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ICTs in Latin American and the Caribbean Firms: Stylized Facts, Programs and Policies

Knowledge Sharing Forum on Development Experiences: Comparative Experiences of Korea and Latin America and the Caribbean

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Knowledge and Learning Sector
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Juan M. Gallego and Luis H. Gutiérrez[1]

Sometimes a difference in degree (in other words, more of the same)
becomes a difference in kind (in other words, different than anything else).
Brynjolfsson and McAfee, 2014

Executive Summary

Adoption of information and communication technologies (ICTs) has been slow in Latin American and the Caribbean (LAC) countries and is not widespread. There is a digital divide between and within countries, including a digital gap in firms' adoption of ICTs. Large and medium-sized enterprises generally have access to the Internet, but adoption of advanced ICTs is low for all firms in these economies, and small and micro enterprises lag way behind. The backwardness in ICT adoption is exacerbated when only a small fraction of society has high connectivity broadband.

Thus the digital infrastructure remains weak despite regional governments' promotion of a digital agenda. Bolder programs are needed. The success of public initiatives requires a competitive environment for internet and telecom service providers as well strong participation of the private sector and public-private partnerships. In particular, the engagement of large firms is necessary to increase ICTs' diffusion in small and medium-sized enterprises (SMEs) that are part of their production chains. Additionally, coordination among different government agencies is critical for improving ICT policies' design and implementation. The relevance of well-designed ICT policies is apparent in empirical and qualitative evidence from Chile, Colombia and Uruguay, where ICT investment indicates a positive impact on firm innovation and productivity.

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As part of what some call the digital ecosystem, the IT industry plays an important role, but we observe large heterogeneity in the LAC region. Brazil and Mexico are two big players with relatively well-developed software and hardware industries oriented to the domestic market, while Costa Rica and Uruguay emerge as IT producers and exporters. In between, medium-sized countries like Argentina, Colombia, Peru and Ecuador are looking for a position in either their internal or external markets. To increase performance in the IT industry and complement the existing ecosystem, ICT policies must be accompanied by industrial programs that go beyond the usual horizontal industrial policies.

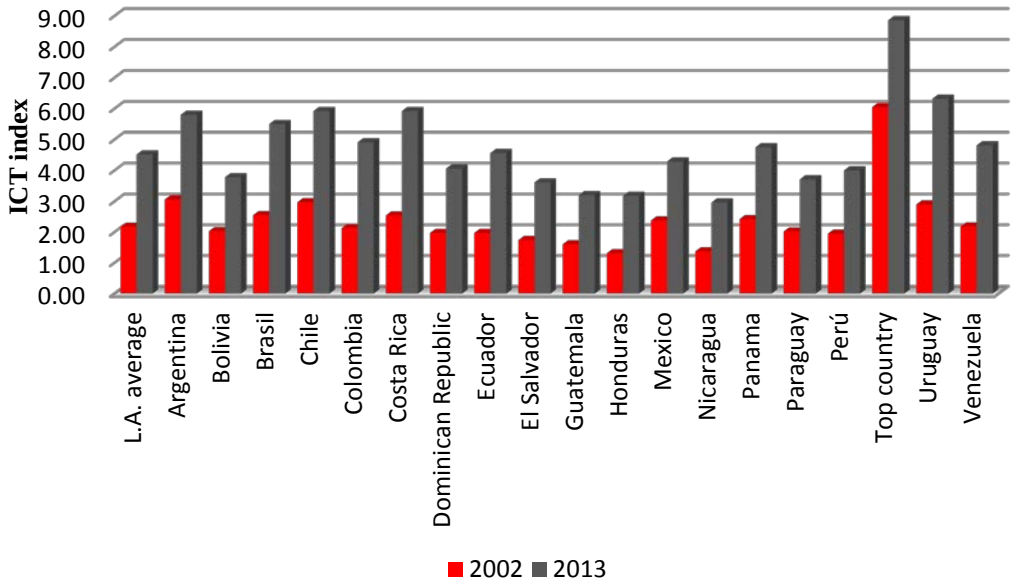
1. Introduction

ICTs figure in the everyday life of all stakeholders in modern societies including people, firms, and governments. The pace of adoption of these technologies conveys challenges and opportunities as well as risks and potentially harmful effects when introduction is not timely. Countries face challenges in easing the introduction of ICTs in different areas of day-to-day life; for instance, in education, health care and in firms' production processes. The need in societies now falling behind the digital frontier offers opportunities, and governments do well to design inclusive and ambitious digital agendas that allow individuals and households to enhance their capabilities in terms of human capital accumulation and increased labor productivity. Foreign and national interests that invest in hardware, software, and human capital capabilities can further exploit the technologies.

