis of the factors contributing to growth are as follows:

- The composition of labour contributed 0.2 percentage points in the European Union and 0.3 in the United States and Argentina. While small, the positive sign indicates a shift in the labour force towards activities requiring a higher skill level. The quality of human resources was the second most important factor for output growth in Brazil and Chile, contributing 1.2 and 0.8 percentage points, respectively. This implies that new entrants to the labour market have a higher average education than the existing labour force.

- The contribution of total capital, measured as capital services per hour, was high in the European Union, the United States, Brazil and Chile. In particular, the contribution was 3.5 percentage points in Chile and 1.3 percentage points in the United States. The United States was the only country where the ICT capital contribution was notable, at 0.8 percentage points, followed by the European Union and Brazil, each with 0.5 percentage points. Argentina and Chile recorded a more moderate contribution of ICT capital, at 0.3 percentage points in both cases. The main difference between the United States, the European Union and Latin America (except Argentina) was in the growth rate of multifactor productivity, which increased to 1.4% in the United States (up from 0.5% in 1980-1995) and fell to 0.3% in the European Union (0.9% in 1980-1995). The contribution of multifactor productivity was negative in Brazil and Chile and positive in Argentina (1.3 percentage points). Since multifactor productivity is a residual, it can be interpreted in many ways, but regardless, it reflects the efficiency of the production processes.

- The contribution of the knowledge economy, defined as the sum of the contributions of the composition of labour, ICT investment and multifactor productivity, was high in the United States and the European Union, at 2.6 and 1.1 percentage points, respectively. A comparison of the 1980-1995 and 1995-2004 subperiods reveals that in the United States, the knowledge economy doubled its contribution from 1.3 to 2.6 percentage points, whereas in the European Union, it fell from 1.6 a 1.1 percentage points. The contribution was also high in Argentina (1.9 percentage points) and Brazil (1.0 percentage points) but moderate in Chile (0.5 percentage points).

To evaluate the impact of the sectoral structure of the economy on productivity in the European Union and the United States, the labour productivity growth rate is decomposed into three large economic sectors: the production of ICTs, the production of other goods and the production of services supplied under market conditions (excluding health, education, public administration and defence). Table II.3 shows that the lag in productivity growth in the European Union is highest in the ICT sector (except Finland) and merchant services (except the United Kingdom), both of which require high levels of digitization. The cases of Finland and the United Kingdom are exceptional because they record labour productivity growth rates in line with or above the United States, with a well-developed ICT production sector in Finland and sophisticated merchant services in the United Kingdom. In countries that are highly specialized in manufacturing, such as Germany and France, the industries with a higher digitization capacity, such as automobiles or machinery and equipment, were also an important source of productivity growth (van Ark, O'Mahony and Timmer, 2008).

Table II.3

SECTORAL CONTRIBUTION TO LABOUR PRODUCTIVITY GROWTH IN THE EUROPEAN UNION AND THE UNITED STATES, 1995-2009

(Average annual growth, in percentage points)

	Total market economy	ICT production	Production of other goods	Market services	Reallocation
	1=2+3+4+5	2	3	4	5
Germany	1.6	0.5	0.9	0.2	0.0
Austria	2.2	0.3	1.7	0.3	-0.1
Belgium	1.8	0.3	1.0	0.5	-0.1
Denmark	1.4	0.3	0.8	0.3	0.0
Spain	0.2	0.1	0.1	0.1	-0.1
Finland	3.3	1.6	1.3	0.4	0.0
France	2.0	0.5	1.0	0.6	0.0
Italy	0.5	0.3	0.3	-0.1	0.0
Netherlands	2.0	0.4	0.6	1.1	-0.1
United Kingdom	2.7	0.5	0.7	1.6	-0.2
European Union	1.5	0.5	0.8	0.5	-0.2
United States	3.0	0.9	0.7	1.8	-0.3

Source: B. Van Ark, M. O'Mahony and M. Timmer, "The productivity gap between Europe and the United States: trends and causes", *Journal of Economic Perspectives,* vol. 22, No. 1, 2008, table 5.
Note: Output comprises the market economy, excluding the health, education, public administration and defence sectors.

The sectoral effect on productivity was later confirmed when the European Union converged with the United States between 2004 and 2007, before the international crisis. In that period, Europe shifted into a second phase in the impact of ICTs, generating productivity increases in economic sectors beyond the ICT sector, in particular financial activities, business services and specialized manufacturing. In 2003-2007, the average labour productivity growth rate in the European Union was slightly higher than the United States (1.9% versus 1.8%), with a strong contribution from total factor productivity (1.0 percentage point) to labour productivity (European Community, 2010).

In the Latin American countries analysed, ICT capital had a small impact on productivity in 1995-2008, mainly in the financial sector (see table II.4). Productivity growth in the financial sector was 1.7% in Argentina and Brazil and 2.2% in Chile; the corresponding contribution of ICT capital was 0.7, 1.5 and 2.2 percentage points, respectively. In contrast to expectations, productivity increases in other services and in the manufacturing and resource processing industries are explained by other factors. The mining sector in Brazil is an exception, where the large contribution of ICT capital to productivity could be related to technological developments in the oil sector.

Table II.4

SECTORAL LABOUR PRODUCTIVITY GROWTH AND THE CONTRIBUTION OF ICT CAPITAL IN ARGENTINA, BRAZIL AND CHILE, 1995-2008

(Average annual growth, in percentage points)

	Total economy	Mining	Industry	Trade	Financial sector
Argentina					
Productivity growth	2.3	1.5	2.0	1.6	1.7
Contribution of ICT capital	0.3	0.1	0.3	0.5	0.7
Brazil					
Productivity growth	1.5	2.7	-0.5	0.7	1.7
Contribution of ICT capital	0.5	1.2	0.5	0.4	1.5
Chile					
Productivity growth	3.7	4.2	2.7	6.0	2.2
Contribution of ICT capital	0.3	0.3	0.4	0.2	1.2

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of KLEMS.
Note: Data for Brazil are for 1997-2009.

Until 2008, the ICT development and diffusion process in Latin America had not generated a structural change with productivity convergence at the level of the economy overall. The increases in productivity in Argentina, Brazil and Chile are not explained by the evolution of the production structure towards digitization and knowledge-intensive sectors. In contrast to the evolution in the United States in 1995-2002 and the European Union in 2004-2007, the countries of Latin America have made only partial progress in fostering digital structural change, which has been limited to some service sectors such as the financial industry, large retail chains and telecommunications.

III. Structural change and equality

A. Structural change and development

Although the analysis of the impacts of digitization shows the importance of considering input variables beyond pure access, the most commonly used model is organized around ICTs. In this chapter, the study of the relationship between ICTs and structural change also includes production structure variables that are not directly tied to ICTs, with a focus on the sectoral dimension.[10] Beyond the contribution of ICTs to an aggregate production function, where they enter as a specific type of capital, this chapter analyses the complementarity between ICTs and the transformation of the production structure. ICTs are now seen as part of a system of mutually reinforcing components, in which interaction between general purpose technologies and the diversification of production is one of the drivers of innovation, learning and growth.

As described in ECLAC (2012), structural change consists in the coevolution of technological paths and the production structure, which requires redefining the international division of labour and endogenous capacities for innovation and learning. Structural change must go hand in hand with the accumulation of new capabilities on advanced technological paths. In a world in which the technological revolution has accelerated tremendously, there are fewer and fewer spaces for competition based solely on static comparative advantages, such as abundant natural resources or cheap, low-skilled labour.

Economic development requires reallocating resources towards technological innovation and knowledge-intensive sectors or activities, as well as diversifying towards sectors and activities in which domestic and external demand are growing rapidly, so that demand can be met by domestic supply and exports and imports can grow together, without putting unsustainable pressure on the balance of payments. Development is thus associated with a productive structure characterized by two types of dynamic efficiency, which represent faster growth paths for

[10] Chapter II considered non-ICT production sectors, on aggregate. Disaggregated studies tend to focus on the explanatory role of ICT investment in specific industries. For example, Schneider (2010) studies the impact of ICT investment (23 industries in 14 countries) on the demand for workers with different skill levels and wages.

productivity, production and employment over time. First, Schumpeterian efficiency occurs through the presence of more knowledge-intensive sectors that generate knowledge and capacity spillovers to the economy as a whole. Second, Keynesian efficiency is associated with specialization in sectors with growing domestic and external demand, which has positive effects on production and employment (Dosi, Pavitt and Soete, 1990).

Without Keynesian efficiency and the expansion of effective demand, technical progress does not guarantee the growth of employment. Without Schumpeterian efficiency, the economy will not be able to maintain the global market share of firms or the goods and services produced, since international competitiveness is increasingly based on technological competency and the capacity to quickly generate or absorb knowledge and innovation.

The two types of dynamic efficiency are related. Generally, the sectors with the fastest-growing demand are also the most dynamic in terms of technology use and knowledge intensity.[11] Structural change is virtuous when it ensures that the technological spillovers and demand growth drive not only a group of large firms, but also the economy as a whole through production chains. This allows the emergence of new agents, and the labour force shifts from less productive sectors to more productive sectors. This process generates a more homogeneous distribution of medium- and high-productivity activities, with a favourable impact on equality.

A more homogeneous distribution of productivity contributes to more equitable distribution of income. An education system that raises the skill level of workers represents the supply side of the equation in the labour market. The demand side depends on the production structure, that is, on a denser matrix that requires and demands more skilled workers, with the corresponding wage increases.

Within this framework, Latin America continues to lag behind in new technologies, and the technological revolution is essentially an exogenous phenomenon. Moreover, local efforts to fully exploit its potential are insufficient. The construction of endogenous capacities and the reduction of economic and social gaps are complementary processes. The complementarities do not arise spontaneously, since there are endogenous forces associated with increasing returns that generate patterns of international divergence.

An international comparison based on a wide set of indicators of the production structure and ICTs shows that the region has lower levels of Keynesian and Schumpeterian efficiency than a broad set of countries (see appendix V). In particular, its capacity for ICT diffusion is lower than the reference countries, except for mobile telephony. The complementarity between the type of production structure and the diffusion of ICTs, and between the type of production structure and spending on technological research and development, creates increasing returns to learning and structural change. The lack of such complementarities represents a significant obstacle to development, which, as discussed in chapter IV, can only be overcome through industrial policies that promote structural change.

[11] There are exceptions associated with what Díaz-Alejandro (1984) calls the commodities lottery, in which a country manages to temporarily achieve high growth due to the abundance of a resource that is in an especially favourable phase of the international demand cycle.

The challenge is to enter a new growth cycle by giving the new technological paradigms a content and direction in line with global and regional challenges. The new paradigms imply paths that are more dynamically efficient and that offer the best technological opportunities, with a fast-growing demand for the goods and services produced under the new paradigms, especially ICTs.

As mentioned earlier, a central aspect of the new paradigms is their impact all across the production structure. These are general purpose technologies, whose impact is multiplied when they can be applied to a wide range of sectors. As a corollary, more diversified production structures offer more opportunities for using these technologies and respond more deeply to their diffusion. Production structures and new technologies thus evolve together, and that phenomenon must be at the centre of analysis.

B. ICTs as a complementary asset

1. ICTs and structural change

The interaction between ICTs and structural change can be illustrated through indicators of the degree of ICT diffusion, measured as the number of Internet users per 100 inhabitants. From a research perspective, these indicators provide an additional benefit: the data are available to construct relatively long series for analysing their evolution in the medium term.

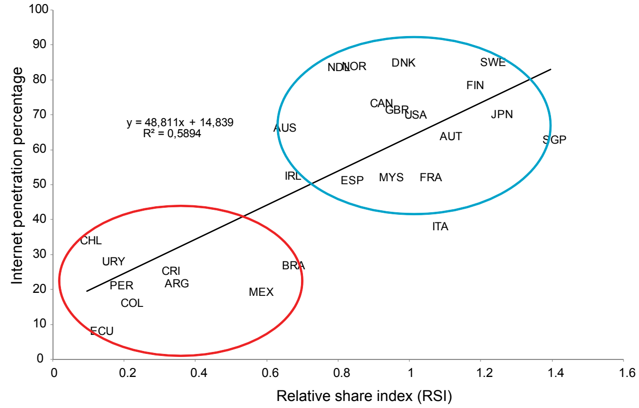
Four proxies are used to capture the intensity of structural change (see appendix V for a detailed description): (i) the relative share of engineering-intensive sectors (RSI) in an economy's manufacturing value added, relative to the corresponding share in the United States; (ii) the EXPY index of export sophistication, developed by Hausmann, Hwang and Rodrik (2007);[12] (iii) the weight of medium- and high-technology industries in total manufacturing value added (MHT); and (iv) the weight of medium- and high-technology exports in total exports (X_MHT/X).

The analysis of figures III.1, III.2 and III.3 leads to two conclusions. First, there is a positive relationship between the proxies of structural change and Internet penetration. As already mentioned, the positive trend reflects the complementarity between two processes: the diffusion of general use technologies and the construction of a complex, diversified production system. Second, the speed and mechanism of ICT diffusion varies widely across the world economy. Because ICT diffusion and structural change have been very intense and simultaneous in the Asian and European economies considered, these countries are concentrated in the north-east quadrant of each figure. In contrast, the Latin American countries are concentrated in the south-east quadrant, where both processes are weak. The coevolution of the two variables implies that the weak diversification of production could be hindering the expansion the digital economy in the region. It is therefore necessary to advance on both fronts simultaneously.

[12] EXPY is an indicator of both Schumpeterian and Keynesian efficiency, insofar as the more sophisticated goods and services exported by rich economies are probably more income-elastic than those exported by poor economies.

Figure III.1

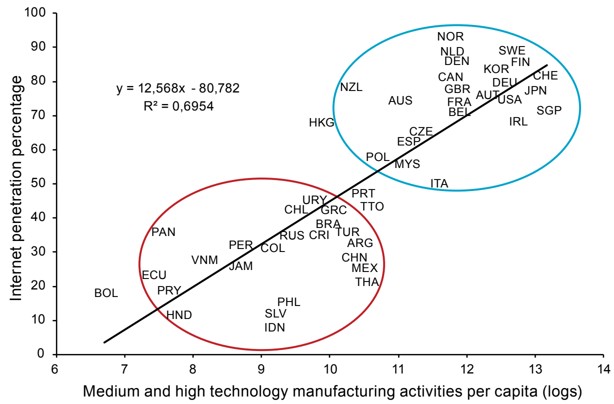
INTERNET USERS AND THE RELATIVE SHARE OF ENGINEERING-INTENSIVE SECTORS (RSI), 2005-2007



Source: Prepared by the author.

Figure III.2

INTERNET USERS AND PER CAPITA VALU ADDED OF MEDIUM- AND HIGH-TECHNOLOGY INDUSTRIES, 2009

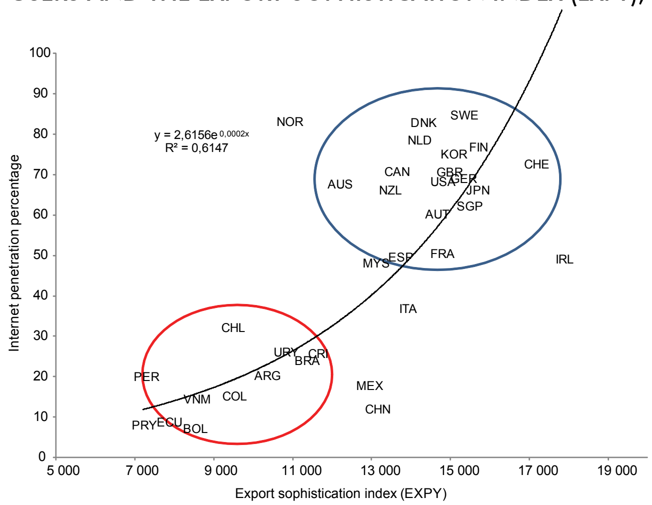


Source: Prepared by the author.

The discontinuity in the development of ICT use and the diversification of the production structure is evident in figure III.3. The best fit of the variables is achieved with the exponential curve, which suggests different slopes —flatter at the beginning, steeper in the later segments. The segmentation of the regions into the two parts of the curve (Latin America in the lower circle; the other regions in the upper circle) is indicative of different linking mechanisms between the production structure and ICTs. The steeper slope of the curve for the Asian and European group indicates a more articulated relationship between the system components, capable of producing increasing returns. The Latin American pattern, in contrast, is less articulated and confined to certain limits, reflecting lower synergies between systems. Overcoming the segmentation between the universes in the figure will require a coordinated effort in terms of the supply of ICTs and their absorption by a diversified production system.

Figure III.3

INTERNET USERS AND THE EXPORT SOPHISTICATION INDEX (EXPY), 2003-2008



Source: Prepared by the author.

The relationship between ICTs and the RSI and between ICTs and the EXPY shows increasing returns, whereas the relationship between ICTs and MHTs is linear. The existence of increasing returns can strengthen the advantage of being a pioneer in a market, but it does not necessarily lead to divergence. In the context of an exogenous shock to some of these variables (for example, through adoption of efficient industrial policies or the strengthening of innovations systems), it is possible to catch up under conditions of increasing returns, as demonstrated by various industrialization experiences in the last half century.

As discussed in the next chapter, the region's challenge is to combine ICT use and diffusion strategies with industrial policies, so that the growth process —which is currently limited in both directions (structural change on the vertical axis and ICT diffusion on the horizontal axis)— can shift into the north-east quadrant and acccelerate substantially.

2. Structural change and growth

The study of the impact of ICTs on growth has gone through different phases. Initially, ICTs were included in growth accounting exercises, as in chapter II, which was an indirect way of considering the role of structural change in the economy. It was assumed that capital was not homogeneous and that some types of capital could make a larger contribution to growth than others. Later, the "Barro regressions" or conditional convergence regressions, based on the existence of decreasing returns to capital, also took into account the penetration of mobile telephony, the Internet and broadband as explanatory variables for growth. Under both methodologies, the theoretical models behind the quantitative exercises left little room for the sectoral dimension and for differences between sectors or technological paths as a source of growth and competitiveness.

The promotion of the digital economy to drive growth requires acting simultaneously on supply (telecommunications infrastructure and ICT industries) and demand (increased digitization of the production sector). The economic impact of ICTs is greater when the different areas of the digital economy are addressed simultaneously. The impact can be measured using simulation models for evaluating and comparing the effects of access policies (mobile telephony and broadband) and policies that promote digitization (use and applications) (Sabbagh and others, 2012; Katz, 2013).

Econometric measures of the economic impact of the expansion of critical infrastructure assess the effects of an increase in the coverage of mobile technology or broadband on GDP growth. These models assume that an expansion of mobile telephony and broadband not only causes a direct effect on investment in infrastructure, but also produces an increase in the total factor productivity of firms, which in turn generates a producer's surplus and an increase in GDP.

Models that simulate the economic impact of the capacity for ICT use or the level of digitization, calculated as a combination of ICT access, use and capacities,[13] measure the impact not only of the adoption of broadband, but also of applications and content. In this case, broadband use is assumed to generate both a producer's surplus and a consumer's surplus by increasing communications and access to information and services on the part of the consumer.

A comparative analysis of the benefits of the knowledge economy in Europe and the United States shows the existence of complementary factors at the firm, industry and institutional levels, which condition the impact of ICTs on productivity and growth. In addition to changes in organizational capital, such as a company's structure and management practices, evidence shows that structural change affects growth and productivity, where structural change is understood as a process that increases the share of knowledge-intensive productive activities, which are associated with a high degree of digitization. According to the sectoral digitization index by Booz & Company, presented in figure III.4, activities with a high degree of digitization pertain to the services sector (financial services, telecommunications, trade and so forth) and advanced manufacturing (electronics, computers, automobiles, machinery and equipment, etc.).[14]

The analysis of the economic impact of increases in the penetration of mobile telephony and broadband infrastructure and an uptick in the digitization index shows that the latter has a greater effect than expanding the coverage of infrastructure (Katz, 2013). In particular, an increase in the digitization index has an impact on per capita GDP growth that is three to four times larger than the impact of an expansion of access, that is, of increased coverage of mobile telephony and broadband considered separately. This result has important implications for public policy recommendations since it indicates that to maximize the impact of ICTs, the development of the digital economy has to go beyond the expansion of infrastructure.

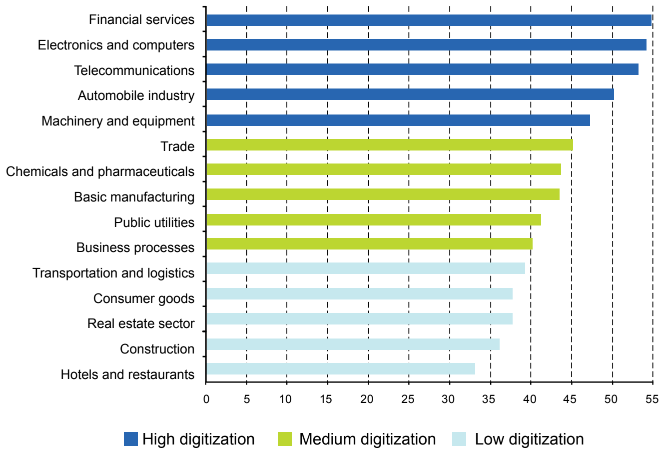
[13] The digitization index used in Katz (2013) is made up of six indicators: affordability of ICT products and services; reliability of digital communications networks; access to broadband, equipment and mobile network coverage; communications network capacity; use of applications and changes in business processes such as e-commerce, government services, mobile data and social networks; and the ICT skill level of the workforce.

[14] The sectoral digitization index from Booz & Company is based on data from the statistical offices of the European Commissions (Eurostat) for businesses with more than 10 employees, considering four dimensions of the digitization process: (i) the level of use of digital processes in the company's operations; (ii) the degree of utilization of digital tools for integrating the company's internal and external processes; (iii) importance of digital processes in commercialization; and (iv) the level of sophistication of the digital connectivity infrastructure (Booz & Company, 2011).

Figure III.4

SECTORAL DIGITIZATION INDEX, 2011

(Index from 0 to 100)



Source: Booz & Company, *Measuring Industry Digitization: Leaders and Laggards in the Digital Economy*, Roman Friedrich and others, 13 December 2011.

If the contribution of ICTs is analysed without taking into account structural change, which incorporates or complements them, then an important part of the growth story is lost. To test the complementarity hypothesis, a simple conditional convergence exercise was conducted, where the explanatory variables included Internet penetration and structural change for 41 countries in 1990-2008. The proxies used for this last variable were the weight of medium- and high-technology exports in total exports (X_MHT/X) and rurality, defined as the percentage of the population in rural areas, which captures the transfer of labour to other industrial activities and services.

The results are presented in table III.1. The coefficient for lagged GDP per capita is negative, as expected in this type of exercise, indicating decreasing returns to the accumulation of capital (homogeneous) or positive technology spillover effects at the international level (catching up). Education has a positive coefficient, as does spending on technological research and development, although this variable is not significant. In the second column, the undervaluation of the real exchange rate (UNDERVAL, defined as a downward deviation from the equilibrium value) is positively associated with growth, as suggested by Rodrik (2008) and McMillan and Rodrik (2011).

Both Internet penetration and the weight of medium- and high-technology exports in total exports are positively associated with growth. The third column of the table shows that when the regression includes an interaction term for structural change and Internet penetration (the product of the proxies X_MHT/X and Internet penetration), the coefficient is positive and significant. The exercise thus confirms the role of these technologies as drivers of growth and, at the same time, suggests that this role complements, rather than substitutes, the role of structural change.

Table III.1
GROWTH, ICTS AND STRUCTURAL CHANGE, 1990-2008

Dependent variable: growth rate of GDP per capita Explanatory variable	(1)	(2)	(3)
Internet	0.03 [a] (0.009)	0.03 [a] (0.008)	
Medium- and high-technology exports	0.05 [b] (0.019)	0.05 [a] (0.018)	
Internet[c] Medium- and high-technology exports			0.05 [a] (0.01)
UNDERVAL index		2.43 [a] (0.86)	2.5 [a] (0.86)
Rurality		-0.2 [a] (0.07)	-0.2 [a] (0.07)
Education measure	9.47 [a] (2.24)	8.65 [a] (2.25)	8.17 [a] (2.24)
Research and development (R&D)	0.64 [c] (0.48)	0.86 [b] (0.49)	0.97 [b] (0.48)
Investment	0.29 [a] (0.03)	0.33 [a] (0.03)	0.34 [a] (0.03)
Lagged GDP per capita (PPP)	-5.51 [a] (1.03)	-6.88 [a] (1.13)	-5.37 [a] (0.07)
Constant	26.83 [a] (7.57)	46.47 [a] (10.27)	34.83 [a] (9.24)
R-squared (within) Hausman test	0.15 Fixed effects	0.17 Fixed effects	0.16 Fixed effects
No. observations	694	694	694

Source: Prepared by the author.
[a] Statistically significant at the 1% level. The dependent variable is the growth of GDP per capita measured at purchasing power parity (PPP). The estimation method is a panel regression with fixed effects. The standard deviations are in parentheses.
[b] Statistically significant at the 5% level.
[c] Statistically significant at the 10% level.