However, if the introduction of ICTs is not timely and inclusive, developing economies, and in particular those in LAC countries, will keep falling behind the advanced digital economies. That seems trivial to say, but given the astonishing pace of development of what has been called the second machine age, countries that fail to introduce new ICTs will be disadvantaged in terms of innovation, performance, productivity, competitiveness and social and economic development. Nowadays, the pervasive presence of ICTs, the convergence of networks, the development of competing networks, and the convergence of broadband and industry create a digital ecosystem where users are active players and governments face not only policy and regulatory challenges but also play a critical role in strengthening that ecosystem. Governments in LAC must keep pushing digital agendas that promote access and usage of ICTs by all stakeholders.

The rapid and unprecedented rise of ICTs has transformed present-day societies. How have Latin American societies, individuals, households, firms and governments kept up with the dynamic and growing trends of ICTs? How have societies in the region handled the pace of the digital agendas put in motion by digitally developed nations? A detailed review of the region's main ICT facts offers some insight into these complex questions. We first make use of international ICT indexes and present country indicators at both society and firm levels. This allows comparison of the region as a whole with South Korea, one of the leading digitized countries in the world, and shows progress by some countries in the last few years.

Figure 1 ICT Development Index in Latin America and the Caribbean Countries



Source: Authors' calculations based on Internatinal Telecommunications Union ITU statistics 2014.

Figure 1 presents the ICT development index for 18 Latin American countries, compared with the index for the top country in the ranking.[2] The LAC region lags well behind the top country for the years 2002 and 2013. However, bearing in mind that the index could underestimate the actual gap given the importance of the diffusion of *basic* ICTs, it appears that the region has somehow closed the gap with the best world performer. The average ICT indicator in 2002 was almost one-third of the top country's score; eleven years later it was almost one-half that of the top scoring country. Also, the ratio between the worst scoring country in the region and the top scoring country in the world was almost five times in 2002 but had fallen to about three times in 2013. In addition, that progression displays heterogeneity among countries in the region; some have progressed at a more rapid pace than others. For instance, Argentina was the top scorer in 2002, at 3.1, while Honduras, the worst scoring, reached only 1.3. That is, an almost 2 ½ ratio. In 2013, Uruguay became the leading country with a score of 6.3, while Nicaragua

[2] The ICT development index, developed by the International Telecommunication Unit (ITU), is a composite index combining 11 indicators into one benchmark measure that serves to monitor and compare ICT developments across countries. Briefly, the index aims to capture three main aspects of the information society: ICT readiness, which includes five infrastructure and access indicators; the intensity of ICT usage, and ICT capability or skills. Theoretically, the index ranges between a minimum of 0 and a maximum of 10. Those bounds are not explicit but can be deduced from the "ideal" values in the 11 indicators framing each country score.

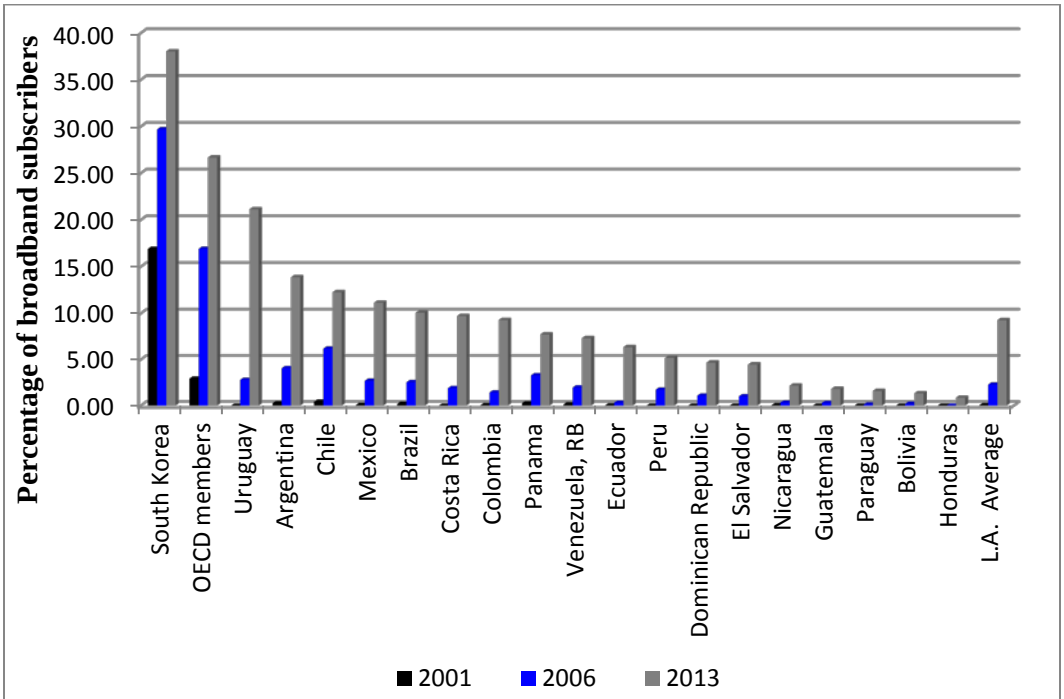
scored only 3. This is close to just a 2 times ratio. Among other facts, Colombia was one of the countries that showed major progress in becoming an information society; Chile and Uruguay have been permanently in the vanguard in the region, while most Central American countries (i.e., El Salvador, Guatemala, Honduras and Nicaragua) have not been able to maintain the pace of the remaining countries in the region.[3]

Another broad indicator of a society's degree of digitalization is the number of subscribers to fixed broadband per 100 inhabitants.[4] Figure 2 presents the trends of this indicator for LAC countries, South Korea and the average for members of the Organization for Economic Co-operation and Development (OECD) at years 2001, 2006, and 2013. LAC countries barely had fixed broadband subscribers in 2001. Only Chile (0.43), Argentina (0.25) and Panama (0.25) reported subscribers. The figures were different for digitized economies. South Korea had almost 17 subscribers per 100 inhabitants; the average for OECD members was only close to 3. By 2006, some countries were pushing the deployment of digital networks, and Chile reported 6.2 subscribers per 100 inhabitants. By then, South Korea had increased its number of subscribers to 30 per 100 people, and the OECD average had increased to 17. By 2013, subscribers to fixed broadband in South Korea had continued to increase up to 38 and so did the average for OECD members. In Latin America, the level reached by Uruguay that year is notorious. From having only about 3 subscribers per 100 people in 2006, the figure had rocketed to 21 by 2013. Argentina, Chile, Mexico, and Brazil were the only LAC countries that overcame the threshold of 10 subscribers per 100 people.

[3] Recently, one of the fast-growing smartphone manufacturers, Huawei, launched the Huawei Global Connectivity Index that is an "ICT assessment framework that measures, analyzes, combines, and forecasts multiple connectivity dynamics on the impact of a country's digital economy and the value generated for its industry transformation toward digital economy." In this index, South Korea is ranked in 8th place while Chile was ranked 20th. Other Latin American countries that appear in the index are Brazil (ranked 26$^{th)}$, Mexico (32$^{nd)}$, Peru (34$^{th)}$, Venezuela (35$^{th)}$, Colombia (37$^{th)}$, and Argentina (39$^{th)}$. Uruguay was not included in the ranking. The leading country was the United States.

[4] Having (high) access to broadband (connectivity) allows people, firms and governments to use more sophisticated and advanced software, to be able to browse the web more rapidly, to game, and to access educational websites and the like.

Figure 2 Fixed Broadband Internet Subscribers (per 100 people)

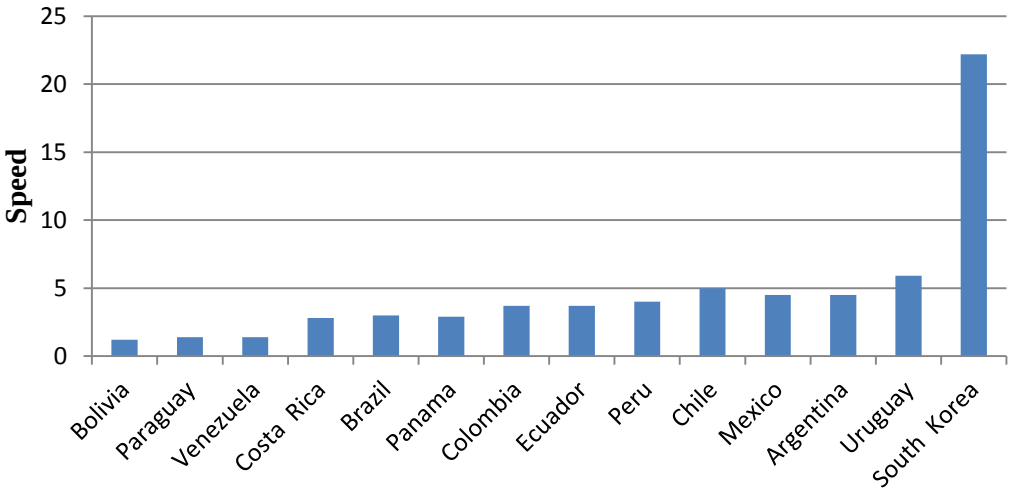


Source: Authors' calculations based on Internatinal Telecommunications Union ITU statistics 2014.

Having broadband access does not translate automatically to high broadband connectivity. The graph presented above shows only a given number of broadband subscribers but without precise information about what is understood by broadband.[5] High broadband connectivity is important because "high-speed, affordable broadband connectivity to the Internet is a foundation stone of modern society, offering widely recognized economic and social benefits" (ITU 2014). Figure 3 shows the average connection speed and gives a better picture of how close or far LAC countries are from leading countries like South Korea in terms of high broadband connectivity.

[5] ITU (2014) states, "ITU and the OECD have defined broadband as a capacity of at least 256 Kbps in the uplink or downlink speed." This definition has been preserved despite being clear that such a speed does not really by any accounts constitute broadband. In a recent news release, it was announced that "the FCC updated its broadband benchmark speeds to 25 megabits per second (Mbps) for downloads and 3 Mbps for uploads. The 4 Mbps/1 Mbps standard set in 2010 is dated and inadequate for evaluating whether advanced broadband is being deployed to all Americans in a timely way, the FCC found." See http://www.fcc.gov/document/fcc-finds-us-broadband-deployment-not-keeping-pace .