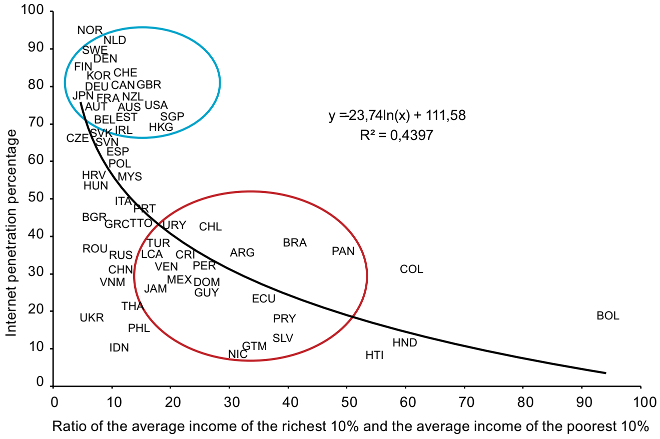
3. The equality dimension

ICTs can serve as an instrument for achieving higher levels of equality through both direct and indirect mechanisms. Direct mechanisms involve the various applications of ICTs for social policy. Examples include the reduction of the gap in telephone and Internet use and the application of digital technologies in education, health, public administration, financial activity and the energy and transportation sectors in order to socially include the poor. Indirect mechanisms work through the boost from ICTs to increase productivity and diversify production, with the corresponding positive effects on high-quality job creation.

Figure III.5 illustrates the relationship between ICTs and income concentration. Countries with greater income concentration have a lower degree of ICT penetration (proxied by Internet penetration). The result is as expected: ICTs are associated with more productive and more diversified production structures, which in turn are associated with a more equitable distribution of income. In this exercise, the more advanced economies already have the advanced complementarities necessary to mitigate the effects of the technological revolution on the wage premium for more qualified workers. Again, a nonlinear function provides the best fit; in this case, the steepest drops in inequality are recorded at the highest levels of ICT use. The figure confirms the hypothesis that the variables mutually reinforce each other and that the virtuous circles are stronger at higher levels of diversification, equality and digital technology use.

Figure III.5

INEQUALITY AND INTERNET PENETRATION, 2009



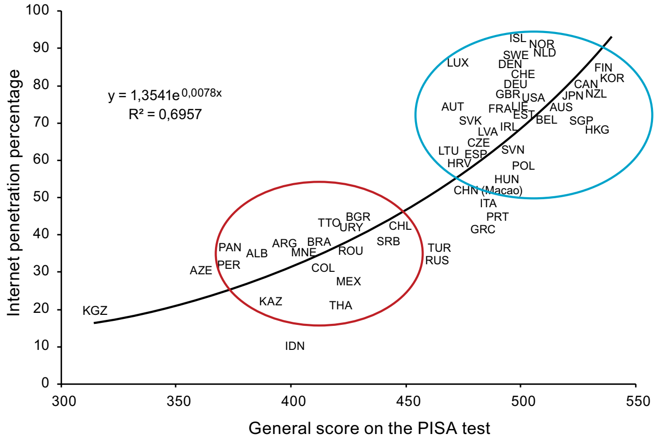
Source: Prepared by the author.

The issue of the impact of technological progress, in particular ICTs, on inequality has been the subject of wide debate. A significant branch of the literature relates the acceleration of technological progress to an increase in inequality. For example, Jaumotte, Lall and Papageorgiou (2009) analyse a panel of 51 countries for 1981-2003; they find that technological change, measured through the share of ICT capital in the total capital stock, has a strong negative effect on the distribution of income, which can be explained by the introduction of a wage premium for highly skilled workers. This occurs in both developed and developing countries, but it is stronger in the latter. The negative impact would be stronger in Asia than in Latin America due to the greater weight of manufacturing in the former, that is, of sectors that are more sensitive to technological change. Similarly, Lansing and Markiewicz (2011), who use a real business cycle (RBC) model, find that the owners of capital benefit much more from technological change —measured through the diffusion of personal computers in the United States in 1980-2007— than do workers, in terms of well-being. Other authors emphasize the impact of other explanatory variables that are not directly related to technology, including changes in the institutional framework of the labour market, changes in social norms, unemployment levels and certain structural processes, such as de-industrialization in several European countries (Atkinson, 2000; Singh and Dhumale, 2004; OECD, 2011, pp. 9-11).

Similarly, the productive diversification and ICT are positively associated with higher educational levels for the same reasons that explain the positive association between ICT and equality. The main direct cause is the impact of ICTs on education, health, access to information (which is increasingly becoming a public good) and social services. The indirect causes are rooted in the relationship between education and the knowledge intensity of the production structure. Education offers capacities that will only be exploited if there is a demand for them, which only occurs when the production structure shifts towards more knowledge-intensive sectors. Figure III.6 illustrates this relationship, measured through the results of the Programme for International Student Assessment (PISA) report.

Figure III.6

ICT USE AND THE PISA TEST RESULTS, 2009



Source: Prepared by the author.

The direction of causality between the production structure, ICTs, equality and education clearly cannot be inferred from the correlation exercises presented. Identifying the forces that are acting in each case is complex, since the interaction between the variables is very strong. Nevertheless, the figures point to a pattern that is consistent with a link between the variables cited, a link that systematically appears weaker in the Latin American countries than in the more advanced economies.

IV. ICT policies for structural change

A. Critical factors

1. Telecommunications infrastructure

The Latin American market for telecommunications services

The Latin American market for telecommunications services represents 10% of the total world market and generated US$ 141 billion in 2010. It has been vigorous and dynamic since the 2000s (ECLAC, 2011) and can be characterized as follows:

- It represents a growth alternative for some of the main international operators, especially from Europe, who are seeking new sources of growth in the face of saturation and increased competition in their home markets;
- It is dominated by transnational corporations and has become one of the main destinations for foreign direct investment (FDI) in most of the countries in the region, with more than US$33 billion in investment announced in 2011 (The fDi Report, 2012);
- It has recorded annual growth rates that are far above the world average, mainly due to the rise in mobile services, which increased their share of the industry from 32% in 2002 to 56% in 2010;
- Fixed-line telephony has had direct competition from mobile telephony, as in other developing regions, which has caused a decline in growth rates for this segment of the industry.

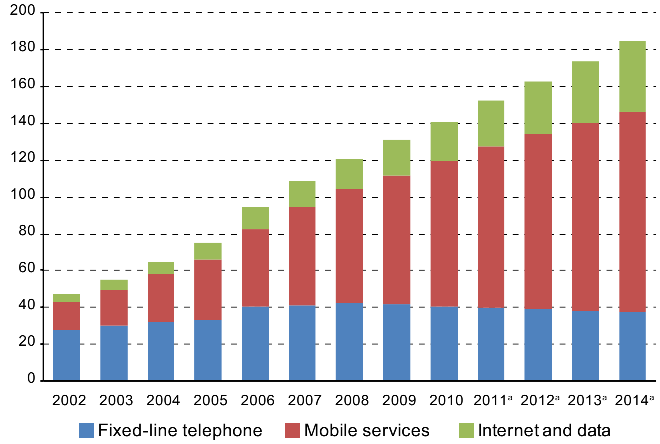
Figure IV.1 shows the evolution of the income structure of the telecommunications services market. A key trend is the declining share of fixed voice services, which fell from 58% of total industry income in 2002 to 29% in 2010. The main companies in the sector have invested a large share of their resources in the deployment of wireless solutions, taking advantage of the existing infrastructure, demographic characteristics and technological advances.

Another important trend in the region is the massive migration of wireless networks to the global system for mobile communications (GSM), which has generated economies of scale, improved the connectivity of the regional infrastructure and facilitated the migration to 3G technologies. Although 3G networks have expanded and now cover a large part of the continent, the penetration of these services is still low in comparison with the advanced economies (see table IV.1). In early 2011, there were 64 3G networks in operation in 27 countries in Latin America. Forecasts show that the share of data services will eventually exceed 30% of total income.

Figure IV.1

LATIN AMERICA: TOTAL INCOME OF THE TELECOMMUNICATIONS SERVICES MARKET, BY SEGMENT, 2002-2010 AND ESTIMATES FOR 2011-2014

(Billions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), *Foreign Direct Investment in Latin America and the Caribbean, 2010* (LC/G.2494-P), Santiago, Chile, 2011, Figure IV.20. United Nations publication, Sales No. E.11.II.G.4.

[a] Projection.

Table IV.1

3G MOBILE COMMUNICATIONS SERVICES, BY COUNTRY AND REGION, 2010

	Japan	Europe	North America	Latin America
Mobile communication users (Millions of people)	117	645	320	564
Penetration of mobile telephony (Percentages)	92	129	93	98
Market share of 3G technology (Percentages)	94	50	31	3
Share of pre-paid phone cards (Percentages)	3	50	12	83
Average income per subscriber (Dollars)	31	20-49	50	14
Data services as a share of mobile services sales (Percentages)	48	27	30	20
Share of smart phones (Percentages)	50	44	43	8

Source: Economic Commission for Latin America and the Caribbean (ECLAC), Foreign Direct Investment in Latin America and the Caribbean, 2010 (LC/G.2494-P), Santiago, Chile, 2011, Table IV.2. United Nations publication, Sales No. E.11.II.G.4.

The rapid growth of mobile data services could generate serious bottle necks among the mobile operators, as has occurred in some more advanced markets, as well as in the region. Avoiding this situation will require adequate policies and investment initiatives. On the one hand, policies will need to be implemented for spectrum allocation and the promotion of mobile broadband usage; on the other, operators have to be willing to invest the necessary resources to offer advanced services at a reasonable price, with broad coverage that is not limited to large urban centres.

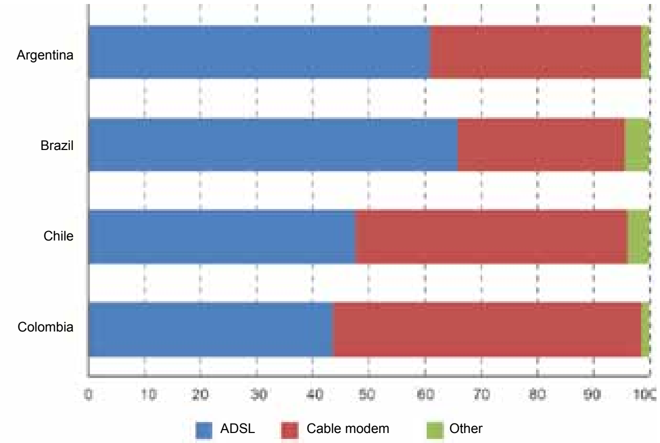
Operators have focused on mobile solutions due to the cost and speed of deployment. However, the region also needs investment in next-generation fibre optic networks, which has been scarce in most countries. This is important because mobile broadband is not a perfect substitute for fixed-line infrastructure, especially for applications that require a large bandwidth.

With regard to broadband access technologies, ADSL and cable modem are still the most commonly used in the region (see figure IV.2), with ADSL accounting for two thirds of access and cable modem for one fourth. The remaining users access the Internet through wireless solutions such as worldwide interoperability for microwave access (WiMAX) or fixed wireless access (FWA).

Figure IV.2

LATIN AMERICA (SELECTED COUNTRIES): FIXED BROADBAND ACCESS TECHNOLOGIES, 2012

(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of *Barómetro CISCO de Banda Ancha 2.0,* 2012.
Note: The source uses the term 2.0 for fixed connections of 2 or more Mbps. and 1.0 for 128 Kbps. or more.

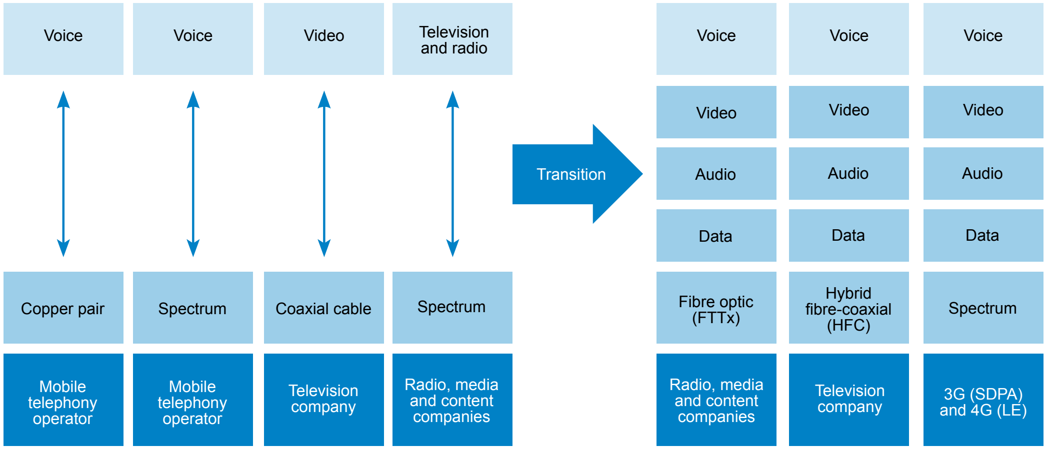
Advanced network investment requirements

One of the main challenges for the telecommunications industry in Latin America is to invest in new network infrastructure and especially to migrate the traditional switched networks to next-generation networks based entirely on Internet protocol (see diagram IV.1). A lag in investment for this transition could generate network saturation in the face of continuous growth of data traffic. The industry is thus facing a dual challenge: to undertake new investments in infrastructure to bring the communication networks up to the required standards for new data traffic services and to maintain the profitability of the services offered with the traditional network infrastructure. The process of reorganizing the industry in Latin America has been influenced by the following factors (ECLAC, 2011):

- The traditional boundaries between voice, data and video traffic are blurring, and the industry's focus is shifting from voice services to broadband. Companies thus face a reduction in income from their traditional fixed and mobile telephony business as a result of the intensive use of social networks and the many applications of voice over Internet protocol (VoIP).
- The new business models and management strategies are oriented towards data traffic, in response to the depletion of traditional income sources. However, over 80% of mobile communication subscribers use pre-paid services, which means that the regional telecommunications market has a low average revenue per user (ARPU). The market for convergent data is limited, as it is confined to high-income segments.
- The telecommunications companies have implemented business strategies that emphasize achieving economies of scale and maximizing profits from their investments in traditional infrastructure, which has held back the spread of the new broadband access technologies.
- There is pressure to invest in infrastructure, mainly next-generation networks, in order to solve the overload problem that the new services and applications generate on the old networks.

Diagram IV.1

MIGRATION OF TRADITIONAL SWITCHED NETWROKS TO NEXT-GENERATION NETWORKS BASED ON INTERNET PROTOCOL



Source: Economic Commission for Latin America and the Caribbean (ECLAC), *Foreign Direct Investment in Latin America and the Caribbean, 2010* (LC/G.2494-P), Santiago, Chile, 2011. United Nations publication, Sales No. E.11.II.G.4.

There is a consensus among the authorities from the countries of the region that investment in broadband infrastructure needs to be higher than it has been to date. To achieve this, it is necessary to generate mechanisms that increase public and private investment so as to match the growth of demand.[15] If the countries of the region are to expand fixed and mobile broadband coverage and increase speeds, in line with more developed countries, the necessary level of investment in infrastructure is far greater than actual investment in the recent period.

[15] See the statement from the sixth meeting of the Regional Broadband Dialogue, available online at http://www.cepal.org/socinfo/orba/.

To estimate the magnitude of the necessary increases in investment, it is useful to compare the evolution of per capita investment in the telecommunications sector in different countries. The data for Brazil, Chile and Mexico, on the one hand, and the United States, Spain and Italy, on the other, show a substantial investment gap in 1990-2010 (see figure IV.3). Investment per capita in the United States is almost five times greater than average investment in the Latin American countries, and three times greater than in the two European countries. The main results of the analysis of the evolution of per capita income in several different countries are as follows:

- The United States has the highest per capita investment, which has evolved over three economic cycles. The first cycle (1993-2000), which corresponds to the period of the greatest ICT diffusion, had the highest growth rate of investment, which doubled. The second (2000-2004) was characterized by the "dot com" crisis, when investment per capita fell more than 30%. Finally, the third cycle, starting in 2005, was a period of recovery, interrupted by the financial crisis of 2008; investment per capita was US$325 in 2005-2007.

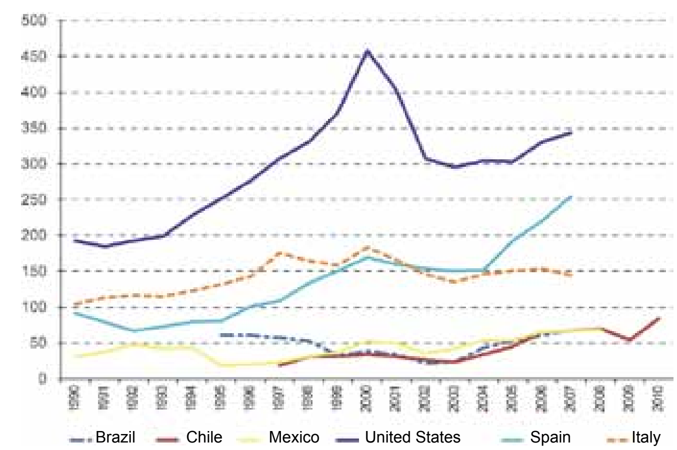
- Spain and Italy display a steady increase in per capita investment, with a slight reduction during the crisis of 2000. In Spain, per capita investment increased between 2004 and 2008, which is explained by the intense ICT diffusion. In 2005-2007, average investment was US$222 in Spain and US$150 in Italy.

- Brazil, Chile and Mexico record a low level of investment and a very slow growth rate relative to the trend in the more developed countries, together with an increase in the investment gap. Of the three countries, only Chile displays convergence of investment per capita starting in 2009. For the 2005-2007 period, average investment per capita was US$60 in Brazil, US$59 in Chile and US$62 in Mexico.

Figure IV.3

PER CAPITA INVESTMENT IN THE TELECOMMUNICATIONS SECTOR IN BRAZIL, CHILE, MEXICO, THE UNITED STATES, SPAIN AND ITALY, 1990-2010

(Dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of LA KLEMS project.

More current data show that while the gap in per capita investment continued to significant in 2012, the most populated countries of the region (Brazil and Mexico) recorded values in line with China. Chile has made tremendous progress, reaching values similar to Spain, Italy and the Republic of Korea as of 2010. Of course, the accumulated stock in the sector is larger in these other countries, since they maintained strong investment per capita throughout the period considered in table IV.2. As expected, the United States continues to have the highest levels of investment per capita.

Table IV.2
PER CAPITA INVESTMENT IN TELECOMMUNICATIONS, 2000-2012
(Dollars)

	Average 2000-2003	Average 2004-2007	2008	2009	2010	2011	2012
Argentina	23.8	20.3	21.0	14.6	16,8	23.2	21.5
Brazil	33.2	32.9	76.3	55.6	64,7	67.9	56.7
Chile	45.7	66.6	104.4	81.8	108,4	116.7	121.7
China	21.5	21.2	33.3	41.5	46,2	53.9	59.9
Spain	148.8	158.4	153.8	119.6	117,7	127.0	115.8
United States	182.3	160.7	265.2	217.7	213,6	216.1	223.2
Italy	137.8	157.9	163.7	143.6	134,8	139.1	124.7
Mexico	40.7	32.9	33.0	24.3	49,9	52.2	52.0
Republic of Korea	150.4	127.1	127.8	103.7	112,1	113.2	106.7

Source: *The Economist Intelligence Unit*, 2012.

2. Endogenous capacities: the applications software industry

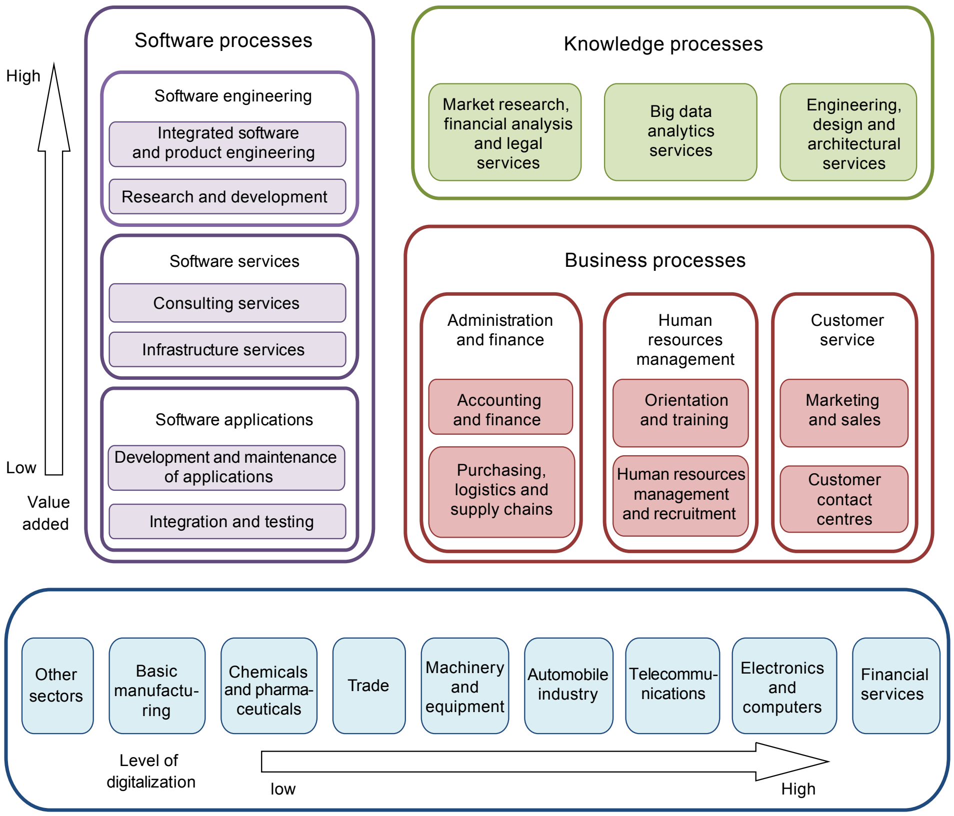
The importance of the applications and software industry lies in its contribution to structural change in developed countries through the transfer and diffusion of new technologies, the creation of skilled jobs and the export of services. International experience shows that the ICT industry, much like manufacturing, is subject to Kaldorian economies of scale, has spillover effects on other sectors of the economy, induces productivity increases and contributes to the diversification of the export supply. It can thus serve as a driver of economic growth in lower-income countries. The industry is characterized by low capital requirements per worker, high value added and opportunities for technological learning.

Amid the convergence of communication networks, hardware equipment and services, software has become the technological core of the industry by providing a platform for this process. The strong international deployment in recent years has occurred in a context of accelerating technological innovation and economic globalization, including the rapid economic integration and opening of large emerging economies, the increasing specialization of world production in global value chains and the internationalization of the services industry. This has evolved as part of the value chain of the applications software industry, characterized by the externalization of software, business and knowledge processes, which is facilitated by ICTs.

Software processes can be classified into three segments according to their proximity to the final user and their value added: applications, services and engineering. Business processes can also be broken down into three segments, based on the degree of specialization: administration and finance, human resources management and customer service. Lastly, knowledge processes and high-value applications are organized by their level of specialization and sophistication into three categories: (i) market research, financial analysis and legal services; (ii) big data analytics services; and (iii) engineering, design and architectural services (see diagram IV.2). Each of these processes makes up part of the value chain of different vertical industries with varying degrees of digitization capacity, such as electronics, telecommunications and financial activities.

Diagram IV.2

SOFTWARE VALUE CHAIN AND ICT APPLICATIONS IN VERTICAL INDUSTRIES



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Gary Gereffi, Mario Castillo and Karina Fernández-Stark, *The Offshore Services Industry: A New Opportunity for Latin America*, Washington, D.C., Inter-American Development Bank (IDB), 2009 and Booz & Company, *Measuring Industry Digitization: Leaders and Laggards in the Digital Economy*, Roman Friedrich and others, 13 December 2011.

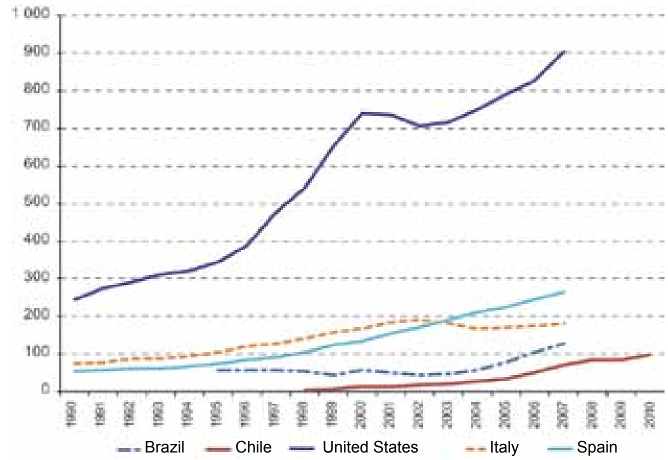
The creation and development of the ICT application software industry has been driven by innovative production clusters, made up of universities, high-level technological centres and leading businesses; angel and venture capital funds; and a culture of entrepreneurship. Based on this initial development, the process expanded geographically through the development of international value chains incorporating countries with available human resources, low costs and sufficient infrastructure, as in some Latin American economies.

The international software industry is dynamic, highly competitive and increasingly globalized, and supply and demand are highly concentrated (ECLAC, 2011):

- International software commerce has grown at rates of over 20% per year. In 2010, the market was US$55 billion for software services and applications and US$30 billion for software engineering. Approximately 26% of production was outsourced, a share that could increase to as much as 50% of the market.
- The United States accounts for more than half of software demand, while companies in the United States and India dominate supply. The biggest demand for applications is from the financial and manufacturing sectors. This trend has intensified in recent years following the buyout and merger of some of the main companies.
- Fast technological change and new consumer needs make the sector extremely competitive. The pressure from competition is reflected in the need to improve service quality, reduce costs and increase system security and reliability; the preference for open source software; and the promotion of cloud computing software versus licensed software.
- Access to global resources is increasingly an option for companies due to the need to take advantage of economies of scale and to establish a global presence. With the exception of sales and marketing activities that require physical proximity to clients and markets, other functions performed by programmers, analysts and engineers can be moved off-site to locations offering a competitive price-quality relation and limited risk.
- Transnational software companies have played an important role, with strategies that have evolved from cost arbitrage to a model of geographically diversified global production.

Figure IV.4 graphs the growth of per capita investment in the software industry in three advanced economies and two Latin American countries. The growth rate was particularly dynamic in the United States starting in 1995, when the development of the digital economy took off. Investment per capita was US$900 in that country in 2007, that is, more than three times the level of Spain, five times Italy, seven times Brazil and 13 times Chile.

Figure IV.4
PER CAPITA INVESTMENT IN THE SOFTWARE SECTOR IN BRAZIL, CHILE, THE UNITED STATES, SPAIN AND ITALY, 1990–2010
(Dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from LA KLEMS project.

B. National broadband policies

1. Challenges for broadband deployment and use

Universal access to broadband continues to be a central objective in the region, given that the service is indispensable for creating opportunities for economic progress and greater equality and participation. In the development of the digital economy, the transmission capacity of the access networks is crucial for taking full advantage of next-generation applications such as e-commerce, e-government, e-health and e-education. The true economic and social potential of tools such as real-time remote diagnostics, interactive multimedia computer programmes for learning or the smart management of transportation and energy resources can only be realized with high connection speeds.

The discussion of Internet and broadband diffusion presented in section I.C revealed that the region lags far behind the OECD countries in terms of fixed and mobile broadband penetration. The low penetration of broadband is conditioned by both demand and supply factors. The demand factors are structural in nature and are associated with socioeconomic variables such as skill levels, age, geographic location and income level. The relevant supply factors include the delay of high-speed networks, international linkages, the difficulties for local content storage and lack of competition in international connectivity. All these factors have a negative effect on the spread of broadband use, the affordability of the service (measured as the ratio of tariffs to per capita income) and service quality.

The main public policy recommendations for addressing the problem of slow demand can be classified into four areas of intervention: first, policies to promote competition to achieve price reductions through rivalry between platforms and between services on the same platform; second, access policies focused on specific segments of the population through the elimination of taxes on basic connectivity plans for low-income households and individuals and the public subsidization of low-cost connectivity plans; third, skill-development initiatives in the formal education system and continuing education programmes; and finally, public initiatives for supplying applications with a high value added for users (Katz and Galperin, 2013).

The diagnosis of Internet connectivity in South America reveals a set of limiting factors associated with economies of scale, access costs, imperfect direct regional connectivity and insufficient content storage (de León, 2013):

- Economies of scale. Due to the size of the population, the distribution of income and the level of per capita income, the region's markets cannot achieve the economies of scale found in the developed countries, which allow the supply of high-quality, affordable services. To overcome this limitation, governments need to support the deployment of broadband, as they do for other infrastructures, in order to move towards greater equality.

- Cost of international internet access. The countries of Latin America face higher costs for accessing global Internet due to the limited availability and high concentration of international connections. This adds between 20% and 40% to the final service price.

- Imperfect direct connectivity between countries of the region. The high cost and low quality of Internet access in the region derives, in part, from the need to go through two international long-distance carriers to get from one country to another. The efficient alternative is to establish direct connections between countries through national internet exchange points (IXP). In the region, there are only 32 active IXPs, and many countries do not have IXPs or have IXPs that do not fully cover national interconnection.

- Remote content storage. The high cost of storage in the region adds an additional cost to Internet access because users have to use international transit to access even locally produced content.

2. Broadband policy areas

A national broadband strategy must be formulated at the highest political level, and its infrastructure must be considered an essential part of the digital economy ecosystem (see diagram I.1 in chapter I). The strategy must include three main components and the public policy institutional framework. The first component is the infrastructure and services associated with national and international networks, local networks and public access points. The second encompasses the production and distribution of access equipment and the development of applications and content. The third is the consumers of broadband services, that is, individuals, companies and governments.

The institutional policy framework includes ICT policies in general, regulatory policies, spectrum management, private investment financing, public financing and access funds, policies to promote demand and training programmes. The strategic objectives of national broadband policies are the following:

- Penetration levels near the medium-income OECD countries, with a focus on schools, small businesses and the poorest households.

- High-quality broadband services in line with international standards in terms of speed and latency.
- Competitively priced broadband services compatible with the average family income in the region.
- National and regional applications and content oriented towards satisfying the needs of the sectors that are furthest behind in terms of broadband use.

Achieving these strategic objectives will require progress in the following action areas:

- International coordination. Regionally coordinated public policies to improve regional and international connectivity through infrastructure initiatives (regional fibre optic rings and new submarine cables to the United States and Europe) and regulatory initiatives (implementation of new IXPs).
- Regulation. Adjustment of the regulatory and normative framework to enhance technological convergence, taking into account the development of open networks, the promotion of competition between services and platforms, efficient management of resources such as the radio-electric spectrum and the principle of technological neutrality.
- Public infrastructure. Coordination, subsidies or direct investment in the expansion of broadband infrastructure, especially for public education and health systems, the lower-income population, rural areas and small cities.
- Policies for ICT skills development. Implementation of programmes to develop applications and content for small businesses, schools and lower-income households; promotion of e-commerce and other business management support tools; improvement and expansion of electronic government services and content; development of advanced applications in the areas of telecommuting, education and health, transportation and the environment; and promotion of investment in data centres and content storage infrastructure.
- Financial institutional framework. Implementation of long-term financing arrangements for investing in broadband infrastructure, the development of application projects and new enterprises, regulatory improvements to promote electronic payment means and the financial inclusion of lower-income sectors.
- The promotion of ICT research and development through technological alliances and consortia in areas of technological convergence, such as mobile broadband, cloud computing, Web 2.0 and big data analytics.

C. Industrial policy for the digital economy

1. Challenges for industrial policy

The main challenge for structural change in the ICT era is the design and implementation of an industrial policy for the digital economy oriented towards developing new technological and productive paths. This requires the use of public incentives to reorient investment decisions towards sectors that can transform the production structure, incorporate higher value added, create high-quality jobs and generate and diffuse productivity increases throughout the economy. An industrial policy for the digital economy must consider two priority objectives:

- The development of the software industry to create new sectors that are highly productive and dynamic.
- The development of digital competencies to increase efficiency and productivity in small and medium-sized businesses.

The structure of sectoral returns depends on technological and productive capacities developed through experience and training gained under the old productive system. The mutation to a new system is not spontaneous; it requires industrial and technologies policies, as shown by historical experience. Furthermore, policies that favour socially and environmentally sustainable structural change must be implemented quickly because the windows of opportunity will not be open indefinitely. In the initial stages of change, policies have more freedom to choose between technological paths and paradigms. At a certain point, growing returns and hysteresis start closing off options and boxing in learning paths. It becomes more difficult to change paths, because there is a "block" in learning processes and capacities. Therefore, the dialogue to raise awareness and generate consensus on the need for active policies to promote a new growth pattern is critical for structural change.

Achieving a new production structure requires more than the ability to buy advanced technologies. It requires strong social and market demands that clearly signal that it is profitable to invest in the production and implementation of new technologies for sustainable activities that promote greater social inclusion. As discussed in ECLAC (2012), investment is the bridge between the present and future; the magnitude and direction of investment today define the structure of tomorrow. The region is undergoing a process of transformation that centres on investment decisions; altering them requires altering the selection environment.

For many years, economists have debated whether industrial policies should be horizontal or vertical. Today, that question is outdated, given the magnitude of the challenges to be addressed. The new issues are about redefining entire growth paths, a new technological and productive landscape, a new way for cities to function, a new culture of production and consumption, a new insertion in the world economy.

Public investment plays an important role because while it is quantitatively small relative to private investment, it generates important complementarities and crowding-in effects. Investing in advanced branches or sectors (which are large scale or technology intensive) may not be attractive for the private sector, especially if they represent high risk or low returns. Direct investment by the public sector can thus open up new areas for private investment. To the extent that the market cannot efficiently resolve the coordination problems inherent in changing production and growth patterns and redefining technological paths, industrial policy is the only way to bring about the convergence in expectations and resources necessary for a leap of such magnitude.

2. Development of the software industry

Status and progress

The offshore software industry is transitioning towards the consolidation of a global services supply model. In this scenario, Latin America could establish itself as an important centre, like India, China and Eastern Europe, thanks to the transnational corporations' new strategies aimed at combining global operations in different time zones, cost levels and operational risk. The evidence on industry trends in internationalization shows that the number of projects being developed in international locations was relatively stable in 2004-2008 and then fell sharply in 2009-2010, as a result of the international crisis. Between January 2003 and November 2010, there were 2,749 investment projects, which were mostly located in India (24%), China (10%) and the United States (10%). Latin America captured 5.7% of total projects, compared with 48% for Asia and the Pacific, 21% for Western Europe and 9.5% for Eastern Europe (see table IV.3).

Table IV.3
SOFTWARE PROJECTS BY REGION
(Number of projects)

Region	2003	2004	2005	2006	2007	2008	2009	2010	Total
Asia and the Pacific	172	226	187	199	134	180	110	92	1 300
Western Europe	34	56	71	80	90	98	81	64	574
North America	11	25	27	13	51	72	65	81	345
Rest of Europe	21	27	34	56	34	36	21	30	259
Latin America and the Caribbean	12	11	12	19	25	22	33	25	159
Middle East	4	3	3	18	4	15	3	8	58
Africa	8	2	8	8	6	13	6	3	54
Total	262	350	342	393	344	436	319	303	2 749

Source: Economic Commission for Latin America and the Caribbean (ECLAC), *Foreign Direct Investment in Latin America and the Caribbean, 2010* (LC/G.2494-P), Santiago, Chile, 2011, Table V.3. United Nations publication, Sales No. E.11.II.G.

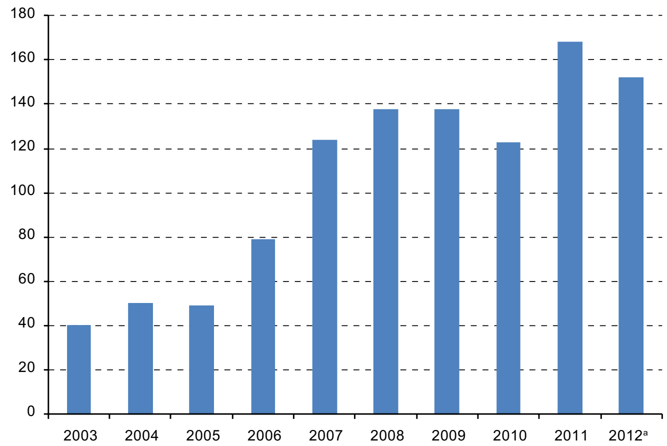
After the start of the crisis, the number of projects fell in Asia and the Pacific and Eastern Europe, while they were stable or increased in North America and Latin America. The main companies developing software projects at the world level were IBM, Microsoft, HP, Oracle, SAP, Google, Sun Microsystem, Fujitsu, Siemens and Capgemini, which accounted for 22% of the total.

The number of projects in Latin America and the Caribbean grew relative to the rest of the world after the financial crisis (see figure IV.5). Despite the international slowdown of the industry, the region captured a record number of projects in 2011 and 2012, with more than US$2.7 billion in technological services and software projects announced in the two-year period (fDi Markets, November 2012).

Figure IV.5

TECHNOLOGICAL SERVICES AND SOFTWARE PROJECTS ANNOUNCED IN LATIN AMERICA AND THE CARIBBEAN, 2003-2012

(Number of projects)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of fDI Markets, November 2012.
[a] Data for January-November.

The importance of the software industry in the region can be seen in the sharp increase in billing and exports. Table IV.4 presents estimates for seven countries, all of which recorded high growth rates. However, export levels are low relative to billing when compared with international successes such as Ireland and India. With the exception of Costa Rica and Uruguay, the software industries have mainly focused on domestic markets, although there have been signs of a change in trend in recent years, especially in Argentina, Chile and Mexico.

Although there are huge cross-country differences in terms of the size and development of the software industry in the region, the countries can be roughly divided into three groups: (i) countries with large, dynamic markets and an industry oriented towards the domestic market, such as Brazil and Mexico; (ii) countries with small markets and an export-oriented industry, such as Costa Rica and Uruguay; and (iii) countries with medium-sized markets and an industry oriented towards both the domestic and export markets, such as Argentina, Chile and Colombia.

Table IV.4

LATIN AMERICA (7 COUNTRIES): ESTIMATES OF BILLING AND EXPORTS IN THE SOFTWARE INDUSTRY

Country	Software billing	Software exports	Ratio of exports to billing
	(millions of dollars)		(percentages)
Argentina			
2003	943	170	18
2009	2 440	547	22
2010	2 834	629	22
Brazil			
2004	9 349	262	3
2006	16 884	885	5
2009 [a]	29 400	2 200	7
Colombia			
2002	614	21	3
2009	1 331	35	3
Costa Rica			
2006	173	80	46
Chile			
2008	1 165	270	23
2009	1 219	…	…
Mexico			
2006	2 400	500	21
2008	4 617	…	…
2009	…	1 400	…
Uruguay			
2004	226	76	34
2008	500	219	44

Source: Economic Commission for Latin America and the Caribbean (ECLAC), *Foreign Direct Investment in Latin America and the Caribbean, 2010* (LC/G.2494-P), Santiago, Chile, 2011, Table V.6. United Nations publication, Sales No. E.11.II.G.4.

[a] Includes hardware.

The development of the software industry in Brazil and Mexico, and to some extent Argentina, is largely explained by their earlier industrialization strategies, through which they developed a manufacturing base and a specialization in computers and electronics. This industrialization process led to the attraction of the largest hardware companies of the time, the transfer of new ICT-related technologies and the development of specialized human resources. The main difference between Brazil and Mexico lies in the fact that the main attraction of the former was its domestic market and the latter, its proximity to the United States. The economic reform processes of the 1990s coincided with outsourcing to Latin America by software companies, as a result of the relocation of the hardware and electronics industry to China and other countries in Asia. The main hardware companies with a presence in Brazil and Mexico, such as IBM, HP and Unisys, began to transform their manufacturing plants into service centres, to take advantage of the infrastructure and skilled labour. Consequently, the main software development centres in Latin America are currently located in areas that previously had a strong specialization in electronics, such as São Paulo, Guadalajara and Monterrey.

At the same time, large software suppliers from the United States began to explore alternative locations close to their home market, mainly in Mexico, and they installed a number of basic ICT service centres; examples include EDS, at that time an affiliate of General Motors, and Affiliated Computer Services (ACS). These were followed by European software companies, such as SAP and Siemens, and a wave of Indian suppliers such as TCS, Infosys, Wipro and HCL. In addition, the development of the electronics industry in Brazil and Mexico provided the basis for a wide range of new enterprises. The largest local companies with an international presence include CPM, Politec, Ci&T, TIVIT, TOTVS and Stefanini in Brazil and Softtek, Neoris and Hildebrando in Mexico.

Policy guidelines

The majority of the countries in Latin America have, to a greater or lesser degree, defined and implemented policies and programmes to support the software industry and to promote and attract FDI. The programmes that have been adopted combine special laws, regimes and promotion activities with incentives that directly or indirectly favour foreign investment in the sector. Most of the seven countries considered have investment promotion bodies, such as APEX in Brazil, the Foreign Investment Committee in Chile, Proexport in Colombia and CINDE in Costa Rica, as well as ProMexico and Uruguay XXI.

Public programmes to support the software industry combine four types of initiatives: (i) incentive programmes for the hardware industry that have been reoriented towards the software sector; (ii) programmes with legal measures to support local industry and the development of software exports; (iii) programmes to attract FDI in software, centred on international promotion and incentives; and (iv) technological innovation programmes that address the critical issues in the industry, mainly human capital formation and research and development capacities. Countries with a long-term industrial support policy are notable for their base of complementarities in higher education, research and development, the legal framework and the local production structure, which enables FDI to produce substantial effects in terms of human capital formation, technology transfer and export growth.

Given the existence of important software development centres in the region, the new public policy challenges are not only to facilitate and promote FDI in the local software and related industries, but also to maximize the positive effects on productivity, human resources formation and technology transfer and innovation. This requires new policies that integrate the development of this industry with the national innovation systems. These policies should address the following gaps:

- Innovation policies are needed to integrate the software industry and software firms with the national and local innovation strategies, addressing issues such as the development of human resources, technology innovation and the promotion of new projects;
- Institutional policies should enhance the public-private institutional mechanism in order to design and implement programmes for developing the sector, with the cooperation of key actors;
- Programme policies need to adopt more effective programmes and incentives to generate a positive impact on the development of the sector and to secure the necessary budgetary resources for implementing them.

3. Incorporation of ICTs in small and medium-sized businesses

Status and progress in the region

Latin American firms have been slow to incorporate ICTs, especially the more sophisticated applications. The region's structural heterogeneity affects the possibilities for ICT access and diffusion in businesses. A large share of the firms in the region are characterized by low productivity and an inadequate organizational structure, which makes it harder for them to adapt to these technologies. Moreover, they generally have significant financial restrictions and limited human resources which prevent them from accessing even the most basic ICT infrastructure. The diffusion of these technologies is further hindered by the weakness of the most ICT-intensive economic sectors in almost all the countries in the region. In addition, within each country, there are very high productivity gaps between micro-businesses and SMEs, on the one hand, and large companies, on the other, which reflect huge differences in capacities, technology, internationalization and wages.

Nevertheless, there has been a sharp increase in the incorporation of basic ICTs in SMEs, which is between 80% and 90% in small businesses and almost 100% in medium-sized firms (see table IV.5). This has not, however, reduced the productivity gap between the groups. This reflects the limitations of policies aimed at promoting the incorporation of ICTs in firms. The greater use of PCs, web pages and Internet connections has not changed the business model of SMEs to any great degree. The cost reductions associated with the introduction of basic ICTs have not been accompanied by significant changes in the organization of work, workers' capacities and management systems. Policies have essentially been horizontal, with no ability to affect the specific needs of firms in terms of their internal organization and the sectoral characteristics of production processes.

As the incorporation of ICTs expands, the need for specific systems and applications grows. In this sense, these technologies have ceased to be general purpose technologies, which creates room for policies oriented to supporting both the supply and demand of ICTs.

Table IV.5
ICT PENETRATION IN INDUSTRY, TRADE AND SERVICES, BY FIRM SIZE
(Percentages)

	Country	Year	Small	Medium	Large	Total
Firms with computers	Argentina	2010	83	96	99	89
	Brazil	2011	98	100	100	99
	Chile	2011	81	95	96	83
	Colombia	2008	99	100	100	99
	Costa Rica	2009	96	98	100	97
	Peru	2007	64	100	100	79
	Uruguay	2007	90	93	96	90
Firms with Internet connection	Argentina	2010	79	96	99	87
	Brazil	2011	97	100	100	98
	Chile	2011	78	94	97	81
	Colombia	2008	97	100	99	98
	Costa Rica	2009	93	97	100	96
	Mexico	2008	89	94	97	-
	Peru	2007	61	97	92	75
	Uruguay	2007	85	93	96	87
Firms that use Internet for transactions with governmental agencies	Argentina	2010	43	70	86	57
	Brazil	2011	64	78	87	70
	Chile	2011	21	37	53	25
	Colombia	2008	50	69	79	58
	Costa Rica	2011	-	-	-	72
	Peru	2007	22	46	47	33
Firms that use Internet for banking and financial services	Brazil	2011	81	91	92	83
	Chile	2011	68	83	91	72
	Colombia	2008	80	90	90	84
	Costa Rica	2011	-	-	-	93
Firms with their own web page	Argentina	2010	52	73	83	63
	Brazil	2011	49	75	91	59
	Chile	2011	29	57	77	36
	Colombia	2008	42	70	84	54
	Costa Rica	2011	-	-	-	78
	Uruguay	2007	45	60	75	48
Firms with intranet	Argentina	2010	15	33	60	26
	Brazil	2011	34	49	72	42
	Chile	2011	17	39	63	17
	Colombia	2008	19	38	64	28
	Costa Rica	2009	35	58	78	48
	Uruguay	2007	22	35	54	26
Firms with extranet	Brazil	2011	27	41	54	34
	Chile	2011	3	16	35	7
	Colombia	2008	6	12	26	9
	Costa Rica	2009	18	30	46	25
	Uruguay	2007	12	21	32	14
Firms that place orders over the Internet	Argentina	2010	21	24	25	23
	Brazil	2011	54	68	68	59
	Chile	2011	11	14	14	11
	Colombia	2008	41	49	50	44
	Costa Rica	2011	-	-	-	58
	Uruguay	2007	36	49	54	39
Firms that take orders over the Internet	Argentina	2010	18	22	23	20
	Brazil	2011	11	14	18	12
	Chile	2011	7	8	10	7
	Colombia	2008	45	51	50	47
	Costa Rica	2011	-	-	-	54
	Uruguay	2007	37	47	44	39
Firms that have implemented ERP	Argentina	2010	21	31	59	29
	Brazil	2011	23	50	75	35
	Chile	2011	25	66	87	34
Firms that have implemented CRM	Argentina	2010	6	13	31	11
	Brazil	2011	23	31	44	27
	Chile	2011	6	17	34	9

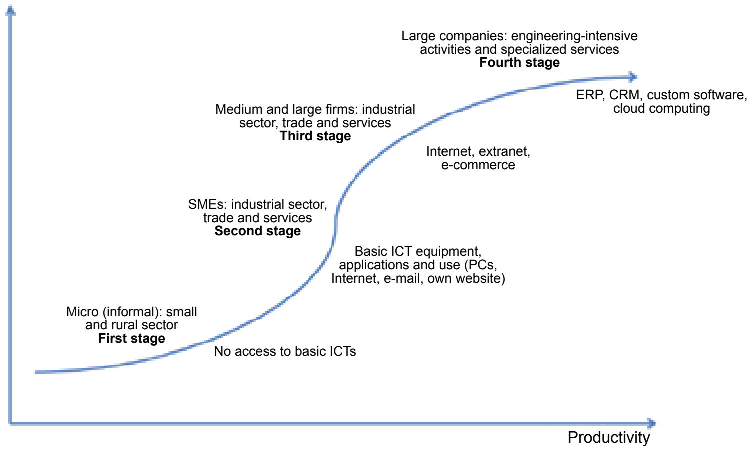
Source: Sebastián Rovira, Pietro Santoleri and Giovanni Stumpo, "Incorporación de TIC en el sector productivo: uso y desuso de las políticas públicas para favorecer su difusión", *Entre mitos y realidades. TIC, políticas públicas y desarrollo productivo en América Latina* (LC/L.3600), Sebastián Rovira and Giovanni Stumpo (comps.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), 2013, table I.2.

Note: The data are not comparable between countries due to methodological differences in data collection and the representativeness of the data.

Diagram IV.3 characterizes the incorporation of ICTs in firms as an evolutionary process, with minimum thresholds of technological infrastructure necessary for moving up into more mature, more advanced stages. Moving out of one stage and into another requires significant efforts and complementarities in terms of business organization and capacities. In general, there are four stages of technological development related to the intensity of ICT use and incorporation. The status of this evolutionary process in the region is as follows (Rovira, Santoleri and Stumpo, 2013):

- Most of the production sector, in particular smaller firms, is in the first or second stage of the intensity of ICT use.
- The first stage, characterized by lack of access to basic ICTs such as a PC or the Internet, encompasses mainly formal micro- enterprises, some small formal companies, informal businesses and many farms and ranches. These enterprises, which account for a large share of the business world, are excluded from the new technological paradigm.
- The second stage, when basic ICTs like the Internet and electronic mail begin to be incorporated, describes a large percentage of Latin American businesses, including the majority of the SMEs. Many industrial activities, some services and most trade-related activities are operating at this stage.
- A smaller percentage of businesses are in the third stage; these are mostly medium-sized and large firms concentrated in industrial activities and more specialized services.
- Finally, in the fourth stage, the use of ICTs involves adapting the firm's equipment and personnel capacities. A very small percentage of Latin American businesses are in this stage, mainly some large companies (transnationals or large nationally funded corporate groups) and a range of firms operating in highly technology-intensive industrial sectors and specialized services.

Diagram IV.3
STAGES OF ICT INCORPORATION IN FIRMS



Source: Sebastián Rovira, Pietro Santoleri and Giovanni Stumpo, "Incorporación de TIC en el sector productivo: uso y desuso de las políticas públicas para favorecer su difusión", *Entre mitos y realidades. TIC, políticas públicas y desarrollo productivo en América Latina* (LC/L.3600), Sebastián Rovira and Giovanni Stumpo (comps.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), 2013.

The digital agendas in the region include few policies to promote the incorporation of ICTs in businesses. Of the 26 countries in the region with a defined digital agenda, only 11 include a strategic component for ICTs in the production sector. Furthermore, this component only addresses SMEs and does not aim to improve the productivity and competitiveness of the production structure as a whole. This contrasts with the policies implemented in more developed countries; for example, the *Avanza* plan in Spain integrates initiatives for citizenship, the economy, the ICT context and public services, giving priority to the digital economy, infrastructure, security and digital content.