Figure 3 Average Connection Speed (mpbs)



Source: Authors' calculations based on Internatinal Telecommunications Union ITU statistics, 2014.

Clearly, differences in degree have become differences in kind. On the one hand, the average connection in South Korea was about five times faster than the average connection in Uruguay, the leading Latin American country in terms of digitalization, and was about twenty-three times faster than the average connection in Bolivia, the least digitized country in Latin America. On the other hand, in the third quarter of 2014, 81 percent of connections in South Korea were above 10 Mbps, while only 7 percent of connections in Uruguay were above that threshold.[6] In a society like South Korea, where individuals, households, firms and the remaining stakeholders enjoy high broadband connectivity, the opportunities open to them in their daily life for enhanced leisure activities, time employment, educational developments, and better personal performance, among other improvements, are more numerous than in developing countries, including those in the LAC region.

The previous figures clearly show that LAC countries lag behind developed nations in terms of a broad concept of the information and knowledge society. But how do LAC households fare in terms of access and usage of basic ICTs? Using national household surveys, sources that provide more reliable information on actual access and usage of ICTs, we organize the available and most up to date information regarding basic ICTs like Internet and computers. Table 1

[6] For the source of this information and related concerning data see Akamai's [state of the Internet] Q4 [2014 Report] Volume 7/Number 4, available at http://www.akamai.com/stateoftheinternet/.

illustrates the stylized facts of Internet access at home, households with computers and mobile or cellular phones for nine LAC countries.

Some interesting facts are worth highlighting. The first is that there exists a wide *digital gap* of household Internet access between and within the countries. The highest percentage of access is found in Chile (65%) and Uruguay (60%). However, in rural areas or in small cities apart from the country capital the percentages are quite low; i.e., 22 percent in Ecuador and 15 percent in Brazil. Thus, asserting that Internet access is diffused in a country hides wide differences. Second, computer use at home is higher, again, in Chile and Uruguay while it is quite low in Ecuador and in rural areas of Brazil and Colombia. Third, as expected, the leading countries in the ITU's ICT development index show higher Internet household coverage as well as computer use at home.

Table 1 Percentage of Households with Access of ICTs at Home

Country	Year	ICT	% Households with
Argentina	**2011**	**Computer**	53
		Internet	44
		Mobile Phone	86
Brazil +	**2013**	**Computer**	53-21
		Internet	48-15
Chile +	**2013**	**Computer**	74-68
		Internet	65-40
Colombia ++	**2013**	**Computer**	51-12
		Internet	44-7
		Mobile Phone	96-90
Costa Rica	**2013**	**Computer**	51
		Internet	47
		Mobile Phone	92
Ecuador	**2013**	**Computer**	50-30
		Internet +	51-22
		Mobile Phone	86
Mexico	**2013**	**Computer**	36
		Internet	31
		Mobile Phone	80
Peru /	**2014***	**Computer**	52-34
		Internet	41-21
		Mobile Phone	85
Uruguay	**2013**	**Computer**	77
		Internet	60

Source: Argentina, 2013, Encuesta Nacional sobre Acceso y Uso de Tecnologías de la Información y la Comunicación (ENTIC) Resultados del tercer trimestre de 2011; Brazil, CETIC, TIC: Domícilios e Empresas 2013; Chile, Intelis- Universidad de Chile, 2014, Estudio Quinta Encuesta sobre Acceso, Usos, Usuarios y Disposición de Pago por Internet en Zonas Urbanas y Rurales de Chile; Colombia, DANE, 2014, Indicadores Básicos de Tenencia y Uso de Tecnologías de la Información y Comunicación en Hogares y Personas de 5 y más años de edad; Costa Rica - 2013 Prosic Hacia la Sociedad de la Información y el Conocimiento, 2013; Ecuador, INEG, Tecnologías de la Información y Comunicaciones (TIC´S)

2013; México, INEG, 2013, Estadísticas sobre Disponibilidad y Uso de TIC en los Hogares; Perú, INEI 2014, Estadísticas de las Tecnologías de Información y Comunicación en los Hogares, Informe Técnico No 4; Uruguay, Aboal et al., 2014.

Note: + Refers to Urban - rural. ++ Refers to Main urban - remaining urban. / Refers to Metropolitan Lima - Other urban. * 3rd semester.

Table 2 supplements Table 1 by presenting data on home computers and Internet access at home for six countries at the lowest and highest level of income for which data is available. As can be observed, only 22 percent and 10 percent of the population at the lowest level of income in Argentina and Brazil could afford a computer while 85 percent and 98 percent of the richest in those countries had one. A similar divide is found regarding Internet access at home. In Brazil, 10 percent of the poorest households had Internet; in Costa Rica the percentage amounted to 20 percent, and 23 percent of the poorest families in Uruguay had access.