While the issue of production and productivity has little weight in digital agendas, the countries of the region do have a number of specific programmes that promote the incorporation of ICTs in this sector, for example in Argentina, Brazil, Colombia, Costa Rica and Mexico (see table A.VI-1 in appendix VI).

As described earlier, several countries in the region have a software-producing sector that has developed growing technological and productive capacities. However, there are few initiatives to coordinate the national supply of ICT-based services with the specific demands of smaller firms. Such initiatives can stimulate the development of markets for these services and technical assistance aimed at SMEs. In the past few years, the region has begun to implement some initiatives to stimulate the matching of ICT supply and demand; examples include the PROIMPE programme in Brazil, components of the Digital MSMEs programme in Colombia and of PROSOFT in Mexico, and a pilot project being implemented in Uruguay by the Ministry of Industry, Energy and Mining (Plottier, Rovira and Stumpo, 2013).

Some government actions indirectly promote the incorporation of ICTs in businesses. In recent years, there has been an increase in web-based public procurement programmes: ChileCompra, Argentina Compra, Comprasnet in Brazil, Compranet in Mexico and in Peru. Other programmes that do not actively pursue the objective of promoting ICT uptake and use have nonetheless stimulated their diffusion in firms; examples include the Internet-based electronic factoring and liquidity system set up by the development bank Nacional Financiera (NAFIN) in Mexico and the *Cartão BNDES* programme of the National Bank for the Economic and Social Development (BNDES) in Brazil.

Challenges and policy guidelines

The design of policies that favour the introduction and effective use of ICTs in businesses in the region presents several challenges. The countries of Latin America vary widely in terms of their characteristics and institutional capacities for intervening with business development policies. From the perspective of public initiatives, it is necessary to consider actions aimed at incorporating ICTs in industrial policies, making them central to the strategies for changing the production structure, modernizing the business model of firms and increasing the economy's competitiveness. In this area, the following policy guidelines can help improve the general environment and specific factors associated with business characteristics and technologies (Rivas and Stumpo, 2011):

- Infrastructure. In the region, many ICT-based applications are limited by problems of service quality, cost and coverage.

- Human resources formation. Developing management and worker capacities must be a priority in the strategies for using ICTs to improve company performance.
- Legal and regulatory framework. It is necessary to promote the use of ICT-based instruments such as electronic billing, certified e-mails, electronic signature and, in general, all operations carried out between consumers and businesses. The legal framework must guarantee the security of these instruments and operations, and the legal and institutional tools must be available for implementing that security.
- Business services and the development of the local ICT industry. There is room for the creation of specialized services, based on local capacities, offering solutions that are currently unavailable to many firms. Countries that have internationally competitive software industries should encourage them to address the needs of local businesses.
- Public digital services. Public online services and government electronic marketplaces can motivate ICT use by firms and, especially, promote the introduction of operations and management mechanisms that require ICT use.
- Information systems. The formulation of policies and the design of specific instruments requires more detailed, precise and current information that is currently available in the majority of the countries in the region. The construction of information systems based on ICT incorporation and use by firms would allow countries to monitor and evaluate the results of their policies.

At the firm level, ICTs can contribute to generating efficiency and productivity gains, thus becoming a tool for enhancing competitiveness in a globalized environment. For these benefits to materialize, investment in these technologies needs to be accompanied by other complementary investments that induce changes within firms and raises their productivity.

V. ICTs for equality and social inclusion

A. ICTs in education

1. Status and progress

In order for ICTs to fulfil their promise in education, minimum conditions must be met in terms of access, use, capacities and content, and they have to advance simultaneously. The existence of an ICT education policy is critical for developing these conditions. The incorporation of digital technologies in education is not a new trend in the region: some countries having been promoting these types of proyects in education for around two decades. The channel through which these countries introduced ICTs in education was, first and foremost, public policy, in the form of plans, programmes and projects that were launched early on, even before the implementation of any national ICT strategy.

Beyond initial aspirations, at the outset, the projects and programmes were strongly oriented towards providing infrastructure, mainly through the installation of computer laboratories. These projects evolved and were expanded into other areas, such as the provision of basic connectivity, teacher training, the application of 1:1 models (one computer per student) and the installation of broadband in schools (see table A.VII-1 in appendix VII). As part of this process, many countries have enacted ICT policies in education, which imply the creation of a new institutional framework and the allocation of greater resources. They have also contributed to shaping a vision of education as a strategic space in the transition towards the information society. Table V.1 outlines the objectives of some of the main national initiatives in eight countries in the region.[16] In addition to the installation of infrastructure, the initiatives cover key dimensions for achieving better results from the strategies for incorporating ICTs in education, revealing a learning process that continues today.

[16] Educational achievements can be divided into competences for the twenty-first century and learning for the curriculum. The former category alludes to a wide set of skills that are indispensable for successful performance, such as expertise in digital technologies, information management (including search, synthesis, analysis and representation), problem solving, critical thinking, collaboration, teamwork, autonomy, creativity and innovation. Learning refers to material in language, mathematics, science and history.

Table V.1

ICT INITIATIVES IN EDUCATION, BY MAIN AND COMPLEMENTARY OBJECTIVES

Objetive	Quality	Equality			Efficiency	
Iniciative	Educational achievement	Social equity	Vulnerable groups	Secondary coverage	Management Resources	Repetition, failure Dropout
A. Policies						
PRONIE (Costa Rica)	Competences	●				
Enlaces (Chile)		●				
Ceibal (Uruguay)	●	Social inclusion				
Colombia-Aprende	Learning	●			●	
B. Programmes						
Uantakua (Mexico)	●		Indigenous			
PIED (Argentina)	●		Disabled			
Centro de Medios (Brazil)				Isolated rural		
AFT-Proniño (Panama)	●					Child labour

Source: Ignacio Jara, "Dimensiones relevantes para tomadores de decisiones", *Las tecnologías digitales frente a los desafíos de una educación inclusiva en América Latina: algunos casos de buenas prácticas* (LC/L.3545), G. Sunkel and D. Trucco (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), 2012.
Note: The rectangles represent the main objectives; the circles, the complementary objectives.

The international debate has highlighted the need for countries to have a formal ICT policy for the education sector, and international organizations are increasingly advocating for the formalization of these policies. Progress has been limited, however: not all the countries in the region have officially published an ICT policy for education, even though the vast majority (92%) have a specialized unit for computers in education within the ministry of education, which is charge of implementing initiatives in this area.

With regard to the goals of ICT policies for education, figure V.1 shows that most countries have targeted their initiatives to changing teaching and learning practices, improving school management and developing student and teacher competence in ICTs. These goals are in line with international trends, which point to the key factors for achieving an effective use of ICTs in education (Barber and Mourshed, 2007). Less frequent goals include improving policy management in the ministry, enhancing student learning and expanding educational coverage.

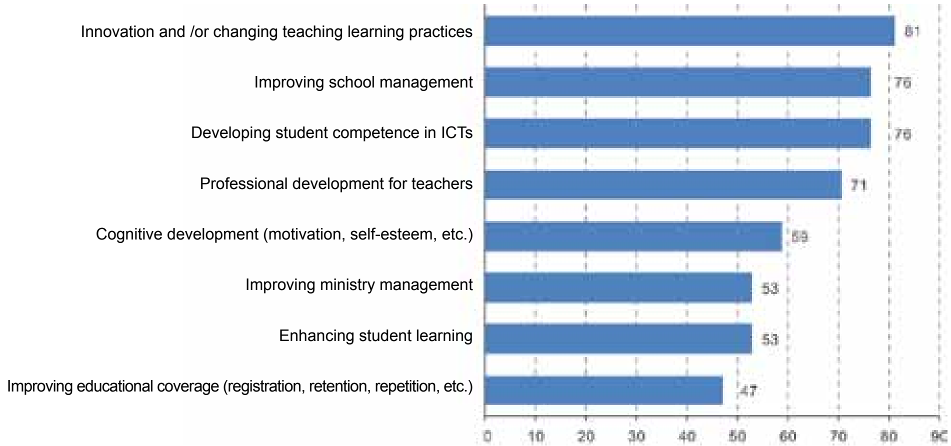
The assessment of the progress and achievements of ICTs in education takes into account factors such as access, use and uptake, as well as content. The main findings are as follows:

Access to ICTs. In the last decade, there has been substantial progress on the incorporation of digital technologies in the education systems of many countries in the region, especially in terms of access and infrastructure. Indicators include the number of students per computer and the share of schools with an Internet connection. In Latin America, 35% of educational institutions, on average, are connected to the Internet, but there is strong variation among the countries (see figure V.2). There are lags relative to developed countries, involving the full range of the enabling infrastructure for ICTs, especially broadband Internet, which affects data transmission quality and speed.

Figure V.1

LATIN AMERICA AND THE CARIBBEAN (17 COUNTRIES): EXPLICIT OBJECTIVES OF NATIONAL ICT POLICIES FOR EDUCATION

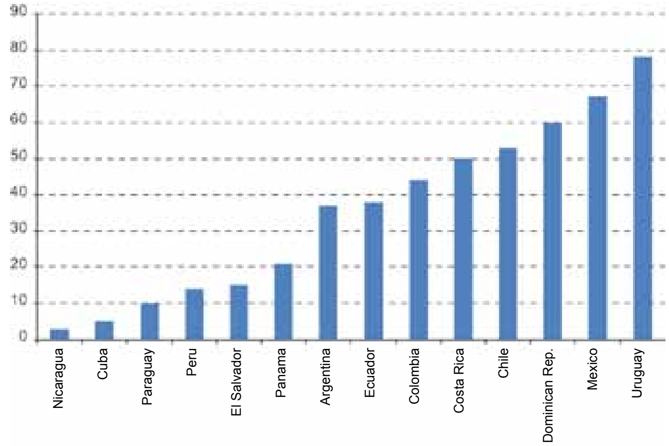
(Percentage of countries)



Source: J.E. Hinostroza and C. Labbé, "Políticas y prácticas de informática educativa en América Latina y El Caribe", *Políticas Sociales series*, No. 171 (LC/L.3335-P), Santiago, Chile, 2011. United Nations publication, Sales No. S.11.II.G.53.

Figure V.2

PERCENTAGE OF EDUCATIONAL INSTITUTIONS WITH ACCESS TO THE INTERNET IN LATIN AMERICA AND THE CARIBBEAN (14 COUNTRIES), 2010

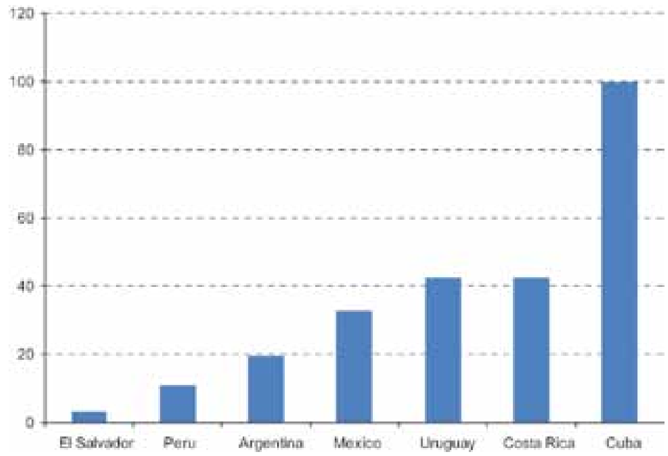


Source: J.E. Hinostroza and C. Labbé, "Políticas y prácticas de informática educativa en América Latina y El Caribe", *Políticas Sociales series*, No. 171 (LC/L.3335-P), Santiago, Chile, 2011. United Nations publication, Sales No. S.11.II.G.53.

ICT use. From the education system perspective, differences in social capital prevent the opportunities represented by ICTs from being fully exploited by the students; the segmentation of public and private schools has a strong impact in this area (Kaztman, 2010). Since students in private schools normally come from high-income households, teaching in these establishments benefits from having a greater share of students socialized within digitized family environments. Data from the 2009 PISA test indicate that students say they use ICTs more frequently at home than at school.

Apporiation of ICT. A fundamental component of exploiting ICTs for educational purposes is the capacity of teachers, administrators and students to use them at a suitable level. Teachers are key for linking ICTs with student learning processes. In order for them to fulfil this role satisfactorily, ICTs need to be incorporated in their training, starting with their early professional preparation and continuing throughout their teaching careers. Not only should teachers receive adequate training for understanding and handling technological equipment and applications, but they should also contribute to the assessment of the effects and limitations of ICT use in learning strategies. Teacher training efforts have mainly focused on primary and secondary education, have varied widely and have generally been aimed at in-service teachers. With the exception of Cuba, teacher training has not had broad coverage in practice (see figure V.3).

Figure V.3
PERCENTAGE OF TEACHERS TRAINED IN THE USE OF ICTS IN LATIN AMERICA AND THE CARIBBEAN (7 COUNTRIES), 2010



Source: J.E. Hinostroza and C. Labbé, "Políticas y prácticas de informática educativa en América Latina y El Caribe", *Políticas Sociales series*, No. 171 (LC/L.3335-P), Santiago, Chile, 2011. United Nations publication, Sales No. S.11.II.G.53.

Digital content. The scope of digitization in curriculum content is still lacking. The challenge facing some of the education portals in the region is to move up to 2.0 websites, which support collaborative creation and incorporate users in the production of content. In some countries, restrictions on the circulation of digital content have had consequences and generated controversy surrounding the legislation on the protection of intellectual property rights and copyright.

2. Challenges and policy guidelines

ECLAC has argued that ICTs are not a goal in and of themselves, but rather instruments for addressing the needs of education systems; in other words, ICTs for education are a means to achieve a development objective that is clearly centred on people. In this context, the design of public policy must, at the very least, take into account the following points (Sunkel and Trucco, 2012):

Caution with high-cost investment. ICT policy for education usually requires a substantial investment. The equipment supply is considerable and constantly changing, so it is important to move cautiously on initiatives involving very complex and expensive technological processes that might have minimal results on education.

An intersectoral vision. Education and ICT policies affect many economic and social sectors. While they imply substantial technological efforts and large investments in infrastructure that must be centred on the education process, their scope often encompasses more general social problems. Consequently, managing policies in this area often represents a bigger challenge than the development of other sectoral policies.

Integration and sequencing. In the development of ICT policies for education, the design should centre on the needs of the beneficiaries and actors in the development process, emphasizing a holistic or integrated approach that can address topics such as access, skills development, applications and policies (Sunkel, Trucco and Möller, 2010).

Comprehensive long-term policies for integrating ICTs in education. If ICTs are to be exploited for educational purposes, such as improving school management, they need to be incorporated from a systemic perspective that takes advantage of complementarities, which in turn should be developed in unison. This requires not only access to technology and connectivity, but also appropriate content and advanced applications, as well as devices and the skills for using them. Along these lines, ECLAC (2010a) recommends designing plans that are centred on the needs of the beneficiaries and actors in the educational process, with an emphasis on the need for an integrated approach that can simultaneously address the different important and necessary dimensions of the uptake process.

The key areas of an ICT strategy for education are the following: access (terminals, connectivity); use (type and model of use, frequency and time of use); skills of teachers, students and establishments; and content (portals, advanced applications). Only under a comprehensive framework is it possible to build indicators for monitoring progress or designing impact evaluation models.

ICTs alone cannot change the social and economic dynamics that have hindered the development of education for decades. In terms of access, policies must continue to move forward in incorporating technological equipment in schools, as this continues to be an important obstacle in some countries in the region. The equipment levels must be sufficient for meeting classroom demand and for students to use outside of class time. Once the initial investment in equipment is made, educational establishments must have a permanent budget for maintenance, technical support and the cost of the broadband connection; all these investments are long term.

The region does not yet have indicators for evaluating and adjusting public policy to changing needs. Thus far, there has been progress in developing harmonized indicators, but these are still based on access conditions and infrastructure, with very little attention paid to patterns of use in the schools.

Equality: the use of ICTs to achieve better results in education. One of the challenges is to take advantage of ICTs to generate virtuous circles that contribute to more equitable results in education. The digital gap in Latin America and the Caribbean must be addressed along different dimensions: the heterogeneous conditions among countries, the socioeconomic inequality, the differences in the availability of equipment and the divergent trends in the exploitation of ICTs or the development of skills and competence.

While the region has made progress on transforming the education system into a more equal port of access to technology for different social groups, this access must translate into significant uses for the beneficiaries. The promotion of ICT use must be aimed at the social groups that historically have been the most underprivileged.

Efficiency: the use of ICTs to improve school management. The implementation of projects in school organization is a challenge in and of itself. In education, certain innovations are very difficult to carry out in practice. There are a number of conditions (leadership, willingness to change and innovation) that are critical for the success of new projects. Schools respond differently and unpredictably to the incentives and mandates of public policy. Leadership is necessary if the changes made possible by ICTs are to be realized. At the same time, schools have to be reorganized so that working with ICTs becomes comprehensive and ordinary, superseding the traditional, individualist and isolated teaching methods. Support and assistance systems are indispensible, especially in the initial phases, for contributing to the uptake and use of these technologies. It is important for management teams to participate in the digital training programmes so that they can take advantage of the full potential of ICTs.

Quality: strengthening the role of teachers and maximizing the pedagogical potential of ICTs. To improve the quality of education, the teaching staff must be trained not only in terms of digital literacy, but also in the innovative use of ICTs in the teaching process. The requirements of the curriculum must be synchronized with the introduction of ICTs in teaching (Peres and Hilbert, 2009). The field is just beginning to understand the best way to integrate ICTs in educational work and to teach the use of ICTs. The countries of the region that have addressed the issue of training have tended to do so through in-service teacher training programmes. However, these skills also need to be developed in the initial period of the professional preparation of educators. The development of technological competence in early teacher training is scarce in the region, and when it does exist, it tends to be very basic and to not prepare teachers to teach with ICTs (Bastos, 2010).

It is important to promote a comprehensive use of ICTs by students, so that they participate fully in building their skills and competence level. Students tend to use technology in line with their interests, exploring it boldly and effectively, but mostly for recreational purposes (communicating with their peers, music, etc.). In order for them to develop the skills necessary for more specialized and functional technological tasks, such as selection criteria and how to use the information on the Internet, the school system needs to guide and motivate them.

B. The development of e-health services

1. Status and progress

Access to health care is highly unequal in Latin America and the Caribbean as a result of various factors that limit access to timely, high-quality medical care: scarce resources (human, infrastructure, equipment and medications); physical and cultural distance between the public supply and citizen demand; and low family incomes. Thus, income level, location and ethnic origin determine the vulnerability and exclusion of millions of households in the region. This translates into high infant and maternal mortality rates.

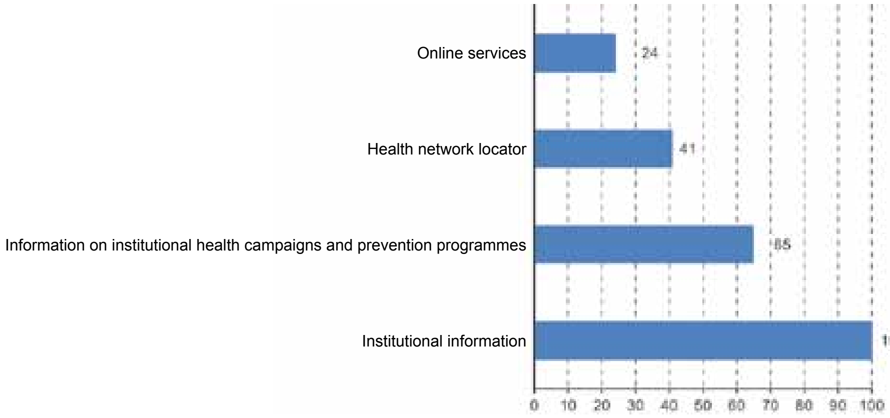
The potential of ICTs in the health sector must be analysed as a function of the challenges facing the region and each country in particular, which are manifested in the following areas:

- Unequal access to and quality of health care.
- Demographic and epidemiological shifts in the population.
- Pressure on health systems related to the availability of resources (professionals, infrastructure and inputs) and the sustainability of public expenditures.
- Utilization of mobile health care (m-health) to improve clinical results, public health monitoring, health education and the presence and treatment of common risk factors.[17]

In the face of these challenges, countries in the region began to reform their health systems, looking to optimize their organization and the quality of care. Although each country has pursued its own particular model, they are all working on improvements in three areas: administrative efficiency, satisfaction of demand and equality of benefits.

Within the framework of the health-care reforms and boosted by the development of e-government policies, ICTs are gradually being incorporated into the region's health systems. A 2009 ECLAC survey of health ministries and services in some of the countries in the region in revealed that in all cases, institutional information was available online, and most also provided online information about health campaigns and prevention programmes. In addition, many of the online services included locating available health-care services and other tasks such as scheduling medical appointments (see figure V.4)

Figure V.4
LATIN AMERICA AND THE CARIBBEAN (17 COUNTRIES): WEB CONTENT OF HEALTH MINISTRIES AND SERVICES, 2009
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), *ICT for growth and equality: renewing strategies for the information society* (LC/G.2464), Santiago, Chile, 2010b.

[17] Estimates indicate that in 2017 Latin America will account for around 7% of the world m-health market, that is, US$1.6 billion (GSMA/PWC, 2012).

The remainder of this section describes the main experiences with electronic health (e-health) in the region.

Electronic health record

While there are some important examples of managing electronic health records in the region, this tool is not yet consolidated. As in the rest of the world, the major challenges have to do with legislation, standards, interoperability and financing.

In 2007, the Secretariat of Health of Mexico launched the implementation of electronic health records, scheduled in six phases between 2007 and 2012, under a Mexican interoperability standard. There are also a number of local initiatives in Chiapas, Yucatán and Nuevo León. The Bolivarian Republic of Venezuela has developed a standardized health record system based on free software platforms (National Public Health System for Social Inclusion, SINAPSIS), which coexists with private electronic medical record initiatives and with other public institutions, such as the National Armed Forces Health System.

Argentina probably has the longest history with electronic health records in the region, as well as international recognition in this area, with an interconnected system for the 43 hospitals managed by the Ministry of Health in Buenos Aires. Uruguay has implemented infrastructure to support the different electronic government projects, in terms of both procedures and services. This includes a high-speed network that interconnects the entire government (Reddy) and a technological platform for improving civil services, both of which facilitate progress on the electronic health records project.

Patient empowerment and security

The region also has important examples of this type of regulation. In Mexico, the Mexican Official Standards on medical records of 1999 recognizes the ancillary use of electronic means for storing health information. Since 2003, the law allows for independent use and includes privacy issues. In 2010, draft regulations on privacy were issued to modify article 16 of the Constitution on privacy and the protection of the individual right of all people to protect their data (Gertrudis, 2010).

Uruguay approved a set of standards in 2008 which facilitate progress in the area of e-health. With a focus on the protection of rights, the legal framework was modified to incorporate Law 18,331 on personal data protection and Habeas Data, the law on access to public information and the Office of Civil Rights, under the Agency for the Development of Electronic Government and the Information and Knowledge Society (AGESIC). Other initiatives include the creation of the National Response Centre for Computer Security Incidents, the adoption of an information security policy for public agencies, the recognition of the admissibility, validity and legal efficacy of electronic documents and electronic signatures and the formation of the Electronic Certification Unit as a control body (Margolis and others, 2010).

Remote medical appointments

Trinidad and Tobago implemented a programme for access to free medication for 40,000 citizens with chronic illnesses. The programme provides a smart card that can be used in a network of 115 private pharmacies that dispense the medicines. The card stores information on the prescription and the prescribed dose. There is an online procedure for verifying the quantity of the medication dispensed versus the amount authorized for the period. Once the transaction is completed, the information is transmitted to a central database (NIPDEC-Infotech), which manages the inventory of drugs at each pharmacy, as well as at the central level (Sandor, 2010).

Telemedicine and telehealth

The cases of telemedicine in the region include some large-scale projects such as the programme implemented in Brazil. This is the area with the strongest progress in e-health in the region, although its development has been closely associated with the consolidation of telehealth. Telehealth, which is broader than telemedicine, includes distance training and continuous education programmes for health-care workers over wide geographical areas that lack specialized human resources or have difficult access to education, which is the case in most of the countries in Latin America.

Initiatives in Argentina include the Garrahan Hospital and the Zaldívar Ophthalmology Institute. The hospital has provided consultation services via e-mail for 12 years and has implemented a telemedicine programme for providing support to health centres in the country's interior, capable of handling highly complex consultations. The Zaldívar Ophthalmology Institute provides virtual consultation services, either deferred or in real time (Oliveri, 2010).

Since 1997, Jamaica has developed a number of telemedicine projects, a tool used in a growing number of medical specialities, such as dermatology, oncology, psychiatry and house-call services (Sandor, 2010). Costa Rica has had a telemedicine programme for almost a decade, focusing on specialized consultations and emergencies, although consultation services are rarely used, and always on the agreement of the parties involved (Cortes, 2010).

In Panama, telemedicine initiatives are aimed at rural areas and prisons, as well as some medical specialties such as teleradiology due to the concentration of radiologists in the capital. The Bolivarian Republic of Venezuela has several initiatives, including the "SOS Telemedicine for Venezuela" programme led by the Central University of Venezuela, which targets vulnerable sectors with serious difficulties accessing health care.

In Colombia, the progressive incorporation of telemedicine has contributed to establishing and consolidating ICT programmes in universities, including the National University, the University of Antioquia and the University of Caldas. For several years, these institutions have been working on education programmes, electronic health records and clinical applications. Programmes such as distance learning for people with chronic illnesses and interactive tools for exchanging information are gradually gaining ground (Vélez, 2010).

In Brazil, the University Telemedicine Network (RUTE), created in 2004, is notable for its size and sustainability. It is an initiative of the Ministry of Science and Technology with support from the Funding Agency for Studies and Projects (FINEP) and the Brazilian Association of University Hospitals (ABRAHUE), under the coordination of the National Education and Research Network (RNP). It encompasses university hospitals from all the states and primary care centres in 12 states, for a total of 1,200 points of service. RUTE supports the improvement of the infrastructure for telemedicine, education and research and promotes the integration of projects among the member institutions and the coordination of health care, through the sharing of medical records, consultations, examinations and second opinions.

The incorporation of ICTs in health care in the region is behind other sectors, such as education and government, and it has followed a pattern of diffusion that is also found in the developed countries. This lag is primarily explained by regulatory problems, security and privacy, deficiencies in standardization and interoperability, and the high cost of the systems.

A wide range of public and private initiatives have been developed in the region since the mid-200s, some new and some deriving from the expansion of older programmes. The projects under implementation address a variety of objectives, such as providing health care in remote areas, connecting primary care centres with specialists at larger facilities, obtaining timely epidemiological information, training health-care workers in isolated areas and improving management systems. Many of these projects are of limited scope, however, and they have not been integrated with broader health policies or with national ICT strategies. This is essentially due to the fact that, with few exceptions, the countries of the region do not have ICT policies for the health sector.

The role of ICTs in health care is a new issue for public policy in the region, although some initiatives stand out. Argentina established the inter-institutional coordination among different territorial levels of government in 2009 and also links e-health policies with general ICT policies and strategies. In 2008, Colombia drew up a framework for promoting and strengthening e-health. Mexico has shown a steady interest in the issue since 2001, albeit with ups and downs in terms of originating products. However, the regional development at the government level contrasts with the experience of universities and the private sector, which have made greater efforts to explore the advantages of using ICTs in health. At the university level, Ecuador has carried out several projects focused on covering the needs of rural and marginal areas, mainly with support from international cooperation funds (Mijares, 2010).

Colombia passed Law 1419 in 2010, establishing the guidelines for developing telehealth and identifying the sources of financing for its implementation. This law complements the resolution issued by the Ministry of Social Protection in 2006 regulating the provision of health-care services through telemedicine.

Panama began implementing ICTs in health in 1999, with the creation of the Medical Documentation and Information Centre (CDMI) in the University of Panama School of Medicine. This centre utilized a fibre optic ring installed in Panama City by a private company, which led to the first thesis on telemedicine, with a focus on teleneurophysiology. Starting in 2000, the University of Panama took on a role of knowledge generation, teaching and diffusion in this area, signed agreements with the Arizona Telemedicine Program (ATP) and contributed to the design of the National Telemedicine Project (Vega, 2010).

The Panamanian National Teleradiology Programme, which was established to address the concentration of radiologists in the capital, is an example of an integrated health system in the region. Thanks to this programme, digital X-ray machines have been installed in 12 positions which are connected via satellite, so that a team of radiologists working in the capital can receive and read images from other parts of the country (Vega, 2010).

2. Policy guidelines

ICTs are an effective tool for reducing inequality and accelerating progress on health objectives. This requires leadership from the authorities in the sector and the agreement of all the actors involved around a common agenda. This must be founded on a national policy for making sytematic progress on the development of infrastructure and connectivity based on interoperable validated systems for health education, prevention of illnesses, medical care and service management.

There are a number of challenges for improving health care in the region. While ICTs can provide powerful, innovative solutions for access, effectiveness, efficiency, monitoring and evaluation, they have to be implemented in combination with other tools and initiatives for building capacities and improving the quality of care.

The digital literacy of the population is also an important factor to take into account if ICTs are to fulfil their potential in the health sector. Patients and citizens play an increasing role in health strategies, which is accentuated with the incorporation of ICTs to the extent that patients have access to the technologies and know how to use them.

The achievements in some developed countries illustrate the potential of ICTs for addressing these challenges. Today it is impossible to offer long-term solutions on health issues in the region without including these technologies. To this end, the demands and restrictions of the sector must be evaluated. The difficulty is identifying the best alternatives for achieving better health care, process optimization and cost containment through the integration of these tools in public health policies and strategies.

While the region demonstrates important progress and experience, many of the cases are academic projects that are not financially sustainable or have low population coverage. Some projects, coordinated with the private sector or supported by favourable donation laws, have achieved greater visibility and a degree of financial stability. An important challenge for the development of e-health in Latin America is to generate government-university alliances to take these localized experiences and introduce them at the level of the public health systems. A good example is the construction of a telehealth model in Brazil and the launching of the "Brazil Telehealth Networks" national plan in 2011.

Each country needs to outline a sectoral strategy in coordination with its more general digital agenda. This assumes that health authorities participate in the ICT policy decisions made by other government bodies or advocates them if they do not already exist or are insufficient. Since the use of these technologies contributes to increasing efficiency and improving administrative processes, a systemic perspective is needed to integrate them into management policies, especially in areas that are critical for achieving public health objectives and goals. That is, countries need to pursue a holistic approach that takes into account the need for integral health strategies, where ICTs are a complementary platform for other policies that converge on the same objective. It is not a matter of generating an e-health public policy, but rather stipulating the use of ICTs in health policy and specifying how they con contribute to achieving sectoral goals.

The rest of this section outlines strategic guidelines for the development of ICTs in the health sector, which each country can adopt on the basis of the challenges it faces in terms of inequality, demographic and epidemiological shifts, and the availability of resources and degree of incorporation of ICTs in the central government and the different sectors of the economy.

Institutional framework and infrastructure. The decision to invest in an ICT strategy will depend on sectoral leadership and the capacity to involve a range of actors, not only because the implied transformations require a consensus to legitimize the willingness to change, but also because many actors —research centres, universities and private firms— have accumulated relevant knowledge and practices as a result of a much larger, more intensive experience than the public sector. At the same time, the decision-making process needs to involve teams of professionals that bring together knowledge of the medical, public health and ICT fields.

Given the scope of the required effort and investment, the institutional framework that must underpin the process is critical. Its design should take into account the definition of priorities, formulation of plans, generation or recommendation of standards, coordination of work groups, and project monitoring and evaluation. The sustainability of the strategy will largely depend on configuration of technical teams capable of acting in coordination to implement and later scale up projects.

The institutional framework must also establish the legal framework to help promote e-health applications by giving actors the required security, including the protection of privacy for patient information and the legal backing for health-care actions that use ICTs. Patient access to their own information also needs to be legislated. These considerations are important in a process in which resistance to technological and cultural change needs to be managed to reduce uncertainty.

Lastly, to ensure the security and quality of health care and related administrative procedures, it is necessary to create a system dedicated exclusively to patient identification. Some countries in the region already have a system that could be used as a health registry. However, confidentiality and privacy can only be secured through the creation of a dedicated system based on some type of "health card".

Integrated information management. The process of improving management, increasing efficiency and raising the quality of health care is closely related to the ability to manage administrative, clinical and health information in an integrated manner.

Electronic medical records are an essential component of integrated information management to the extent that the lion's share of clinical or administrative data to be managed is patient-related. While it is possible to make progress on the development of modules for managing specific processes (such as logistical processes associated with infrastructure, equipment and supplies or billing processes), effective data integration can be achieved only

[18] In the report, Colombia and Chile stand out for their use of online query tools and social networks, with both countries ranking among the top eight in the world. For example, the Colombian government website includes several mechanisms for e-participation through the use of tools (forums, blogs, surveys) and social networks (Facebook, Twitter, etc.), which allow people to express their opinions and make comments. This positioned Colombia in sixth place in the ranking in 2012, on par with Finland and Japan.

[19] The EDGI measures the public sector's ability to provide electronic and mobile services through three components: online services, telecommunications infrastructure and human capital. The EDGI considers four stages of development of e-government: emerging online presence (stage I), enhanced presence (stage II), transactional presence (stage III) and connected presence (stage IV). Taking into account the stage of each government, the services offered are rated on a scale of 0 to 1.

with the incorporation of electronic medical records. It is especially important to ensure interoperability (technical, semantic and operative) in order to support the integration of the region's health systems, most of which are currently fragmented.

Telehealth. This component is directly related to the provision of health care to segments of the populations with difficulties of access. The implementation of these applications requires connectivity between the different levels of care, which must be established in the first line of strategy.

The medical specialties to be covered by telemedicine will depend on the priorities dictated by the requirements of the population to be served and the state of progress of the different countries. The optimization and reallocation of resources is one of the key objectives to consider.

Telemedicine programmes should be complemented with distance education for health workers to update their knowledge and service protocols. This type of initiative is directly related to the goals of improving quality, lowering training costs and reducing job desertion and staff rotation among this group of workers.

With regard to patients and the community, the objective is to provide information for self-care and to promote healthy habits, which are increasingly relevant due to the increase in the incidence of chronic degenerative diseases.

Finally, progress needs to be made on regional or international agreements that facilitate e-health practices beyond national borders. ICTs open up a range of possibilities for distance care and complementarities between countries, including the exchange of information (interoperability) and patient mobility.

C. Electronic government

1. Status and progress

In line with world trends, the first electronic government initiatives in Latin America and the Caribbean were implemented in the late 1990s, with a focus on budget performance, financial administration and customs and tax management. Electronic government (e-government) has evolved through the following phases (Red GEALC/IDRC/OAS, 2008):

- Digitization of public administration. Large investments in computers were made in the 1970s and early 1980s to automate management processes.
- Client-server phase. Migration to client-server applications and Windows-style interfaces began in the mid-1980s, when personal computers with individual processing capacity made it possible to apply these more economical, modular solutions that could be implemented quickly. The introduction of the Windows platform simplified and expanded the interaction of government workers via computers, which ceased to be the exclusive domain of engineers and were transformed into a common office tool.
- Government informational websites. The use of the Internet went beyond the academic, security and defence spheres and proliferated in other areas of society starting in the

mid-1990s. the concept of e-government began to take form when public administrators identified the Internet as a new channel for citizen interaction; the first government informational websites were then created.

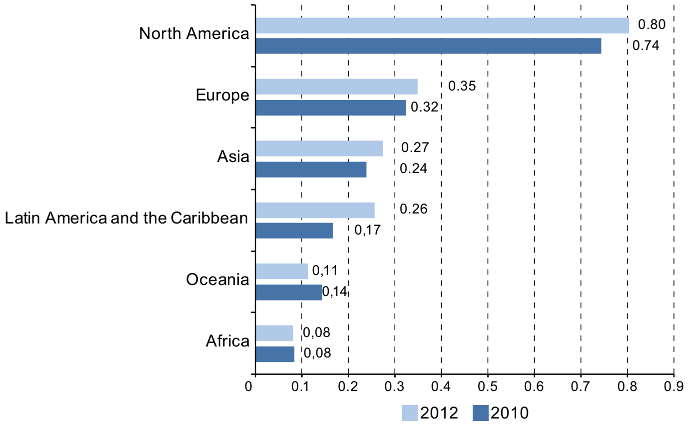
- Government service websites and the formulation of national strategies. Countries in the region have been positioning themselves for the information society since the late 1990s, providing a range of government information and services online. Some countries such as Brazil, Chile, Colombia, the Dominican Republic, Mexico and Peru formulated strategies that have served as national models for the development of e-government. Since then, the evolution of e-government has been uneven, with Brazil, Chile, Colombia and Mexico taking the lead in this area.

The e-government initiatives that have been implement in the region in the past decade have generated significant improvements in public management in many countries. In the e-government report published by the United Nations Department of Economic and Social Affairs (UN DESA), the e-participation index assesses the quality and usefulness of the information and services provided by a country to involve its citizens in the formulation of public policies through the use of e-government programmes. Latin America and the Caribbean was the region that made the most progress in this area in 2010-2012 (ECLAC, 2013a).[18]

The region was also ranked second in the world in terms of the share of countries that invite people to connect via social networks ("Follow us on Facebook or Twitter"). According to the UN DESA e-government development index (EGDI[19]), in 2012, South America, the Caribbean and Central America were above the world average and recorded the biggest increase in the index between 2010 and 2012 (after Europe) (see figure V.5).

Figure V.5

UNITED NATIONS E-GOVERNMENT INDEX BY REGION, 2010-2012



Source: Economic Commission for Latin America and the Caribbean (ECLAC), *Monitoreo del Plan de Acción eLAC2015* (LCR.2190), Santiago, Chile, 2013.
Note: North America includes the United States and Canada.

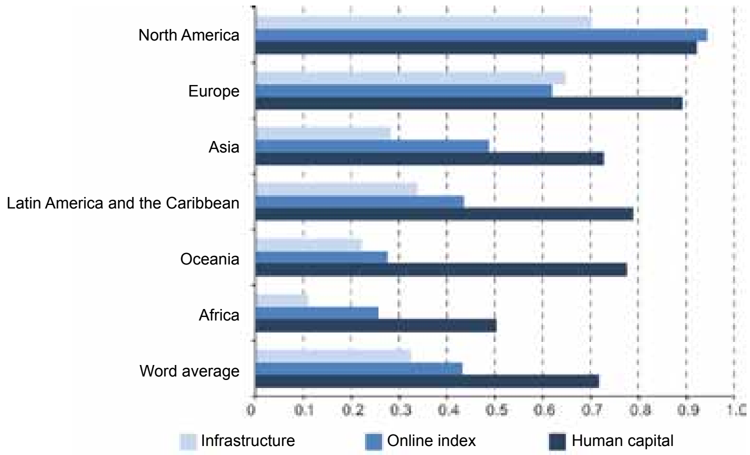
[20] In 2012, Colombia and Chile had an online services component 0.84 and 0.75, respectively, while the average for developed countries was 0.65.

[21] The National ICT Plan proposed that effective ICT use was not an option, but a requirement for government entities.

An analysis of the components of the index shows that improvements are largely related to progress on infrastructure and the development of online services, which are precisely the areas where the region lags furthest behind other world regions (see figure V.6). Despite significant progress, in 2012 only Colombia, Chile and Mexico offered more than 60% of public services online, versus a regional average of 43%.

Figure V.6

COMPONENTS OF UNITED NATIONS E-GOVERNMENT INDEX, BY REGION



Source: Economic Commission for Latin America and the Caribbean (ECLAC), *Monitoreo del Plan de Acción eLAC2015* (*LCR.2190)*, Santiago, Chile, 2013a.

While all the countries in the region registered improvements in the absolute value of the EDGI in 2003-2012, and several also improved their position in the ranking, a large share dropped in terms of their relative positions. The five countries in the region with the highest ranking were Chile (39th), Colombia (43rd), Barbados (44 h), Antigua and Barbuda (49th) and Uruguay (50th).

Countries like Colombia and Chile[20] have invested substantial resources in developing e-government, positioning themselves as global leaders. In particular, Colombia's National ICT Plan gave a huge boost to e-government[21] and established the general guidelines of a government online strategy in 2008, which made it possible for the country to move up from 54th in this component in 2003 to 16th in 2012.

Interoperability facilitates the progression of services towards higher stages of e-government as it improves the exchange of information and communication between systems. The United Nations 2012 survey on e-government highlights a group of countries —including Colombia— that offer e-government services for civil identification, which, at the very least, implies the integration of databases such as birth certificates and identification and passport numbers. The survey further indicates that only a third of the countries in the world have an online tracking system, including Argentina and Colombia.

Another world trend identified in the report is the formulation of policies that use online tools to improve institutional coordination and strengthen whole-of-government services. The index analyses aspects such as the existence of one-stop shops. Regional leaders in this area include Argentina, Colombia, Costa Rica, Mexico, Peru and Uruguay.

The results show that the region needs to continue and intensify the efforts undertaken thus far, boosting the quality of the online government services provided to citizens and firms. Countries need to sustain the e-participation efforts that promote inclusion and citizen empowerment and to encourage the development and adoption of interoperability standards for government services and platforms.

In Latin America and the Caribbean, the most important experiences have been in government procurement systems, tax management and the conditional family transfer programmes.

More efficient public sectors: government procurement systems. Electronic government purchasing has been an efficient instrument for realizing the objectives of government procurement policy, increasing transparency and empowering social control mechanisms on public administration. ICTs have radically changed the way public entities conduct procurement. The traditional public tender has been replaced by selection methods that, based on the use of these technologies, enable especially competitive processes such as auctions, framework agreements and commodity exchanges, which create a favourable scenario for transparency and generate savings.

One problem yet to be solved is the implementation of interoperability policies that support the interaction of information systems related to government procurement, such as budget or payment systems. Such policies could benefit the people who participate in procurement.

Combining tax efficiency and equality. Tax administrations have been pioneers in the incorporation of ICTs in e-government in the region, the provision of online services and information and the integration of databases. The current challenge is to integrate these "information islands" with more backward areas of public administration. This integration is important because tax policy is crucial for developing the provision of public services and improving the distribution of income.

The most critical factor for implementing ICTs in tax administration is the contradiction between transparency and the right to privacy. Interoperabilty between different public administration divisions should not imply that all databases are freely accessible. The right to privacy must be respected throughout the process of optimizing public administration through ICT use. In handling digital information, public entities must guarantee that that fundamental civil rights are protected when information is archived, manipulated, managed or diffused. The balance between transparency and privacy requires a regulation that recognizes the need to modernize public administration and respect the rights of citizens.

Fighting poverty: conditional cash transfer (CCT) programmes. CCT programmes provide an example of how e-government can be an instrument for social development. Given the limitations of traditional programmes to significantly reduce poverty, governments in different parts of the world began to adopt anti-poverty programmes based on conditional cash transfers, which consist in the delivery of monetary resources subject to the behaviour of the recipients (Mariscal and Lepore, 2010). ICTs have helped improve efficiency and better target the always-scarce resources available for these efforts.

The use of ICTs in this area has improved interoperability between agencies and increased transparency. The *Bolsa Família* CCT programme in Brazil is an example of interoperability, where the size and decentralization of the country represent a challenge in terms of coordination.

ICTs facilitate interaction between the federal level and the local and regional income transfer programmes and support the implementation of heterogeneous models of decentralized quality management (Lindert and others, 2007).

With regard to transparency, the *Oportunidades* programme in Mexico, whose objective was to reduce extreme poverty, gave special attention to transparency in government action. Because the programme was launched in the midst of a fiscal crisis and a change in the party composition of the legislature, there was strong political pressure for accountability. Therefore, from the beginning the programme budget included provisions on transparency, access to information, impact evaluations and auditing mechanisms. The use of ICTs in these areas interacted with political agreements and institutional arrangements and served as a mechanism for improving efficiency, effectiveness and social integration.

2. Challenges and policy guidelines

An assessment of the status of e-government in the region suggests that, in addition to the positive experiences, some important challenges remain in terms of the provision of services, access and use. Countries need to address the following areas:

- Increase the amount of information and number of procedures available online;
- Improve the interoperability between services in order to eliminate sources of inefficiencies and difficulties in service provision;
- Provide access to broadband Internet for the municipalities that are furthest behind;
- Heighten the impact of the greater ICT use in public management.

Addressing these challenges will require progress on the following initiatives:

- Continue to promote training for government officials and service users in the utilization of tools for accessing e-government services at the local level;
- Increase online information and interactive applications for citizens and firms using Web 2.0 tools, through government websites and public procurement programmes;
- Expand the availability of electronic transactions designed for fixed terminals and portable devices connected to mobile broadband;
- Ensure that all municipal governments with a broadband connection have community content;
- Promote the coordination and interoperability of public administration based on open standards.

This broadens the scope of e-government, evolving from a basic exploitation of ICTs towards an open public administration model that redefines the supply of services and public policies, opening space for civic participation and collaboration in decision-making and in problem identification and resolution. Achieving this will require paying closer attention to new trends in the digital paradigm, which tend to expand and redefine the traditional e-government strategies.

The concept of open government creates a new paradigm of interacting with citizens and centres e-government strategies on the issues of transparency, the opening up of data and civic participation. At the same time, trends like hyperconnectivity, high-speed networks, mobility and related applications, big data analytics and cloud computing —which have the ubiquity of the Internet as a common denominator— reduce the time and place restrictions on access to information and content. This is made possible by the constantly increasing capacity for data processing and transmission, which are connecting more and more devices and people and evolving towards smart systems. This, in turn, has given rise the concept of smart cities and the formation of integrated participatory strategies for the management of local government with an intensive use of new technologies.

In this sense, governments must promote the deployment of technology, taking advantage of technological convergence and mobility to ensure that services reach the end users. It is imperative to create the conditions for the non-discrimination of content and applications, while also paying attention to privacy and security threats (ECLAC, 2013b). Based on that evolution, e-government strategies must take into account the following elements:

Open government. This new model expands the capacity for civic action in the face of challenges in the form of greater participation, transparency, the decentralization in the production of knowledge and the resolution of traditional public management problems (Alujas, 2012). It emerged out of increasingly complex and varied social demands, with a citizenry that uses alternative spaces for social articulation and new models of interaction deriving from the digital culture and based on an intensive use of new technologies and social networks. Although the philosophy of open government is not limited to e-government, the new paradigm has strengthened and updated its promise and opened new horizons in the e-government strategies. Thus, participation and cooperation, which traditionally were weak aspects of e-government initiatives, have been reinforced by the emergence of open government websites based on open data.

Civic participation. The technologies associated with the Web 2.0 facilitate access to government information, improve the quality and variety of its content and feed back into the government. They also promote greater involvement in the political process. The mechanisms for applying and disseminating information among citizens are growing exponentially. *Computación en la nube*. Consiste en la oferta de servicios de computación a través de Internet, donde el usuario puede contratar, según sus necesidades, capacidades de procesamiento y almacenamiento en línea. Es un modelo de negocio que permite al usuario acceder en forma rápida a servicios estandarizados y responder a la demanda en forma flexible, adaptándose a cargas inusuales de trabajo y pagando sólo por el consumo efectuado. Los gobiernos están paulatinamente adoptando estos servicios, que se denominan “nube gubernamental” (*G-Cloud*). Se prevé que las organizaciones gubernamentales eliminen sus infraestructuras computacionales actuales y utilicen servicios en la nube, gestionados por terceros. Así, el gobierno electrónico podrá rápidamente desplegar aplicaciones sin la necesidad de costosas instalaciones de infraestructura que usualmente presentan bajos niveles de utilización y poca flexibilidad (Concha y Naser, 2012).

Cloud computing. Cloud computing involves the supply of computer services over the Internet, where users can contract online processing and storage capacity according to their needs. This business model allows users to quickly access standardized services and flexibly respond to demand, accommodating unusual work loads and paying only for actual consumption.

Governments are gradually adopting these services, which are called a government cloud (or G-Cloud). Government organizations are expected to eliminate their current computer infrastructures and use cloud services managed by third parties. Thus, e-government can rapidly deploy applications without the need for costly infrastructure installations that are usually characterized by low utilization and limited flexibility (Concha and Naser, 2012).

Big data analytics. These processes generate more and better information for decision-making in public policy, in areas such as disease and disaster prevention, natural resource management and security, through data generated by mobile devices and analysis of social preferences and behaviours (World Economic Forum, 2012; UN Global Pulse, 2012).

Better coordination between central and local governments. Local problems are increasingly solved autonomously and hence more rapidly than would be the case if the central government were involved. With shared systems and interoperable platforms, the duplication of functions and information can be avoided, especially in critical areas such as security and privacy. Many countries are paying closer attention to ICT-based mechanisms for improving collaboration among their different agencies and between these and local governments.

VI. Conclusions

ICTs have a positive impact on economic growth in Latin America, in a context of mass diffusion of new technologies at the international level, an accelerated transition towards economies based on advanced manufacturing and sophisticated services and changing business processes, driven by the regional and international development of the software industry. This process is made possible by the convergence of Internet-based devices, applications, networks and platforms. At the same time, there is increasing interaction between mobile technologies, cloud computing services, big data analytics, the universalization and diversification of the use of social networks and the ubiquity of remote sensors.

Given the speed of the technological revolution underway, the countries of Latin American countries have not been able to make a significant reduction in the digital divide relative to the more developed economies, which is particularly severe in the more advanced technologies like fibre optic connections and high-speed mobile broadband. The problem is most urgent for the countries that are furthest behind, given the strong heterogeneity of the Latin American region. The old and new gaps are warning signs for addressing the growing digital heterogeneity between and within countries, while also representing an opportunity for regional cooperation and coordination in the digital economy.

Making progress on the structural change that is necessary for development and the reduction of inequality in the region requires formulating and implementing a new phase of ICT strategies based on the integrated development of the digital economy, defined as ICT industry sectors (telecommunications, hardware, software and ICT services) and the network of economic and social activities facilitated by the Internet. The digital economy is a source of increased production, economic growth and sustainable development; tapping that potential will require institutions and policies that ensure the creation of synergies between the diffusion of new technologies and a shift in the production structure towards digitization and knowledge-intensive sectors.

A. Importance of the digital economy

After two decades of implementing policies focused on infrastructure development, Internet access and ICT diffusion, the evidence shows that the digital economy accounts for a strong share of GDP. According to ECLAC estimates, this share is at least 3.2%, on average, for Argentina, Brazil, Chile and Mexico. This compares with an average of 5.0% for the 27 countries of the European Union.