Table 2 Digital Gaps by Level of Income

Country	Year	ICT	Lowest Level of Income	Highest Level of Income
			% Households with	
Argentina *	**2011**	**Computer**	22	85
		Internet	16	78
		Mobile Phone	68	98
Brazil +	**2013**	**Computer**	10	98
		Internet	8	98
Costa Rica *	**2013**	**Computer**	20	80
		Internet	20	86
		Mobile Phone	86	97
Mexico **	**2010**	**Computer**	2	78
		Internet	1	67
		Mobile Phone	22	92
Ecuador	**2013**	**Internet +**	14	51
Uruguay **	**2013**	**Computer**	76	89
		Internet	23	88

Source: Argentina, 2013, Encuesta Nacional sobre Acceso y Uso de Tecnologías de la Información y la Comunicación (ENTIC) Resultados del tercer trimestre de 2011; Brazil, CETIC, TIC: Domícilios e Empresas 2013; Costa Rica - 2013 Prosic Hacia la Sociedad de la Información y el Conocimiento, 2013, capítulo 4; Ecuador, INEG, Tecnologías de la Información y Comunicaciones (TIC´S) 2013; México, Palacios, 2013, p. 29; Uruguay, Aboal et al., 2014.

Note: + Refers to Social Class DE (Lowest level of income) and A (Highest level of income). * Quintile; ** Decile

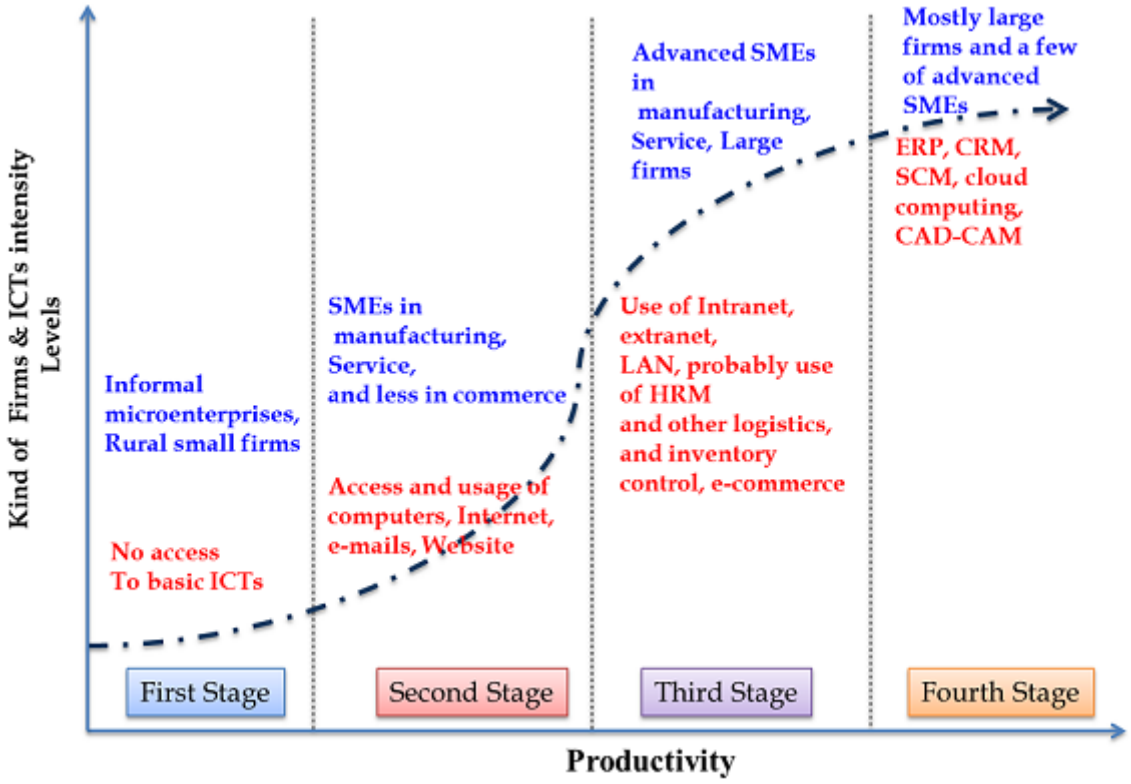
This brief introduction has provided strong evidence that home access to computers and the Internet, two main basic information and communications technologies, is not widespread throughout the main Latin American countries. If, as shown above, the quality of average (high) broadband connectivity across Latin American countries is also relatively low compared to that in a developed nation like South Korea, the digital lag is substantial. This is despite efforts by governments in the region in the last decade or so regarding their digital agendas and fiber optic deployment plans.

In what follows, we present updated information on the stylized fact of ICT usage and access by firms in LAC countries. Furthermore, we examine the development of the IT industry in these countries. We also briefly analyze the main aspects of digital agendas and institutional arrangements in the region in general and in particular those of Chile, Colombia and Uruguay. We present two interesting case studies and discuss lessons learned before concluding.