The digital economy has not progressed evenly, but rather the region has fragmented into two blocs in the ICT development process, which advance their digital strategies at two different speeds. The three countries with the best performance have an ICT development index of 75% of the level recorded by OECD countries, while the three worst-performing countries have an index of just 38%. The development of critical infrastructure is thus highly asymmetrical among the countries in the region; for example, the ratio of mobile broadband penetration between the three best and worst performers in the region is 15 times.

The results of ECLAC growth accounting exercises for four countries (Argentina, Brazil, Chile and Mexico) show that ICTs account for a large share of gross fixed capital formation and that ICT capital is an explanatory factor for economic growth and increased productivity, but to a lesser degree than in developed countries.

The share of ICT investment in gross fixed capital formation in the region in 1990-2010 is comparable to the share in more developed countries: Brazil is comparable to the United States, while Argentina, Chile and Mexico are similar to Spain and Italy. In 1995-2008, there was a positive relationship between ICT capital, economic growth and productivity. ICT capital explained 14% of GDP growth in Brazil, 7% in Chile and Mexico and 5% in Argentina. In the developed countries, ICT capital explained between 13% and 25%.

In contrast to the pattern in the United States in 1995-2002 and the European Union in 2004-2007, the countries of Latin America have made only partial progress on the generalized growth of labour productivity based on increased digitization. Argentina, Brazil and Chile have recorded a modest increase in productivity only in the financial sector and, to a lesser extent, large retail chains and telecommunications.

B. The digital economy for structural change

Structural change is here understood as a process that allows increasing the share of knowledge-intensive production and digitization. The challenge is to consolidate a model of technological diffusion and innovation for changing the production structure which integrates knowledge and production based on the specific economic and institutional characteristics of each country. The evidence presented in this book shows that the incorporation of ICTs, measured through Internet penetration, is clearly correlated with production structures and foreign trade patterns that are intensive in medium- and high-technology goods, that is, with virtuous structural change.

The speed and mechanism of ICT diffusion vary between countries. Some Asian and European countries underwent intense ICT diffusion processes and strong structural change. In contrast, the countries of Latin America experienced weaker diffusion processes and more muted structural change. The advanced countries have generated increasing returns from a better articulation between the production structure and ICTs, while the Latin American region has fewer synergies as a result of a weaker articulation. To promote a digital economy for structural change, countries must simultaneously act on the complementary fronts of supply factors (such as broadband infrastructure and the ICT industry) and demand factors (access, affordability, user skills).

ECLAC considers the digital economy to be part of a new vision of development that can act as a catalyst for structural change, promoting long-term investment, the diversification of the production structure and greater convergence of productivity levels for the economy as a whole. However, the region needs to focus on formulating multipurpose strategies for the digital economy, since countries with relatively greater ICT development need to try to increase the impact on growth and social inclusion, while countries that are further behind need to close the digital divide.

C. ICTs policies for structural change

The process of digitization and structural change is not spontaneous, but rather is generated in institutional contexts that are conducive to innovation, that promote the development of ICT sectors and that provide incentives to rapidly diffuse new applications to non-ICT sectors of the economy. Cross-country differences in productivity are explained not only by access to and diffusion of new technologies, but also by complementary factors at the firm, industry and institutional levels. These factors create positive externalities, technological spillovers and increases in productivity throughout the economy.

Policies should act on critical factors that condition the deployment of the digital economy. They should establish an institutionality for the digital economy that integrates ICT policies for structural change and ICT policies for equality and social inclusion. The main components of the former are national broadband policies and industrial policies for the digital economy.

National broadband policies must be formulated at the highest policy level, incorporating strategic objectives that transform them into true state policies. At the very least, their components should include international coordination, regulation, the development of public infrastructure, the creation of ICT capacities, the financial institutional framework and the promotion of technological research and development. Industrial policy for the digital economy must consider, as a point of departure, the development of the software industry for creating new high-productivity sectors and developing digital competencies in the production sector, mainly in small and medium-sized firms.

The importance of the software industry lies in its contribution to the structural change of developing countries via the transfer and diffusion of new technologies, the creation of skilled jobs and the export of services. Although this industry has been promoted in countries such as Argentina, Brazil, Chile, Colombia, Mexico and Uruguay, the use and uptake of ICTs in production sectors has been weaker, particularly in SMEs.

D. The contribution of ICTs to equality and social inclusion

The deep inequalities in the distribution of income and access to public services that prevail in the region condition the pattern of Internet access and use. This is why it is important to have public access networks (telecentres, free hot spots), to provide an alternative to access at home or in the workplace. State intervention is essential for ensuring equality of access and ICT use, which must be considered a national public service because it facilitates the provision of social services such as health care, education and e-government.

In the past decade, most of the countries in the region have made significant progress in the incorporation of digital technology in education systems, especially in terms of access and infrastructure. However, progress is still weak on two key factors associated with effective ICT use: the uptake of the technology by the user and the development of relevant educational content. A fundamental component for taking advantage of ICTs in education is the capacity of teachers, administrators and students to use them, with teaching being the key for linking ICTs with student learning processes. Consequently, ICTs must be incorporated into teacher training, both in their initial studies and in continuous education programmes over the course of their careers. These efforts have not been sufficient in the region: they have generally targeted in-service teachers only and have not had wide coverage. The development of digital content, in particular the digitization of the curriculum, remains scarce. The challenge facing some education portals is to move to Web 2.0 sites that support collaborative creation, incorporating users in the production of content.

With regard to health reforms, ICTs are gradually being incorporated into the region's health systems, with a boost from the expansion of e-government. Some of the most important initiatives have to do with electronic medical records, empowering patients, data confidentiality, remote medical appointments and telemedicine. While there has been substantial progress, in many cases these are academic projects that are not financially sustainable and that have limited coverage. A challenge for the development of e-health in Latin America is to create government-university alliances to perfect initiatives currently in operation, develop new ones and implement them in public health systems.

In the area of electronic government, some countries in the region have made progress on incorporating online services and significantly improving public management. ICTs contribute to the efficiency of public sectors, tax administration and anti-poverty programmes based on conditional cash transfers. Trends in this area point to the growing use of an open government model, increased civic participation through social networks, the generalized use of cloud computing in government (G-Cloud) and the expansion of big data analytics to support policy decisions.

As stated in the foreword to this book, the digital economy is a crucial force for driving structural change, reducing inequality and increasing social inclusion. Its role as a catalyst for change depends on the creation of the complementary assets analysed in the book's chapters, especially with regard to the institutional structure and capacity for supporting SMEs, industrial policy, education, health and e-government. We hope that the proposals described for each point contribute to fostering the economic and social development of Latin America, within a framework of structural change for equality.

Bibliography

Alujas, Álvaro (2012), "El gobierno abierto en América Latina" [online] http://www.politicadigital.com.mx/?P=leernoticia&Article=21624&c=9.

Amsden, A. (1992), *Asia's Next Giant: South Korea and Late Industrialization*, New York, Oxford University Press.

Atkinson, A.B. (2000), "The changing distribution of income: Evidence and explanations", *German Economic Review*, No. 1.

Barber, M. and M. Mourshed (2007), *How the World's Best-Performing School Systems Come Out on Top*, McKinsey & Company.

Barrantes, Roxana, V. Jordán and F. Rojas (2013), "The shifting digital paradigm in Latin America", *Broadband in Latin America: beyond connectivity* (LC/L.3588), V. Jordán, H. Galperín and W. Peres (coords.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC)/Regional Dialogue on the Information Society (DIRSI), forthcoming.

Bastos, María Inés (2010), "El desarrollo de competencias en TIC para la educación en la formación de docentes en América Latina", paper prepared for the Conference the Impact of ICT on Education, Brasilia, United Nations Educational, Scientific and Cultural Organization (UNESCO), April.

BCG (The Boston Consulting Group) (2012a), *The Connected World - The Digital Manifesto: How Companies and Countries Can Win in the Digital Economy*, Dean David, S. Digrande, D. Field and P. Zwillenberg, January.

______ (2012b), *The Connected World - The Internet Economy in the G-20*, D. Dean and others.

Boehm, B.W. (1981), *Software Engineering Economics*, Prentice-Hall.

Bold, William and W. Davidson (2012), "Mobile broadband: redefining Internet access and empowering individuals", *The Global Information Technology Report 2012: Living in a Hyperconnected World*, Soumitra Dutta and Benat Bilbao-Osorio (eds.), INSEAD (The Bussiness School of the World), World Economic Forum.

Booz & Company Inc. (2011), *Measuring Industry Digitization: Leaders and Laggards in the Digital Economy*, Roman Friedrich and others.

Carvalho de Lorenzo, Marina (2010), "O uso de tecnologias da informação e comunicação em programas de transferência condicionada de renda. O caso do Programa Bolsa Família", paper of the Alliance for the Information Society (@LIS2, unpublished.

ECLAC (Economic Commission for Latin America and the Caribbean) (2013a), *Monitoreo del Plan de Acción eLAC2015* (LCR.2190), Santiago, Chile.

______ (2013b), "Estrategias TIC ante el desafío del cambio estructural en América Latina y el Caribe: balance y desafíos de renovación", *Project Documents*, No. 534 (LC/W.534), Santiago, Chile

______ (2012), *Structural Change for Equality: An Integrated Approach to Development* (LC/G.2524(SES.34/3)), Santiago, Chile.

______ (2011), *Foreign Direct Investment in Latin America and the Caribbean, 2010* (LC/G.2494-P), Santiago, Chile. United Nations publication, Sales No. E.11.II.G.4.

______ (2010a), *Time for equality: closing gaps, opening trails* (LC/G.2432(SES.33/3)), Santiago, Chile.

______ (2010b), *ICT for growth and equality: renewing strategies for the information society* (LC/G.2464), Santiago, Chile.

Chang, Ha-Joon (2002), "Breaking the mould: an insitutionalist political economy alternative to the neo-liberal theory of the market and the State", *Cambridge Journal of Economics*, vol. 26, No. 5, Oxford University Press, September.

Cimoli, Mario, A. Hofman and J. Mulder (2010), *Innovation and Economic Development: The Impact of Information and Communication Technologies in Latin America and the Caribbean*, Edward Elgar.

Cimoli, Mario, G. Dosi and J.E. Stiglitz (eds.) (2009), *Industrial Policy Development: The Political Economy of Capabilities Accumulation*, Oxford University Press, Initiative for Policy Dialogue Series.

ComScore Inc (2012), *Futuro Digital – Chile*, Webinar presentation [online] July.

Concha, Gastón and Alejandra Naser (eds.) (2012), "El desafío hacia el gobierno abierto en la hora de la igualdad", *Project Documents*, No. 465 (LC/W.465), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), February.

Coremberg, A.A. (2011), "Formación bruta de capital fijo en Argentina por tipo de activo y sector de actividad económica", unpublished.

Cortés, Jaime (2010), "Avances y desafíos en salud-e y telemedicina en Costa Rica", *Avances y desafíos en salud-e y telemedicina en América Latina y el Caribe* (LC/L.3252), Andrés Fernández and Enrique Oviedo (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

De León, Omar (2013), "Regional and international connectivity", *Broadband in Latin America: beyond connectivity* (LC/L.3588), V. Jordán, H. Galperín and W. Peres (coords.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC)/Regional Dialogue on the Information Society (DIRSI), forthcoming.

De Vries, de G. and others (2010), *ICT Investment in Latin America: Does it Matter for Economic Growth?*, Information Society project, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Díaz Alejandro C. (1984), "Latin America in the 1930s", *Latin America in the 1930s*, R. Thorp (ed.), New York, Macmillan.

Dosi, G., K. Pavitt and L. Soete (1990), *The Economic of Technical Change and International Trade*, London, Harvester Wheatsheaf Press.

Draibe, S. (2009), "Programas de transferência de renda condicionada", *América Latina: desafios da democracia e do desenvolvimento. Políticas sociais para além da crise*, Fernando H. Cardoso and Alejandro Foxley, Rio de Janeiro, Ed. Campus.

Easterly, W. and R. Levine (2002), "It's not factor accumulation: stylized facts and growth models", *Economic Growth: Sources, Trends and Cycles*, N. Loayza and R. Soto (eds.), Banco Central de Chile, Santiago, Chile.

European Commission (2010), *Europe's Digital Competitiveness Report, 2010*.

Flores-Roux, Ernesto M. (2013), "Mobile broadband: the urgent need for speedier roll-out", *Broadband in Latin America: beyond connectivity* (LC/L.3588), V. Jordán, H. Galperín and W. Peres (coords.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC)/Regional Dialogue on the Information Society (DIRSI), forthcoming.

Gartner (2012), *Gartner Market Databook*, tercer trimestre.

Gereffi Gary, Mario Castillo and Karina Fernández-Stark (2009), *The Offshore Services Industry: A New Opportunity for Latin America*, Washington, D.C., Inter-American Development Bank (IDB).

Gertrudis, Nancy (2010), "Avances y desafíos en salud-e y telemedicina en México", *Avances y desafíos en salud-e y telemedicina en América Latina y el Caribe* (LC/L.3252), Andrés Fernández and Enrique Oviedo (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Gruber, H. and P. Koutroumpis (2011), "Mobile telecommunications and the impact on economic development", *Economic Policy*, vol. 67, July.

GSMA (GSM Association) (2012), *Latin American Mobile Observatory: Driving Economic and Social Development through Mobile Broadband*, London.
GSMA/PWC (GSM Association/PricewaterhouseCoopers) (2012), *Touching Lives through Mobile Health Assessment of the Global Market Opportunity*.
Harchaoui, T. and others (2002), "Information technology and economic growth in Canada and the U.S.", *Monthly Labor Review*, October.
Hausmann, R., J. Hwang and D. Rodrik (2007), "What you export matters", *Journal of Economic Growth*, vol. 12, No. 1.
Hinostroza, J.E. (2009), "Integración de TIC al currículum: propuestas y realidades en Latinoamérica", *serie Políticas Educativas y TIC en Latinoamérica, Publicación,* No. 2, Ministry of Education, Government of Chile.
Hinostroza, J. E. and C. Labbé (2011), "Políticas y prácticas de informática educativa en América Latina y El Caribe", *Políticas Sociales series*, No. 171 (LC/L.3335-P), Santiago, Chile. United Nations publication, Sales No. S.11.II.G.53.
Hulten, C. R. and F.C. Wykoff (1981a), "Economic depreciation and the taxation of structures in United States manufacturing industries: an empirical analysis", *The Measurement of Capital*, D. Usher (ed.), Chicago, University of Chicago Press.
______ (1981b), "The estimation of economic depreciation using vintage assets prices: an aplication of the Box-Cox power transformation", *Journal of Econometrics*, No. 15.
______ (1981c), "The measurement of economic depreciation", *Depreciation, Inflation and the Taxation of Income from Capital*, C.R. Hulten (ed.), Washington, D.C., The Urban Institute Press.
IDC (International Data Corporation) (2012), "Competing on the 3rd platform, opportunities at the intersection of mobile, cloud, social and big data", paper presented at IDC Predictions for 2013 [online]
Infante, R. (2011), "América Latina en el "umbral del desarrollo". Un ejercicio de convergencia productiva", *Working document*, No. 14, Inclusive development project, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).
ITU (International Telecommunication Union) (2012), *Measurng the Information Society 2012*.
Jara, Ignacio (2012), "Dimensiones relevantes para tomadores de decisiones", *Las tecnologías digitales frente a los desafíos de una educación inclusiva en América Latina: algunos casos de buenas prácticas* (LC/L.3545), G. Sunkel y D. Trucco (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).
Jaumotte, F., S. Lall and C. Papageorgiou (2009), "Rising income inequality: technology, or trade and financial globalization?", *IMF Working Paper*, Washington, D.C., International Monetary Fund (IMF), September.
Jorgenson, D.W. (2005), "Accounting for growth in the information age", *Handbook of Economic Growth*, P. Aghion and S. Durlauf (eds.), vol. 1A, North-Holland, Amsterdam.
Jorgenson, D.W. and B. Fraumeni (1992), "Investment in education and U.S. economic growth", *The Scandinavian Journal of Economics,* No. 94, Supplement.
Jorgenson, D. . and Z. Griliches (1967), "The explanation of productivity change", *Review of Economic Studies*, vol. 34.
Juniper Research (2013), "Press Release: mHealth Users of Remote Health Monitoring to Reach 3 Million by 2016: Smarphones Play Leading Role", February [online] http://www.juniperresearch.com/viewpressrelease. php?pr=285.

Katz, Raúl L. (2013), "Broadband, digitization and development", *Broadband in Latin America: beyond connectivity* (LC/L.3588), V. Jordán, H. Galperín and W. Peres (coords.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC)/Regional Dialogue on the Information Society (DIRSI), forthcoming.

Katz, Raúl L. and Hermán Galperín (2013), "The demand gap: drivers and public policies", *Broadband in Latin America: beyond connectivity* (LC/L.3588), V. Jordán, H. Galperín and W. Peres (coords.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC)/Regional Dialogue on the Information Society (DIRSI), forthcoming.

Kaztman, R. (2010), "Impacto social de la incorporación de las TIC en el sistema educativo", working paper of Alliance for the Information Society, phase 2 @LIS2 Project, Education component, Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), unpublished.

Koutroumpis, P. (2009), "The economic impact of broadband on growth: a simultaneous approach", *Telecommunications Policy*, No. 33.

Lall, S. (2004), "China's competitive performance: a threat to East Asian manufactured exports?", *World Development*, vol. 32, No. 9.

______ (2000), "The technological structure and performance of developing country manufactured exports. 1985-1998", *Working Paper*, No. 44.

Lansing, K. and A. Markiewicz (2011), "Technology diffusion and increasing income inequality", August [online].

Levy, Santiago (2007), *Productividad, crecimiento y pobreza en México: ¿Qué sigue después de Progresa-Oportunidades?*, Washington, D.C., Inter-American Development Bank (IDB).

Lindert, Kathy and others (2007), "The nuts and bolts of Brazil's Bolsa Família Program: implementing conditional cash transfers in a decentralized context", *Social Protection Discussion Paper*, No. 0709.

Mariscal, Judith and Walter Lepore (2012), "Oportunidades y uso de TICs: innovaciones en programa de combate a la pobreza", working paper, No. 226, Toluca, Economic Research and Teaching Centre (CIDE) .

Margolis, Álvaro and others (2010), "Avances y desafíos en salud-e y telemedicina en Uruguay", *Avances y desafíos en salud-e y telemedicina en América Latina y el Caribe* (LC/L.3252), Andrés Fernández and Enrique Oviedo (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

McKinsey & Company (2012), *Online and Upcoming: The Internet's Impact on Aspiring Countries*, O. Nottebohm and others, January.

______ (2011), *Internet Matters: The Net's Sweeping Impact on Growth, Jobs, and Prosperity*, Matthieu Pélissié du Rausas and others, May.

McMillan, M. and D. Rodrik (2011), "Globalization, structural change and productivity growth", *NBER Working Paper*, No. 17143, National Bureau of Economic Research.

Mijares, María Teresa (2010), "Avances y desafíos en salud-e y telemedicina en Ecuador", *Avances y desafíos en salud-e y telemedicina en América Latina y el Caribe* (LC/L.3252), Andrés Fernández and Enrique Oviedo (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Navarro, Lucas (2012), "Dinámica de las diferencias de género en el uso de Internet en América Latina: ¿se cierra la brecha?", Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), December, unpublished.

OECD (Organization for Economic Cooperation and Development) (2011), *Growing Income Inequality in OECD Countries:What Drives it and How Can Policy Tackel it?*, Paris.

Oliveri, Nora (2010), "Avances y desafíos en salud-e y telemedicina en Argentina", *Avances y desafíos en salud-e y telemedicina en América Latina y el Caribe* (LC/L.3252), Andrés Fernández and Enrique Oviedo (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Peres, Wilson and Martin Hilbert (eds.) (2009), "Information Societies in Latin America and the Caribbean Development of Technologies and Technologies for Development", *Libros de la CEPAL*, No. 98 (LC/G.2363-P), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Plottier, Cecilia, Sebastián Rovira and Giovanni Stumpo (2013), "Una iniciativa sectorial para la difusión de TIC en las empresas. La experiencia de Uruguay", *Project Documents*, No. 535 (LC/W.535), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC)/ Ministry of Industry, Energy and Mining (MIEM), March.

Prescott, E. C. (1998), "Needed: A Theory of Total Factor Productivity", *International Economic Review*, No. 39.

Red GEALC/IDRC/OEA (Network of e-Government Leaders of Latin America and the Caribbean/International Development Research Centre/Organization of American States) (2008), *De la teoría a la práctica: cómo implementar con éxito el gobierno electrónico. La experiencia regional y las barreras de la e- innovación*, October.

Rivas, Diego and Giovanni Stumpo (2011), "Las TIC en el tejido productivo de América Latina", *El desafío de las TIC en Argentina. Crear capacidades para la generación de empleo* (LC/R.2178/Rev.1), M. Novick, and S. Rotondo (comps.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Rodrigues, M. and A. Rodríguez (orgs.) (2012), "Information and communication technologies (ICT) for agricultural development in Latin America: trends, barriers and policies", Santiago, Chile, Comisión Económica para América Latina y el Caribe (CEPAL), inédito.

Rodrik, D. (2008), "The real exchange rate and economic growth", *Brooking Papers on Economic Activity*, Nº 2.

Rovira, Sebastián, Pietro Santoleri and Giovanni Stumpo (2013), "Incorporación de TIC en el sector productivo: uso y desuso de las políticas públicas para favorecer su difusión", *Entre mitos y realidades. TIC, políticas públicas y desarrollo productivo en América Latina* (LC/L.3600), Sebastián Rovira and Giovanni Stumpo (comps.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Sabbagh, Karim and others (2012), "Maximizing the impact of digitization", *The Global Information Technology Report 2012: Living in a Hyperconnected World*, Soumitra Dutta and Benat Bilbao-Osorio (eds.), The Bussiness School of the World (INSEAD)/World Economic Forum.

Sandor, Tomás (2010), "La salud electrónica en el Caribe", *Avances y desafíos en salud-e y telemedicina en América Latina y el Caribe* (LC/L.3252), Andrés Fernández and Enrique Oviedo (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Scheryer, P. and others (2003), "OECD capital services estimates: methodology and a first set of results", *OECD Statistics Working Papers*, No. 6.

Schneider, D. (2010), "The impact of ICT investments on the relative demand for high-, medium-, and low-skilled workers: industry versus country analysis", *Humboldt-Universität Discussion Paper*, No. 2010-017, Berlin, febrero.

Schumpeter, J. (1935), "The analysis of economic change", *Review of Economic Studies*, May.

_____ (1912), *Theory of Economic Development*, Leipzig.

Singh, A. and R. Dhumale (2004) "Globalization, technology and income inequiality: a critical analysis", *Inequality Growth and Poverty in an Era of Liberalization and Globalization,* Giovanni Andrea Cornia, Oxford University Press.

Sunkel, Guillermo and Daniela Trucco (eds.) (2012), *Las tecnologías digitales frente a los desafíos de una educación inclusiva en América Latina: Algunos casos de buenas prácticas* (LC/L.3545), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Sunkel, Guillermo, Daniela Trucco and Sebastián Möller (2010), "Aprender y enseñar con TIC en América Latina. Potenciales beneficios", *Políticas Sociales series*, No. 169 (LC/L.3291-P), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), inédito.

Tholons and C.R. Durán (2007), *El reto de las tecnologías de la información*, Mexico City, National Autonomous University of Mexico.

Timmer, Marcel and others (2007), *EU KLEMS Growth and Productivity accounts Part I Methodology* [online]

United Nations/Global Pulse (2012), *Big Data for Development: Challenges & Opportunities*, New York, May [online] http://www.unglobalpulse.org/sites/default/files/BigDataforDevelopment-UNGlobalPulseJune2012.pdf.

Van Ark, B., M. O'Mahony and M. Timmer (2008), "The productivity gap between Europe and the United States: Trends and causes", *Journal of Economic Perspectives*, vol. 22, No. 1.

Vega, Silvio (2010), "Avances y desafíos en salud-e y telemedicina en Panamá", *Avances y desafíos en salud-e y telemedicina en América Latina y el Caribe* (LC/L.3252), Andrés Fernández and Enrique Oviedo (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

Vélez, Jorge (2010), "Avances y desafíos en salud-e y telemedicina en Colombia", *Avances y desafíos en salud-e y telemedicina en América Latina y el Caribe* (LC/L.3252), Andrés Fernández and Enrique Oviedo (eds.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC).

VISA América Economía (2012), "Los años del boom", *Estudio de comercio electrónico en América Latina*, May.

Wade, R. (1990), *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialisation*, Princeton, Princeton University Press.

Databases:

fDi Markets (2010) [online] www.fdimarkets.com

ITU International Telecommunication Union (2011), World Telecommunications Indicators Database.

ORBA (Regional Broadband Observatory), Economic Commission for Latin America and the Caribbean (ECLAC), Santiago, Chile.

OSILAC (Observatory for the Information Society in Latin America and the Caribbean), Economic Commission for Latin America and the Caribbean (ECLAC), Santiago, Chile.

Appendices

Appendix I
Connectivity initiatives in Latin America and the Caribbean

Table A.I.1

CONNECTIVITY INITIATIVES IN PUBLIC INSTITUTIONS IN LATIN AMERICA AND THE CARIBBEAN (17 COUNTRIES), 2012

Country	Initiative	Description
Argentina	National Argentina Connected Plan	The main line of action for government services and cultural content includes technology for better management and quality in communications between the different areas of government and the promotion of the development of convergent content with social value.
	National Data Centre and Federal Fibre Optic Network	Under development by the company ARSAT, this will be the focal point of the future Federal Fibre Optic Network, which will support the implementation of connectivity solutions and specific services for public institutions. This network is defined and configured as layers of connectivity/services, where each layer represents a connectivity solution, for example, in health, security, education or culture.
Barbados	ICT Strategic Plan of Barbados	The Plan has two roles: to improve the delivery of both government and private services through ICTs and to promote access to and use of these technologies. One of the objectives is to transform the public and business sectors into an e-environment.
Brazil	National Broadband Plan	One of the priorities of the Network is to establish "government points of contact of public interest."
	Digital Cities Project	This programme finances the deployment of the network connection infrastructure among municipal agencies (fibre optic ring), and between municipal agencies and local public facilities (schools, hospitals, libraries, tax service centres, etc.), as well as the installation of free Internet access points in widely used spots.
	Federal Government Fibre Optic Network	This fibre optic network infrastructure for metropolitan communications (*Infovia Brasília*) was created to serve federal government agencies located in Brasilia/Federal District. A federal government network with national coverage is being built through 2014, to be operated by Telebras. Additionally, several local and state governments have their own networks.
Chile	Digital Strategy 2007 – 2012	One of the goals is to utilize ICTs to improve government.
	State Connectivity and Communications Network (State INTRANET	In order to establish a base for exchanging different types of information, the databases from related agencies will be connected through INTRANET. Each public institution can offer different citizen services using the new information technologies, with the possibility of better broadband and high availability.

Table A.I.1 (continued)

Country	Initiative	Description
Colombia	*Vive Digital* Broadband Plan	One of the strategic objectives is for 100% of municipal centres to have wireless Internet coverage, with 3G services and at least 50% with next-generation services like 4G.
	National fibre Optic Project	This prjoect expects to supply free connectivity, for five years, to 2,000 public institutions in almost 800 municipal centres. In each municipality, the programme will benefit two to three institutions in the areas of education, health, defence and culture.
	High-speed Network of Colombia (RAVEC)C	The network, which aims to securely connect state agencies, currently connects 122 agencies and is functioning in Bogotá and four major cities.
Costa Rica	National Telecommunications Development Plan	The established objectives include incorporating ICTs in public management, connecting public institutions to at least broadband Internet, and giving Internet access to 100% of staff members at their workplaces
Cuba	Framework Programme for the Digitization of Cuban Society	A programme to incorporate ICTs in government.
Dominican Republic	Fibre Optic Network	This network of approximately 2,500 km of fibre optic cable connects all the municipal centres of the country (31 provinces and a national district); it will incorporate 103 additional localities in the medium term and 21 in the long term.
	National Development Strategy 2030	The objectives are to increase broadband access and connectivity at affordable prices and to improve the capacity and quality of the country's international access through continuous updating and extension of the physical infrastructure, including the availability of an open-access, branched fibre optic backbone.
Ecuador	National Broadband Development Plan	One of the strategies is to stimulate the deployment of infrastructure in less served sectors, to support the government's objectives in the areas of public education, medical care and e-government..
Guatemala	National Agenda for the Information and Knowledge Society	The plan includes public policies, legal practices and governability for the formation and management of government networks.
Jamaica	e-Powering Jamaica	Objectives include improving the ICT infrastructure to support and secure the nation's information assets and harmonizing the public sector systems to ensure full integration and interoperability.
Mexico	National Fibre Optic Backbone (Red NIBA)	NIBA offers connectivity services to the country's institutional actors, the federal government, state governments, municipalities and educational institutions.
	Digital.mx Agenda	Objectives include government connectivity and system harmonization, guaranteeing the broadband connectivity of government offices.
Panama	Strategic Digital Agenda of the Governmental Innovation Authority	The project for free wireless Internet access (WiFi) in public entities envisages that government institutions and public companies will provide WiFi service to areas involving citizen services and assistance.
Paraguay	ICT Director Plan 2012	ICTs are to become a strategic focus for achieving sustainable development in Paraguay. Priority areas are defined as infrastructure, e-government, human resources development, research and development, ICT industry, e-commerce, standards, legal framework, awareness and ICT organization. The goals established for 2015 were defined around the United Nations e-government development index (EDGI): namely, the e-government ranking for online services should move up from 95th to 65th.
Peru	Digital Development Plan for the Information Society in Peru, Digital Agenda 2.0	The Digital Agenda promotes interoperability among government institutions and the development of an e-government strategy.
	National Broadband Development Plan of Peru	The plan recommends having broadband connectivity in public entities, with an emphasis on educational centres and health establishments.
Venezuela, Bolivarian Republic of	National Telecommunications, Informatics and Postal Services Plan 2007-2013	One of the strategies is the transformation of the state and the promotion of e-government. Policies include the implementation of mechanisms for the communication, generation, preservation and diffusion of knowledge associated with ICT use and best practices for public management.

Table A.I.1 (concluded)

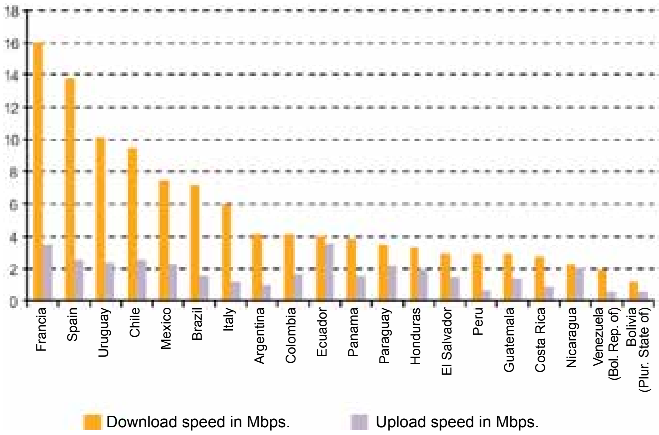
Country	Initiative	Description
Uruguay	CEIBAL Plan	As of October 2012, the CEIBAL Plan has connected 99% of urban public primary schools, 92% of rural public primary schools and 93% of secondary schools. The goal set in the 2015 Digital Agenda is "to provide fibre optic connection to all public primary and secondary schools located in urban centres with a population of over 10,000 inhabitants". Additionally, the CEIBAL Plan forges agreements with local governments to connect facilities such as libraries, playgrounds, cultural centres, museums, theatres and zoos.
	MEC Centres	The MEC Centres, of the Ministry for Education and Culture, are spaces that facilitate access to education, scientific and technological innovation and cultural services, as well as being used to carry out the National Digital Literacy Plan. There were 119 MEC Centres as of 2012.
	Salud.uy Health Programme	The *Salud.uy* Health Programme comprises a health data network for sending and processing images, supporting the electronic medical records platform and facilitating collaboration and research at the national and regional levels.
	REDuy Network	This high-speed network connects public agencies, providing a high level of security and availability, increasing efficiency and effectiveness and significantly improving the services provided using the latest technology. As of 2012, there were 123 implementation units connected, from an initial goal of 100.

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of information provided by the working group on eLAC2015.

Appendix II
Status of broadband in the region

Figure A.II.1

FIXED BROADBAND CONNECTION SPEEDS IN 2012

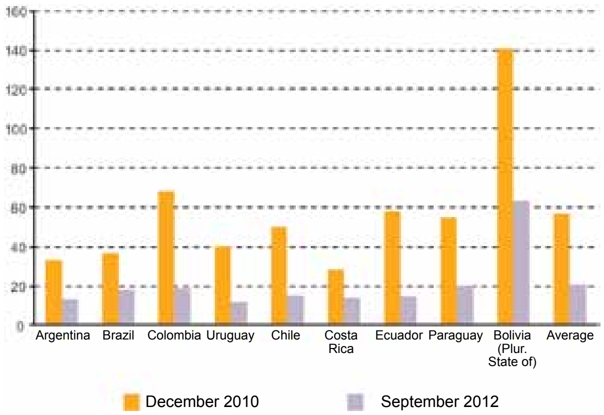


Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional Broadband Observatory (ORBA), on the basis of data of Ookla to 1 September 2012.

Figure A.II.2

EVOLUTION OF FIXED BROADBAND TARIFFS BETWEEN DECEMBER 2010 AND SEPTEMBER 2012

(US$ per 1 Mbps)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), Regional Broadband Observatory (ORBA), on the basis of published rates by the operators to September and December 2012.

Note: In the Plurinational State of Bolivia, the fixed broadband tariff was US$140.9 in December 2010 and US$63,4 in September 2012.

Appendix III
Model of the determinants of the probability of Internet use

The following specification is used for the Probit model:

$$P(use = 1) = F\begin{bmatrix} \propto + \beta_0 * woman + \beta_1 * \log(income) + \beta_2 * age + \beta_3 * years\ of\ schooling \\ + \beta_4 * unemployed + \beta_5 * student + \beta_6 * retired \\ + \beta_7 * skilled\ worker + \beta_8 * urban\ area \end{bmatrix}$$

where the variables are defined as follows:

- The dependent variable, $P(use = 1)$, is the probability of using the Internet anywhere. The variable *use* is a dummy value that takes a value of one if the individual reports having used the Internet from any access point and zero otherwise.
- ***woman*** is a dummy value that takes a value of one if the individual is a woman and zero otherwise. This variable is not expected to be significant.
- log ***(income)*** is the logarithm of per capita household income. This variable is expected to have a positive sign, as a higher income is expected to increase the probability of using the Internet. This variable captures the fact that higher-income households are more likely to be connected to the Internet.
- ***age*** is the age of the individual in years. This variable is expected to have a negative sign, as older individuals are expected to be less likely to use Internet.
- ***years of schooling*** is the number of years of formal education completed by the individual. The expected sign is positive: a higher education level is expected to increase the probability of using the Internet.
- ***unemployed*** is a dummy value that takes a value of one if the individual is unemployed and zero otherwise. This variable is expected to have a negative sign.
- ***student*** is a dummy value that takes a value of one if the individual is exclusively a student and zero if the individual does not participate in the labour market and is not a student. This variable is expected to have a positive sign, as students are believed to be more likely to use Internet.
- ***retired*** is a dummy value that takes a value of one if the individual is retired and zero if the individual does not participate in the labour market and is not retired. The expected sign is negative, as someone who is not working and not a student is expected to be less likely to use Internet.
- ***skilled worker*** is a dummy value that takes a value of one if the individual is employed in a high-skilled job[22] and zero if the individual is employed in any other type of job. This variable is expected to have a positive sign.
- ***urban area*** is a dummy value that takes a value of one if the individual lives in an urban area and zero if he or she lives in a rural area. This variable is expected to have a positive sign.

[22] High-skilled workers include the following: (i) executive and legislative branch officials, upper management in public administration and public companies and professionals; (ii) professionals, scientists and intellectuals; iii) mid-level professionals and technicians; and (iv) office employees.

The econometric model is used to estimate the marginal effect of each variable. The marginal effect is the response or change of the dependent variable (in this case, the probability of Internet use) when a marginal change occurs in one of the socioeconomic variables, the occupational status variable or the labour market insertion variable considered in the model. The marginal effect is given by the derivative of the regression equation relative to the explanatory variable in question.

$$Marginal\ effect = \frac{\partial P_i}{\partial age_i} = f\begin{bmatrix} \propto + \beta_0 * woman + \beta_1 * \log(income) + \beta_2 * age + \beta_3 * years\ of\ schooling \\ + \beta_4 * unemployed + \beta_5 * student + \beta_6 * retired \\ + \beta_7 * skilled\ worker + \beta_8 * urban\ area \end{bmatrix} * \beta_2$$

In the case of the dummy variables, the marginal change would be the change in the variable, that is, if the individual changes his or her status. For example, becoming employed (if unemployed), ceasing to be a student and entering the labour market.

Estimating the regressions, such as equations (1) and (2), produces the coefficient for each of the variables. To then find the marginal effect, the function is calculated at the average of the independent variables. The econometric package used to estimate the model performs this process internally, and the output directly generates the marginal effects.

Table A.III.1

PROBIT MODEL OF THE DETERMINANTS OF THE PROBABILITY OF INTERNET USE

Variable / Country	Brazil	Chile	Costa Rica	Ecuador	Honduras	Paraguay	Peru	El Salvador	Uruguay
Female	0.0068	-0.0301	-0.0324	-0.0129	-0.0025	-0.0097	-0.0648	-0.0048	-0.0147
	[0.0019]***	[0.0040]***	[0.0090]***	[0.0032]***	[0.0010]***	[0.0041]**	[0.0031]***	[0.0009]***	[0.0037]***
Log(income)	0.1943	0.1462	0.1114	0.0793	0.0155	0.0764	0.0866	0.0183	0.2327
	[0.0016]***	[0.0039]***	[0.0072]***	[0.0034]***	[0.0013]***	[0.0042]***	[0.0031]***	[0.0015]***	[0.0039]***
Age	-0.0112	-0.0103	-0.0073	-0.0086	-0.0011	-0.0022	-0.0114	-0.0012	-0.02
	[0.0001]***	[0.0002]***	[0.0004]***	[0.0002]***	[0.0001]***	[0.0002]***	[0.0001]***	[0.0001]***	[0.0002]***
Years of education	0.0031	0.0553	0.0135	0.0357	0.0084	0.0063	0.0325	0.0093	0.0508
	[0.0001]***	[0.0008]***	[0.0020]***	[0.0006]***	[0.0006]***	[0.0009]***	[0.0005]***	[0.0006]***	[0.0007]***
Unemployed	0.0322	0.098	0.1738	0.0702	0.0171	0.1241	0.0732	0.0101	-0.0249
	[0.0050]***	[0.0112]***	[0.0549]***	[0.0142]***	[0.0075]**	[0.0238]***	[0.0050]***	[0.0046]**	[0.0097]***
Student	n.a.	0.3922	0.5549	0.2289	0.0361	0.2076	n.a.	0.0969	0.1889
		[0.0083]***	[0.1428]***	[0.0086]***	[0.0037]***	[0.0167]***		[0.0071]***	[0.0091]***
Retired	n.a.	0.047	0.0651	0.0516	-0.0115	-0.0022	n.a.	0.0067	0.0418
		[0.0171]***	[0.0262]**	[0.0282]*	[0.0025]***	[0.0263]		[0.0087]	[0.0093]***
Skilled worker	0.438	0.2262	0.2903	0.1837	0.0045	0.2359	0.1522	0.0159	0.2483
	[0.0029]***	[0.0085]***	[0.0187]***	[0.0118]***	[0.0027]	[0.0206]***	[0.0099]***	[0.0031]***	[0.0064]***
Urban area	0.2189	0.2016	0.1067	0.0937	0.0232	0.0892	0.1189	0.0173	n.a.
	[0.0029]***	[0.0063]***	[0.0084]***	[0.0045]***	[0.0023]***	[0.0072]***	[0.0038]***	[0.0018]***	
No. observations	355 450	222 291	11 367	75 912	29 259	18 460	80 133	77 611	123 631
Pseudo *R*-squared	0.2789	0.369	0.4779	0.4786	0.4739	0.3848	0.4499	0.4682	0.3949

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT.
Robust standard errors are in parentheses. * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

Appendix IV
Growth accounting framework

Estimation of capital inputs

The economic growth model can be written as:

$$Y = F(A, K, L) \quad (1)$$

where output (***Y***) is obtained as a function of the combination of technology (***A***), capital (***K***) and labour (***L***).

In logarithms, the growth of output can be expressed as:

$$\dot{Y}/Y = \left(\frac{F_A A}{Y}\right)(\dot{A}/A) + \left(\frac{F_K K}{Y}\right)(\dot{K}/K) + \left(\frac{F_L L}{Y}\right)(\dot{L}/L) \quad (2)$$

Assuming complete and efficient factor markets and constant returns to scale, the return to factors of production is equal to their marginal productivity. Under this hypothesis, equation (2) can be rewritten as:

$$\dot{Y}/Y = g + \alpha(\dot{K}/K) + (1-\alpha)(\dot{L}/L) \quad (3)$$

where α is the GDP share of income from capital and [insert equation (g ≡...)]. In this context, the variable g is known as multifactor productivity and is an indicator of how efficiently the economy combines labour and capital to produce value added.

In theory, all the variables in equation (3) except g are observable, so they are usually estimated after rearranging as follows:

$$g = \dot{Y}/Y - \alpha(\dot{K}/K) - (1-\alpha)(\dot{L}/L) \quad (4)$$

Equation (4) measures how efficiently the factors are used in an economy. There are sources of variable measurement error, but they are all minor relative to the problem of defining and measuring the capital stock and capital services (Jorgenson and Griliches, 1967). In general, the certainty of the estimate of the capital contribution is limited by the availability of data.

Just as workers are repositories of the stock of human capital and provide services that can be measured in hours worked, capital goods represent a stock that produces a flow of services which constitute inputs in the production process. The difference is that while workers receive a wage in exchange for their services, capital goods are generally the property of the firms that utilize them, so there is no record of payment for the services rendered.

Therefore, measuring the contribution of capital in the production process requires the correct estimate of the flow of services deriving from different types of capital assets, together with the weights used in their aggregation. The estimate of capital service flows starts by measuring the available capital stock over time. Once they have been estimated, the respective user cost of capital is calculated and used to aggregate the different asset classes in a capital services index.

Capital services

To obtain the flow of capital services, the services are assumed to be proportional to the productive capital stock available for each type of good:

$$\lambda_{j,t} K^{p}_{j,t} \qquad (5)$$

where $\lambda_{j,t}$ is a proportionality factor and $K^{p}_{j,t}$ is the net capital stock of the different types of productive assets in the economy.

In theory, the proportionality factor $\lambda_{j,t}$ captures the effect of variations in the use of installed capacity across the economic cycle. Since capacity utilization is particularly difficult to measure, the proportionality factor is generally assumed to be equal to one for all assets at all times, that is, $\lambda_{j,t} = 1 \quad \forall j$, $\forall t$.

Once the flow of capital services has been estimated for each asset class, the next step is to aggregate the assets. The assumption of perfect competition in the factor market implies that a benefit-maximizing company will utilize capital goods to the point at which the return is equal to the marginal benefit of the good. Therefore, the capital services of different asset classes are weighted by the user cost of capital.

Capital stock

The net capital stock of the different types of productive assets available in the economy are estimated using the following formula:

$$K^{p}_{t,j} = \sum_{\tau=0}^{T_j} I_{j,t-\tau} R_{j,\tau} E_{j,\tau} \qquad (6)$$

where $I_{j,t-\tau}$ is investment of vintage τ expressed in constant prices; $R_{j,\tau}$ is the asset retirement function, which determines the share of vintage τ investment that currently survives; and $E_{j,\tau}$ represents the age-efficiency profile, which captures the loss of an asset's productive efficiency it ages. To apply equation (6), we need to define the average service life of each type of good,[23] as well as the asset retirement and efficiency functions used.

A geometric function is used to jointly model the retirement of assets and their loss of efficiency. The functional form is:

$$R_{j,\tau} E_{j,\tau} = \left(1 - \frac{R_j}{\overline{T}_j}\right)^{\tau} \qquad (7)$$

[23] The average life is the life expectancy of an asset, while the maximum life is the age at which the longest-lived asset in the cohort is retired.

where the parameter [insert variable (missing in the original)] defines the speed of efficiency loss[24] and [insert variable (missing in the original)] is the average service life of the asset.

User cost of capital

In equilibrium, the market price of any asset is equal to the expected present value of the flows they generate. In the case of capital goods, the flows are equivalent to what the owner would receive in rent from the asset in the same period. Therefore, the market value of an asset with maximum life and current age [insert variable is given by

$$p_{j,t,\tau} = \sum_{s=0}^{T_j} \left[\frac{\mu_{j,t+s,\tau+s}}{\Pi_{k=0}^{s}(1+i_{t+k})} \right] \qquad (8)$$

where i_t is the nominal rate of return, which is assumed to be equal for all asset classes, and $\mu_{j,t,\tau}$ is the rental price of the asset with age τ in period t, or the user cost, which under the assumptions made in the exercise is equal to the marginal productivity of the asset and is expressed as

$$\mu_{j,t,0} \approx p_{j,t,0}(i_t + d_{j,t,0} - q_{j,t}) \qquad (9)$$

The user cost is estimated using the exogenous rate of return obtained from observed market interest rates. The problem is that the relevant rate depends on the financial profile of each firm, so the usual practice is to use average asset and liability rates.

The use of an exogenous rate of return implicitly assumes that economic agents have complete information (Harchaoui and others, 2002). This implies that there are no agency problems between owners and managers of the factors of production. It also assumes that there is a complete and efficient market for second-hand assets, which implies that investment decisions are reversible, that capital assets are divisible and that the different asset classes are substitutes in the production process.

One of the consequences of adopting an exogenous rate of return is that, in general, the total value of capital services will not equal the gross surplus obtained from the national accounts. This discrepancy can be explained as a difference between expected costs and actual costs, as evidence that the production process is not characterized by constant returns to scale or as the presence of imperfect markets.

Gross fixed capital formation

Gross fixed capital formation (GFCF) is a critical input for calculating the net capital stock, as it is made up of goods used to produce or generate value in a production process. Therefore, its decomposition by asset class is of the utmost importance for the correct estimation of capital service flows, as well as for disaggregating the growth contribution of each asset. Differentiation by asset class makes it possible to identify the role of ICT capital versus non-ICT capital in economic growth.

[24] The usual practice is to use the values estimated for the United States by Hulten and Wykoff (1981a, 1981b, 1981c), which are 1.65 for machinery and equipment and 0.91 for construction.

There has been a strong accumulation of ICT capital in the last couple of decades, but the build-up is uneven among the economies in the study. Therefore, while the national accounts now include official series on investment in computer and telecommunications equipment, the history is not extensive. When this series is not available, an estimation methodology must be used instead. Software, in particular, is not measured in much of the region. The applied methodology is in line with guidelines from the OECD and the Bureau of Economics Analysis (BEA).

For countries and time periods that are missing official series, computer and telecommunications equipment are estimated using the commodity flow method, which tracks the products from their domestic production or import to their final destination, consumption or investment. First, ECLAC industrial surveys and trade statistics are used to obtain the apparent expenditure on office, computer and telecommunications equipment (that is, national production plus imports minus exports). Next, the share of investment over apparent expenditure on these goods is calculated in the input-output matrix for each country. Finally, to obtain the investment series for office, computer and telecommunications equipment, this share is applied to the apparent expense obtained in the first step:

$$I_{i,t} = \frac{I_{i,t}^{IO}}{(Q_{i,t}^{IO} + (M_{i,t}^{IO} - E_{i,t}^{IO})} * (Q_{i,t} + M_{i,t} - E_{i,t}) \qquad (10)$$

where $I_{i,t}$ is investment in good i (office, computer and telecommunications equipment) in year *t*; Q_{it} is domestic production of these goods, M_{it} is imports and E_{it} is exports. The superscript IO denotes the use of the input-output matrix for each country (Argentina 1997, Chile 2003, Brazil 2000 and Mexico 2003).

Gross fixed capital formation in software

This method cannot be used to obtain investment in software because this good is not explicitly recorded in the countries' input-output matrix or in all their databases. It is therefore estimated using a methodology based on the acquisition or production of software, which is treated as gross fixed capital formation.

The literature distinguishes between three types of software, which are treated as investment for the estimation: (i) commercial off-the-shelf (COTS) software, which comprises standardized programmes designed for the mass market and which is valued at the purchase price; (ii) custom software, which is designed exclusively for the firm that needs it and is valued at a basic estimated price; and (iii) in-house software, which covers programmes designed by the firm itself for internal use with no intent to market the product and is valued on the basis of the labour costs of the professionals involved in product creation.

Investment in COTS software can be estimated from the capitalized value of software produced domestically, plus imports and trade margins and minus exports, household consumption and software integrated by default in hardware equipment. Custom software is estimated from the valuation of national programming and design services, plus imports of these services and minus exports. In-house software, due to the lack of a basic observable price, is estimated as the sum of production costs, understood as the number of IT professionals weighted by their average income, minus non-labour and administrative costs. If the actual time dedicated to software production is unknown, the recommended rule is to use 50% as an adjustment factor. This rule was proposed by Boehm (1981), who estimates the time spent by computer programmers and analysts on the production of new software programmes.

A number of possible deflators have been proposed for obtaining the real series. Given the data availability, the construction of the series becomes more complicated when software is broken down by type. Therefore, specific assets were estimated according to the harmonization method described by Scheryer and others (2003), which allows deflating the total software series.

Data collection is not extensive in the countries analysed, so data were extrapolated backwards using an elasticity between hardware and software in the OECD countries, calculated by Vries and others (2010). Finally, the constant software series was estimated using the harmonized method described in Schreyer and others (2003).

$$P_{soft\ country\ x} = \frac{P_{GDP\ country\ x}}{P_{GDP\ US}} P_{soft\ US}$$

Estimation of labour inputs

As described above, employment is a determining factor in the productivity analysis defined by equation (4), so it is important to measure its impact on the growth contribution.

Hours worked provide a starting point for an economic measure of the labour factor, but they can be affected by individual characteristics of workers, which generates differences in productivity in those hours worked. Therefore, keeping quality constant could result in a biased estimate that ignores the heterogeneity of the labour force.

Disaggregating hours worked by the individual characteristics of workers and by the economic sectors in which they are employed can improve the results on the determinants of growth, from an economic perspective. A better estimate of labour quality would differentiate between a measure that reflects status and quality versus a simpler measure that does not incorporate the heterogeneity of workers and human capital.