2. ICTs in Latin American Firms

The introduction of ICTs by firms can be viewed as having various stages, not necessarily lineal. That is, some firms follow all the stages, others jump from the least advanced stage to the more advanced one, and others are founded directly in an advanced stage. This is illustrated in Figure 4. The graph is also helpful in illustrating the current state of micro, small and medium-sized firms' ICT introduction in most Latin American countries.

Figure 4 Evolution Path of ICT Adoption by Firms



Source: Author's adaption from Rovira and Stumpo, 2013 and UNCTAD, 2014.

What is the level of ICT diffusion in Latin American firms? Is this diffusion different by firm size or by ICT complexity level? These questions are addressed in Tables 3 and 4, which show the diffusion of more advanced ICTs and Internet usage for three e-commerce activities. The picture is mixed across countries, but clearly adoption and usage of ICTs increase with firm size, decrease with ICT complexity. SME and micro enterprises have not made much use of these technologies, which surely has affected their performance and competitiveness. Also, as was suggested by Figure 4, diffusion of more advanced ICTs like intranet and extranet tends to be lower. This is confirmed in Table 4. The percentage of large firms using intranet is not greater than 82 percent for Colombian firms, 68 percent in Costa Rica and 62 percent in Chile. The percentage of firms using extranet is even lower. In general, by firm size, ICT diffusion and adoption seem to follow the path described in Figure 4.

Table 3 Use of More Advanced ICTs

ICT	Country	Year*	Micro	Small	Medium	Large
Percentage of firms using Internet to e-banking	**Bolivia**	**2010**			72-85	
	Brazil	**2013**		84	92	95
	Chile	**2011**		68	83	91
	Colombia	**2012**	30	89	93	96
	Costa Rica	**2011**				93
	Ecuador	**2012**	51	69	78	
	Uruguay	**2009**		26	65	
Percentage of firms with website	**Argentina**	**2010**		52	73	83
	Brazil	**2013**		50	74	89
	Chile	**2011**	9	21	53	75
	Colombia	**2012**	16	66	79	84
	Costa Rica	**2012**	35	50	67	95
	Ecuador	**2012**	9	23	50	
	Uruguay	**2009**		23	55	75
Percentage of firms with LAN	**Brazil**	**2013**		82	90	98
	Colombia	**2012**		98	99	99
	Ecuador	**2012**	42	47	58	
	Uruguay	**2009**		26	65	
Percentage of firms with intranet	**Argentina**	**2010**		18	34	61
	Bolivia	**2010**			45	
	Brazil	**2013**		28	41	57
	Chile	**2011**		17	39	63
	Colombia	**2012**		54	68	82
	Costa Rica	**2012**	30	27	57	68
	Ecuador	**2012**	39	42	57	
	Paraguay	**2010**			14	
	Peru	**2012**	1			
	Uruguay	**2009**		22	69	54
Percentage of firms with extranet	**Bolivia**	**2010**			19	
	Brazil	**2013**		24	37	52
	Chile	**2011**		3	16	35
	Colombia	**2012**		17	25	38
	Costa Rica	**2009**	9.1		19.2	32.2
	Paraguay	**2010**			5	

	Uruguay	**2009**		22	79		
Percentage of firms that place orders through Internet	**Argentina**	**2010**		21	24		25
	Brazil	**2013**		55	71		62
	Chile	**2011**		11	14		14
	Colombia	**2012**	10	64	64		61
	Paraguay	**2010**				45	
	Uruguay	**2013**		27	41		54*
Percentage of firms that receive orders through Internet	**Argentina**	**2010**		18	22		23
	Brazil	**2013**		16	20		20
	Chile	**2011**		7	8		10
	Colombia	**2012**	7	62	60		56
	Costa Rica	**2011**		20	21		27
	Mexico	**2008**		45	51		50
	Paraguay	**2010**				47	
	Uruguay	**2013**		21	24		44*

Source: Rovira y Stumpo 2013. Bolivia, INE 2010, TIC en Empresas; Brazil, CETIC, TIC :Domícilios e Empresas 2013; Chile, MEFT, 2012, Caracterización del Uso de Internet en los Emprendedores Chilenos;, Colombia, Gallego and Gutiérrez (2014); Costa Rica, 2009, Prosic, Acceso y uso de las Tecnologías de la Información y la Comunicación (TIC) en las empresas de Costa Rica, 2012 Prosic Hacia la Sociedad de la Información y el Conocimiento, 2012; Ecuador, Ministerio de Telecomunicaciones y de la Sociedad (2014); México Palacios, 2013; Paraguay, DGEEC, Censo Económico Nacional, 2011; Perú, INEI 2014, Resultados de la Encuesta de Micro y Pequeña Empresa, 2013; Uruguay, Aboal et al. (2014).

Note: * refers to 2007.

Table 4 Two Advanced ICTs

ICT	Country	Year	Small	Medium	Large
% of Firms with ERP	**Argentina**	**2010**	21	31	59
	Brazil	**2013**	19	44	69
	Chile	**2011**	25	66	87
% of Firms with CRM	**Argentina**	**2010**	6	13	31
	Brazil	**2013**	19	35	39
	Chile	**2011**	6	17	34

Source: Rovira y Stumpo 2013 and Brazil, CETIC, TIC: Domícilios e Empresas, 2013.

3. State of the Latin American IT Industry

This section focuses on the Latin American IT industry, the hardware and software segments. The development of this industry has been different across countries in the region. To take into account the different development paths followed by the most important countries, we first analyze the cases of Brazil and Mexico, the IT powerhouses of the region. Then, we describe the state of the remaining six countries with significant IT industries. The objective is to put in perspective the magnitudes of the regional industry with the aim of providing some insights about what frameworks should be designed by regional governments. One can be somewhat bolder and say that there should exist a close relationship between the development of the IT industry and the evolutionary path of adoption of ICTs by the society at large.

3.1 The Brazilian and Mexican IT Industry

Historically, only two countries in the region, Brazil and Mexico, have adopted explicit industrial policies regarding the creation of an IT hardware industry, and they have cornered about 95 percent of total hardware IT production the region (Pérez and Hilbert 2009). In Brazil, the hardware industry started in 1967 with the creation of the Free Zone of Manaos and the introduction of an incentive regimen for the production of information and telecommunications goods. The Brazilian industry started with an assembly of goods or semi-knocked down items, which delayed the development of the national IT industry in the opinion of experts (Pérez and Hilbert, op. cit.).

Although some years later Brazilian administrations indirectly promoted a national IT industry by imposing some restrictions on imports of ICT goods, most production continued to involve only the assembly of imported goods to be sold in the local market and in MERCOSUR markets.[7] Table 5 gives some idea of the size of the hardware industry in Brazil in 2009, taking as reference the total *added value* of the Brazilian IT industry by segments. The value added amounted to US$6.2 billion, a tiny amount compared to the total Brazilian value added of US$1477 billion. The bulk of the IT production was represented by two items: typewriting machines and information equipment and electronic and communications equipment. In 2009, Brazil's ICT spending as a proportion of GDP was about 5.8 percent.

[7] The picture of the hardware IT industry in Brazil may be improving recently due to Lei do Bem, as worldfinance.com has argued. For instance, that press site notes a deal by Foxconn Technology Group, the Taiwanese firm that produces Apple products like iPhones, iPads and iPods. The deal is supposed to be worth US$12 billion. Production of iPhones started in December 2011.

Table 5 Brazilian IT Industry

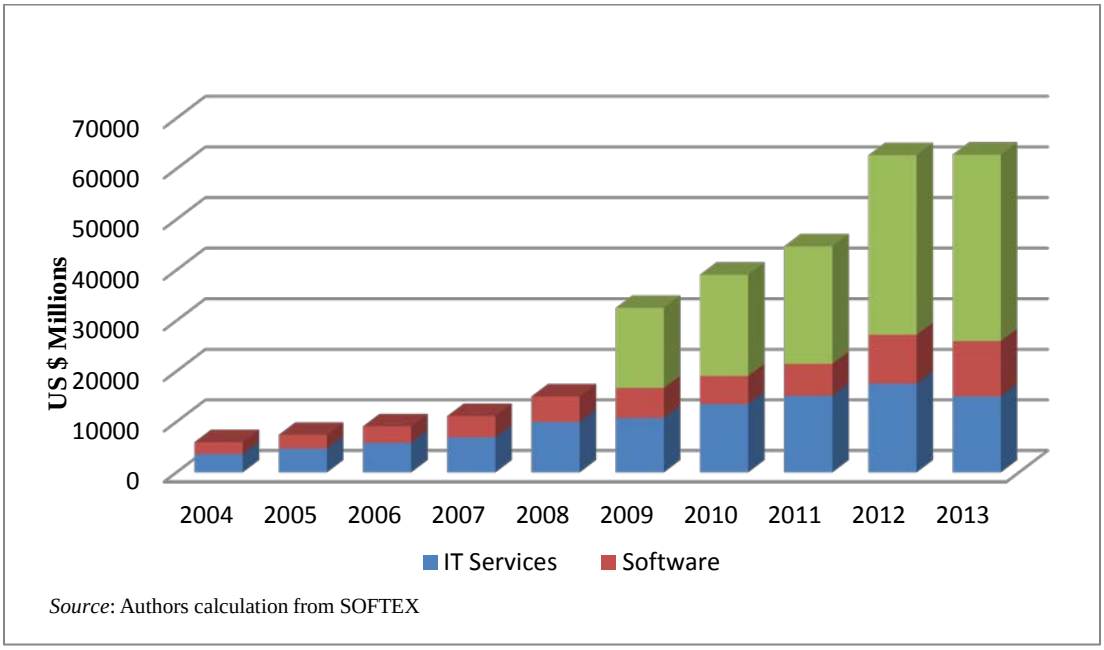
Added value of the ICT industry by segment, 2009, US$ billions

ICT industry	6,2
Typewriting machines and information equipment	1,8
Wires and electric cables	0,7
Electronic material and communications equipments	2,6
Equipments for testing and control and taylor-made	1,1

Source: SOFTEX, 2013

A better picture of the recent evolution of the Brazilian IT industry can be seen in Figure 5, where the three main segments of that industry are presented. In 2004, the sum of the software and IT service markets was close to US$6 billion; nine years later, the market of those two segments was five times greater, reaching US$26 billion. Figure 5 shows that the hardware market[8] reached about US$16 billion in 2009, increasing constantly through the years to US$37 billion in 2013.