In recent decades, efforts have been aimed at explaining the different determinants of employment, which thus contribute to faster or slower growth. This report estimates the labour factor by taking into account the main determinants of the unemployment of the labour force, using an adjustment measure to correct for these factors. Given that the objective is to measure the growth impact of the contribution of the labour force, the first challenge is to get around the usual problems of data availability on the labour market, which underlie the counties' employment surveys and require the KLEMS methodology.

The estimation is based on the multifactor productivity model of Jorgenson and Fraumeni, (1992) and the EU KLEMS recommendations (Timmer and others, 2007), which centre on capital-labour substitution. This measure can be divided between increased hours worked and improved quality, considering workers with different capital human capital stock levels. The model thus supports distinguishing changes in labour quality, by incorporating inputs such as hourly wages and more specific characteristics of the employed population and thereby recognizing the heterogeneity of the labour market.

To estimate labour services, the growth rate of labour inputs (L_t) is expressed as a transcendental logarithmic (translog) function, which is a generalization of a Cobb-Douglas function for the categories, or characteristics, given by sex, age group, educational level and economic sector, and is defined as:

$$\Delta \ln L_t = \sum \bar{v}_t \Delta \ln H_{it} \qquad (11)$$

where the weights are given by the average share of each category in the value of sectoral labour income,

$$v = \frac{W_{it}H_{it}}{\sum W_{it}H_{it}} v = \frac{W_{it}H_{it}}{\sum W_{it}H_{it}} \qquad (12)$$

$$\bar{v}_t = 0.5\ (v_t - v_{t-1})$$

where W_{it} is the set of prices for all categories.

This decomposition allows the identification of the relationship in the growth contribution when labour market heterogeneity is observed.

Necessary data for the analysis

Capital factor

To calculate capital and labour services, the inputs needed for carrying out the methodology reviewed above were provided by the central banks and national statistics institutions of each country, according to the availability of official data. Each methodology considers a disaggregation by economic sector, using a standardization based on the disaggregation available in the national accounts of each country, as detailed in table A.IV.1.

Table A.IV.1

ECONOMIC SECTORS

Agriculture, hunting and fishing
Mining and quarrying
Manufacturing
Electricity, gas and water
Construction
Trade, hotels and restaurants
Transportation and communication
Financial services
Community and social services

Source: Economic Commission for Latin America and the Caribbean (ECLAC).

As a first step, calculating capital services requires the GFCF series, which should be broken down by asset class. Table A.IV.2 shows the classification proposed by the KLEMS methodology. The breakdown does not necessarily coincide with the GFCF classifications published by the national statistics institutes and central banks of the countries in the study. These differences derive from the lack of a disaggregation for some goods and methodological changes introduced in the period of analysis through changes in the benchmark years of the national accounts. Therefore, the exercise not only assumes a link through magnitudes, but also, to the extent possible, considers the need to undertake a prior homogenization of those magnitudes.

Table A.IV.2

BREAKDOWN OF GFCF BY ASSET CLASS

Construction
Residential construction
Non-residential construction
Transportation equipment
Machinery, equipment and other products
Agricultural products
Metal products and machinery
Metal products
Mechanical machinery and equipment
Electrical machinery and equipment
ICT products
Office machinery and computer equipment
Telecommunications equipment
Software

Source: CEconomic Commission for Latin America and the Caribbean (ECLAC).

Based on the official data from each country and the estimate of all or part of ICT capital, an approximation of the proposed decomposition was performed (table A.IV.3).

Table A.IV.3

BREAKDOWN OF GFCF BY COUNTRY AND ASSET CLASS

	Argentina (1993-2008)	Brazil (1995-2008)	Chile (1990- 2008)	Mexico (1990-2008)
Construction	x	x	x	x
Residential construction	x	x	x	x
Non-residential construction	x	x	x	x
Transportation equipment	x	x	x	x
Machinery, equipment and other products	x	x	x	x
Agricultural products		x	x	x
Metal products and machinery		x	x	x
Metal products		x		
Mechanical machinery and equipment		x		
Electrical machinery and equipment		x		
ICT products	x	x	x	x
Office machinery and computer equipment	x	x	x	x
Telecommunications equipment	x	x	x	x
Software	x	x	x	x

Source: Economic Commission for Latin America and the Caribbean (ECLAC).

Given the discrepancies in the national accounts series whenever the benchmark or base year is changed, it is necessary to establish the link in both real and nominal terms. Splicing an individual series is a simple problem; however, additional rules are needed when dealing with a set of series that are interlinked by multiple identities. In this case, they are adjusted so that the sum of the components is equal to the aggregate.

Software is a relatively young asset, whose insertion in Latin America has mostly occurred in the last few years and whose measurement is even more recent. Consequently, the application of the methodology is limited by the availability of data and hence must be based on the different surveys available from national statistics institutes, central banks and so forth.

COTS software is measured mainly through purchases by firms, excluding licenses that come with computer equipment. For Chile, the satellite ICT survey includes data on software investment, based on an acquisition methodology. For Brazil and Mexico, this type of software is estimated using data published by Business Software Alliance (BSA), which estimates the percentage and amount of piracy in each country. This estimated percentage is then used to calculate the difference, which corresponds to licenses sold in the formal market and valued at market price.

Custom software is measured through sales. Since these transactions are with a specific industry, custom software investment can be estimate based on the income of firms that provide IT services.[25] For Chile and Brazil, the services survey provides information on the income earned by firms that provide IT services. For Mexico, the survey on technological research and development also provides information on the income of firms whose line of business is related to the provision of IT services.

In-house software is estimated from labour costs, which requires information on the salaries of specialists in the field, in particular software engineers.[26] For Chile, the employment survey and the supplementary income survey were used to extract the wage bill share for software engineers, and then the 50% rule proposed by the OECD was applied. The series was adjusted using the Monthly Services Survey to obtain the final series. For Brazil and Mexico, this asset is estimated on the basis of salaries paid by firms that provide IT services. The information is extracted from the services survey and uses the same methodology, with the series adjusted by 50% to obtain the estimated value of software developed by professionals within the firm.

Once the partial estimate by type of software is obtained, the series is aggregated to obtain gross fixed capital formation, summing the three software classes and then adjusting them for exports and imports. Finally, the short series are extrapolated backwards based on the elasticity of hardware and software, calculated using a panel of data for OECD countries from de Vries and others (2010).

For Argentina, a special methodology was adopted due to limited data availability, such that software GFCF is derived from a sales estimate by the Argentine Chamber of Software for some years, extrapolated backwards based on the ratio of hardware to software stock (Coremberg, 2011).

[25] Specifically, software consultancy and supply, as defined by the International Standard Industrial Classification (ISIC Rev. 3) code 722.

[26] Software engineers as defined by ISIC code 213.

Labour factor

The development of the labour services methodology requires time series for key variables —such as hours, employment and labour income— and their different decompositions. This supports a detailed analysis of the factor's impact on economic growth.

The decomposition of the input variables allows the identification of the relationship to the growth contribution when there is observed heterogeneity in the labour market. Therefore, for each economic sector included in table A.IV-4, hours and income are classified by sex, three age groups and three educational levels.

Data on hours and income cover the period from 1990 to 2009 based on information extracted from household surveys for each country. For Argentina, the data were taken from the Permanent Household Survey and the national accounts; for Brazil, the National Household Sample Survey (PNAD) and the Annual Social Information Report (RAIS); for Chile, the National Employment Survey (ENE) and the Supplementary Income Survey (ESI); and for Mexico, the National Occupation and Employment Survey (ENOE), the National Employment Survey (ENE) and the Economic Census (1993 and 1998).

Table A.IV.4

CLASSIFICATION CHARACTERISTICS

Economic sectors	Agriculture, hunting and fishing
	Mining and quarrying
	Manufacturing
	Electricity, gas and water
	Construction
	Trade, hotels and restaurants
	Transportation and communications
	Financial services
	Community and social services
Sex	Female
	Male
Age group	15-29 years
	30-49 years
	50 y years or over
Education level	Low skill
	Medium skill
	High skill

Source: Economic Commission for Latin America and the Caribbean (ECLAC).

The microdata were linked in order to construct methodologically homogeneous estimates for the four countries to identify workers by education level, age, gender and economic sector in which they are employed, which is critical for the application of the KLEMS methodology. With this information, it was possible to estimate workers in terms of actual hours worked and the labour income associated with each of their characteristics.

Appendix V
Production structure indicators

To operationalize the concepts of technological capacities and structural change, and to compare their evolution in the region with international trends, a broad set of indicators is needed. This appendix uses the following indicators and analyses their strengths and weaknesses.

(a) Investment in technological research and development (R&D) and number of patents per inhabitant, which are indicators of technological efforts and results.

(b) Relative productivity, defined as the quotient of labour productivity in one economy versus a benchmark advanced economy (usually the United States, as it represents the technological frontier and has strong investment and trade links with Latin America).

(c) Weight of medium- and high-technology exports in total exports (X_MHT/X), as classified by Lall (2004).

(d) Relative share of engineering-intensive sectors (RSI) in the manufacturing value added of an economy relative to the United States.[27] A higher RSI should indicate a more knowledge-intensive industry.

(e) Degree of ICT diffusion, measured by four penetration indicators: (i) mobile telephony (MT); (ii) fixed-line broadband (FB); (iii) mobile broadband (MB); and (iv) Internet. These are important indicators of a society's acquired skills in the technologies associated with a new, far-reaching technological paradigm, which have a strong impact on the economy's competitiveness, general efficiency, and future growth paths.

(f) Adaptability index (AI), defined as the ratio of the share of dynamic and non-dynamic sectors in total exports. Dynamic sectors are defined as those whose world demand, measured by the value of exports, grows more than the measure.[28]

(g) Export sophistication (EXPY). This index was developed by Hausmann and others (2007),[29] using very disaggregated international trade data, to identify differences in the quality or level of sophistication of exports. Exports originating in high-income countries are assumed to be more knowledge intensive than those originating in low-income countries. The rationality for this distinction lies in the fact that wealthier economies have greater technological and market capacities, which allow them to

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[27] The relative share index (RSI) is calculated as RSI = S_i / S_r , which is the quotient of the relative share of engineering in the manufacturing value added of a country (S_i) compared with the corresponding share in a reference country (S_r, in this case the United States).

[28] Historically, the most dynamic sectors have been the more modern branches of manufacturing (machinery, electro-electronics, transportation equipment, etc.). That pattern does not always hold at the product level, however, as there are some dynamic agricultural and mineral products.

[29] To construct this index, we have to first construct the PRODY index, which is a weighted measure of the per capita income of countries that export a certain good, using as a weight the country's revealed comparative advantage in that good (such that each good has a PRODY). The EXPY is then calculated for each country as the weighted average of its PRODYs, based on the weight of each good in the country's export basket. A country with a high EXPY is essentially exporting goods that are also exported by high-income countries.

compete in more demanding markets with differentiated goods. The EXPY is an indicator of both Schumpeterian and Keynesian efficiency, to the extent that the more sophisticated goods and services exported by wealthier economies have a higher income elasticity than the exports of poorer economies.

Indicators (a) through (d) reflect capacities defined in a broad sense and capture Schumpeterian efficiency. Indicator (e) also has to do with Schumpeterian efficiency; it captures the degree of absorption (from the perspective of use) of the ICT paradigm. Indicator (f), in contrast, reflects the dynamism of external demand; it captures the growth of efficiency or Keynesian efficiency, independently of the technological foundations of the sector. Finally, the indicator (g) captures both types of efficiency, to the extent that it reflects the ability to produce more sophisticated goods for high-income markets.

Two of the indicators (RSI and X_MHT/X) involve the manufacturing sector; four are aggregate indicators that apply to all sectors of the economy (relative productivity, R&D, patents and the EXPY), thus reducing the bias of the former in favour of a specific sector; three are associated with the pattern of trade (EXPY, AI and X_MHT/X); and four capture ICT diffusion (MT, FB, MB and Internet), a key factor for international competitiveness.

To compare the indicators of the dynamic efficiency of the production structure in Latin America with other regions, the countries are sorted into different groups. The region is divided into South America and Central America, and the three largest economies are also shown separately (Brazil, Mexico and Argentina). The emerging economies of Asia are included as a benchmark, since they represent a case of successful development and closing the technology and per capita income gaps vis-à-vis the more advanced countries.

The developed economies are divided into two groups: those where the share of natural resources and natural-resource-intensive manufacturing in total exports is over 70% (ME-NR) and those where this share is under 70% (mature economies). This division is intended to show that natural resources are not an obstacle to structural change; in fact, they can provide the foundations for moving into new sectors and activities with increasing degrees of knowledge incorporation. More specifically, the production structure of the ME-NR countries is very different from the structure of Latin American economies, despite the similar weight of natural resources in exports (see table A.V.1). The structural difference between these two groups stems from the use of income from natural resources to implement industrial policies, as well as the country's ability to manage macroeconomic prices so as to avoid a negative impact on the production of new tradable goods.

In the table, the indicators of technological effort and results (R&D and patents) are less favourable in Latin America than in other regions, at both the subregional and country levels. Latin America also lags behind in relative productivity. For example, labour productivity in South America is only a third the level of developing Asia. The same can be said for the knowledge intensity of manufacturing: the relative weight of engineering (RSI) in Latin America is less than a quarter of the level in developing Asia. The adaptability index is not only lower in South America, but also shows a very unfavourable trend vis-à-vis Asia: the AI more than quadrupled in Asia between 1985 and 2007, whereas it only doubled in South America. Central America displays a more favourable trend, with the AI growing from 0.2 to 1.1 as a result of progress in export assembly activities.

Table A.V.1

INDICATORS OF TECHNOLOGICAL CAPACITIES AND STRUCTURAL CHANGE

	Relative productivity (%)	X_HMT/X (%)	EXPY	RSI	Patents per 1 million of inhabitants	R&D (%)	AI	MT	FB	MB	Internet (%)
	2001-2010	2007	2008	2005	1990-2010	1996-2009	2000-2007	2009-2011	2009-2011	2009-2011	2009-2011
Argentina	25.7	22.0	10.4	0.4	1	0.5	0.59	132.9	9.6	8.4	40.6
Brazil	11.7	32.0	11.4	0.7	0.5	1.0	0.43	105.8	7.1	12.0	41.6
Mexico	19.8	60.5	13.2	0.6	0.6	0.4	0.56	79.1	9.6	2.3	31.2
Developing Asia	33.8	64.3	14.6	0.9	17.2	1.3	0.56	119.8	15.0	36.7	48.5
South America	12.1	18.5	9.1	0.2	0.4	0.4	0.81	104.3	5.2	5.6	35.4
Central America	11.0	34.2	11.2	0.2	0.3	0.2	n.d.	107.6	3.2	3.2	19.8
Mature economies w/ abundant natural resources (ME-NR)	71.3	32.4	14.1	0.8	55.2	2.0	0.52	119.0	28.5	49.9	83.1
Mature economies	76.3	64.6	15	1.1	126.1	2.4	0.37	116.7	29.1	51.3	76.3

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of *International Telecommunication Union, Information and Communication Technology (ICT) Statistics* [online database] http://www.itu.int/ITU-D/ict/index.html; CEPALSTAT [online database] http://websie.eclac.cl/sisgen/ConsultaIntegrada.asp/; World Bank, *World Development Indicators* (WDI), [online database] http://databank.worldbank.org/; Organization for Economic Cooperation and Development (OECD), *The Labour Force Survey* (MEI) [online database] http://stats.oecd.org/; *European Commission, Eurostat* [online database] http://epp.eurostat.ec.europa.eu/, *United Nations Commodity Trade Statistics Database* (COMTRADE), [online database] http://comtrade.un.org/db/default.aspx; United States Patent and Trademark Office (USPTO), [online database] http://www.uspto.gov/;

Legend: Relative productivity: Labour productivity relative to the United States, averaged from 2001 to 2010 (simple average in the case of aggregates). AI: Adaptability index, 1985-2007. X_MHT/X: Percentage of exports corresponding to medium- and high- technology manufacturing products, as classified by Lall (2000) for 2007. EXPY: export sophistication index, calculated as the weighted average (by export share) of the PRODY index. The PRODY is the weighted average (by revealed comparative advantage of each country) of the per capita income of the countries that export a given good. RSI: relative share index of high-technology sectors in total manufacturing, in comparison with the technological intensity of the United States (year: 2005). Patents: patents granted by the United States Patent and Trademark Office, per million inhabitants. R&D: R&D spending over GDP. MT: penetration of mobile telephony. FB: penetration of fixed (wired) broadband. MB: penetration of mobile broadband. Internet: penetration of Internet. ME-RN: Developed economies with a high share of natural resources in total exports.

Note: Developing Asia is defined as the sum of the Republic of Korea, the Philippines, Hong Kong (China), Indonesia, Malaysia, Singapore and Thailand. Mature economies include France, Germany, Italy, Japan, Sweden, the United Kingdom and the United States. Developed economies with abundant natural resources are a set of countries with a high per capita GDP and a share of natural resource exports of over 30% (Denmark, Finland, Ireland, Norway, Australia and New Zealand). Patent data are averaged over 1990-2010. R&D spending covers the period 1996-2009, and the averages are calculated using the available data for each country in each year. To calculate the RSI, South America includes Argentina, Brazil, Chile, Colombia, Ecuador, Peru, the Plurinational State of Bolivia and Uruguay. Central America includes Costa Rica and Panama. Mature economies are France, Italy, Japan, Sweden and the United Kingdom. For relative productivity, South America includes Argentina, the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Ecuador, Paraguay and Peru. Central America includes Costa Rica, Honduras and Panama. [translator's note: the text says over 70% for NR and NR manufacturing.]

Medium- and high-technology exports are greater in Mexico and Central America than in South America. For Mexico, this variable is higher than the developed economies that are natural resource exporters and similar to developing Asia. This is in line with the better performance of the AI and the EXPY in Mexico and Central America compared with South America, but it contradicts other indicators of technological capacity and structural change in the table. This occurs because the high X_MHT/X indicator in Mexico and Central America strongly reflects the pattern of exports to free trade zones or under special "import for export" provisions, which is explained by labour costs and not by knowledge intensity. The low values of other variables —such as patents, relative productivity and the RSI— confirm the absence of an upgrading process.

The greater diversification of the ME-NR economies becomes evident on comparing them with the countries of Latin America. The RSI in the former is four times that of South America and Central America, while the EXPY is also high, more similar to emerging Asia than to Latin America. The other indicators point to the same conclusion. These structural differences contrast with the fact that the weight of natural-resource-based exports is not much different in South America or Central America than in the ME-NR economies.

Appendix VI
Programmes for ICT adoption in firms

Table A.VI.1

DIRECT PROGRAMMES FOR PROMOTING THE ADOPTION OF ICTS IN FIRMS

Country	Programme (responsible institution)	Description
Argentina	Technological Modernization Programme (FONTAR)	The Argentine Technological Fund (FONTAR) aims to improve the competitiveness of firms by financing projects for technological innovation. The FONTAR Technological Modernization Programme is targeted to financing technological innovation and modernization projects. The CAE business credit line is a revolving credit facility, through which FONTAR grants loans between AR$1 million and AR$4 million, for a nine-year term, depending on the project to be financed. Projects financed include the incorporation of ICTs in production processes.
	Access-to-Credit and Competitiveness Programme (SEPYME)	For firms that are investing in technical assistance for improving competitiveness, product and process innovation, technological upscaling and quality certifications, this programme refunds up to 60% or 80% and AR$130.000. Companies can use up to 35$ of the refund for the purchase of hardware equipment and software licenses.
Brazil	PROIMPE (SEBRAE)	The Programme for the Promotion of the Use of Information Technologies in Micro and Small Businesses (PROIMPE) was instituted by SEBRAE in 2003, with the goal of stimulating ICT diffusion among small businesses, organized in local production clusters, and contributing to the development of development of small businesses that provide ICT solutions.
	PROSOFT Comercialización (BNDES)	Prosoft Comercialización is a programme for financing software purchases and related services in the domestic market. The supply firms and products targeted for financing must be accredited by BNDES and respect the standards for products developed in Brazil.
	SEBRAETEC (SEBRAE)	The SEBRAE Programme for Technological Consulting (SEBRAETEC) was launched in 2011 to give micro and small businesses access to technological services and know-how. SEBRAETEC tries to connect supply and demand through a registry of businesses that offer solutions for optimizing management processes and improving specific aspects of products and processes.
	Connect Your Business (SEBRAE)	SEBRAE, with the participation of Google and Yola, has implemented the “Connect Your Business” initiative, to help micro and small businesses create their first web page, quickly and simply.
Chile	Digital Entrepreneurship (SERCOTEC)	This programme promotes e-commerce in small businesses through free training courses for entrepreneurs and micro and small businesses.
Colombia	Digital MSMEs (Ministry of Information and Communication Technologies)	Started in 2008, the Digital MSME Programme represents one of the few regional examples of the articulation of ICT supply and demand. The programme focuses on four components: (1) Create the conditions for ICT uptake by businesses; (2) Cofinance ICT projects in micro, small and medium-sized enterprises (MSMEs) that generate effective ICT uptake by businesses; (3) Support businesses in the ICT sector that supply solutions to MSMEs in other economic activities; and (4) Provide risk capital for some ICT projects in MSMEs or ICT firms.
	iNNpulsa (Ministry of Trade, Industry and Tourism)	The iNNpulsa programme promotes innovation in new products or services, the significant improvement of products or services and the modernization of suppliers, distributors and productive chains. The initiative calls for supporting the implementation of Internet-based applications that improve the connectivity of Colombian micro-businesses and SMEs.
	COMPARTEL (Ministry of Information and Communication Technologies)	The COMPARTEL programme includes specific provisions for strengthening the opportunities offered by ICTs to improve the competitiveness of underdeveloped regions and MSMEs.
Costa Rica	Access for SMEs (Ministry of Economy, Industry and Trade)	The objective of this programme is to increase the competitiveness of SMEs through three lines of action: (a) supply of cloud computing tools at vary low cost; (b) training module on cloud computing; and (c) access to financing under special conditions for the incorporation of latest-generation hardware.
El Salvador	Promotion of digital maturity for MSMEs (CONAMYPE)	This training programme provides institutional technicians with the technical skills necessary for consulting to MSMEs on digital issues.
Mexico	PROSOFT (Ministry of Economy)	This programme for the development of the national software industry was first implemented in 2002 with the objective of articulating supply needs with demand from micro-businesses and SMEs. PROSOFT 2.0 was launched in 2008.
Peru	Pyme al Mundo (COMEXPERÚ)	In 2011 the Foreign Trade Society of Peru (COMEXPERÚ) launched the Pyme al Mundo website to promote the diffusion of e-commerce among SMEs in the Peruvian business sphere.
Uruguay	Pilot Project (Ministry of Industry)	This programme connects ICT supply and demand in the following production sectors: shipbuilding industry, forestry/wood, biotechnology and pharmaceuticals .

Source: Sebastián Rovira, Pietro Santoleri and Giovanni Stumpo, “Incorporación de TIC en el sector productivo: uso y desuso de las políticas públicas para favorecer su difusión”, *Entre mitos y realidades. TIC, políticas públicas y desarrollo productivo en América Latina* (LC/L.3600), Sebastián Rovira and Giovanni Stumpo (comps.), Santiago, Chile, Economic Commission for Latin America and the Caribbean (ECLAC), 2013.

Appendix VII
1:1 models in the region

Table A.VII.1

1:1 MODELS IN LATIN AMERICA, 2011

Country	Initiative	Start date	Objective	Scope	Beneficiaries
Uruguay	Educational Connectivity/Basic Computing for Online Learning (CEIBAL)	2006	670 000 computers	450 000 computers	Students and teachers.
Argentina	*Conectar Igualdad*	2010	3 000 000 computers	1 799 358 computers	Students and teachers in secondary schools, students in special schools and teacher training.
Chile	Mobile Computer Laboratories (LMC)	2009	250 000 students	50 186 students	Third- and fourth-grade students in municipal primary schools.
Brazil	One Computer per Student (UCA)	2009-2010	37 000 000 students	350 schools 42 680 computers	Students and teachers at the primary level in public schools.
El Salvador	Closing the Knowledge Gap	2009	800 000 students	1 080 students	Students and teachers of low-income or off-grid primary schools.
Peru	One Laptop per Child	2008	600 000 students	513 204 students	Students and teachers at the primary level in single-teacher schools in extremely poor rural areas. Coverage is to be expanded to the secondary level.
Venezuela (Bolivarian Republic of)	Canaima Project: Educational Use of Information and Communication Technologies (ICTs)	2008	875 000 computers	437 500 computers	Students and teachers at the primary level.
Ecuador	*Mi Compu*	2010	4 020 students	3 896 students	Second- to fourth-grade students in primary schools in two interior provinces.
Paraguay	1:1 Pedagogic Model	2010	1 500 000 computers	20 000 students 20 000 teachers	Students and teachers at the primary level.
Bolivia (Plurinational State of)	One Computer per Teacher	2006	5 739 computers	1 000 computers	Teachers.
Costa Rica	Mobile Technologies Project	2007	25 000 computers	900 computers	Teachers and students in primary and secondary schools (I and II cycles).
Colombia	Pilot Project 1 to 1	2008	1 500 computers	300 computers	Students at the secondary schools

Source: Latin American Network of Educational Portals (RELPE), "Experiencias 1 a 1 en América Latina. Seminario Internacional Experiencias 1 a 1 Nacionales", *Serie Seminarios*, Buenos Aires, 2011

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