Figure 5 IT Industry in Brazil (US$ million)



Source: Authors calculation from SOFTEX

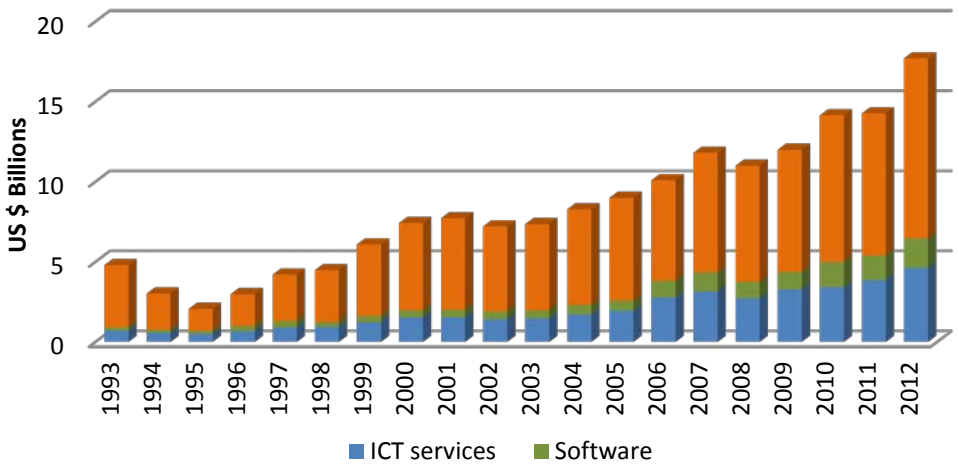
In the case of Mexico, the creation of what are called *maquilas* in the north of México, the North American Free Trade Agreement, and the intense competition U.S. IT firms were facing

[8] Unfortunately, no data on the hardware market for previous years was provided by the source.

from Asian countries led several well-known U.S. and European firms to locate some production in the *maquilas*. The production of IT goods was free of import duties if made within 10 miles the U.S. border and if all the production was then exported to the United States. U.S. firms initially produced TV and radio goods in México, but U.S. computer and telecommunications firms began production later.

In 2002 a public policy backed by all Mexican trade associations was launched, a milestone for the software industry. The PROSOFT program (in Spanish, *Programa para el Desarrollo de la Industria del Software*) set the guidelines for the development of this industry. Figure 6 presents data showing the evolution of the IT industry in Mexico. Clearly, the hardware market claimed a larger share. In 1993, the hardware market was close to US$4 billion; almost 20 years later it had reached US$11.2 billion. Yet, although the software industry is relatively smaller, it has grown at higher rates. In 1993, the market was US$230 million; in 2012 it reached US$1.8 billion.

Figure 6 IT Industry in México (US$ billion)



Source: Authors calculation from Select 2012

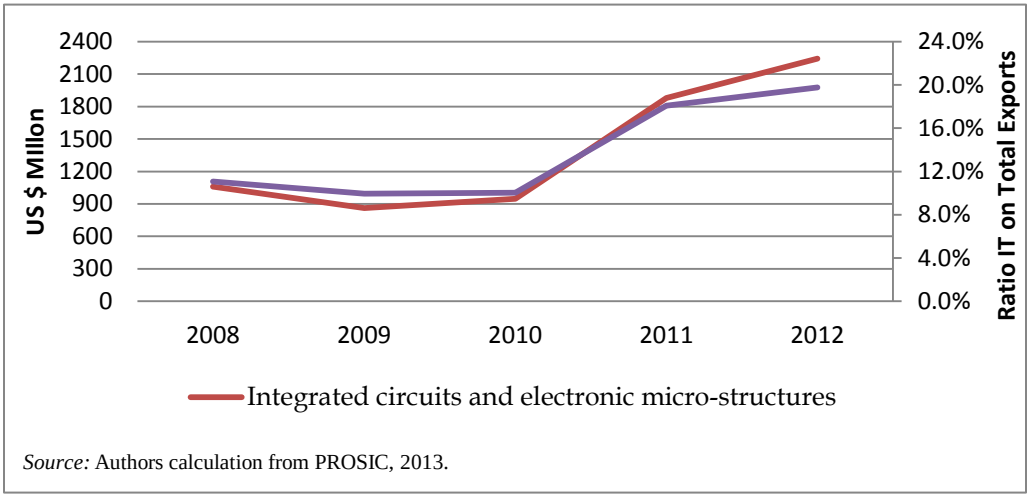
In both the Brazilian and Mexican IT industry it is worth emphasizing that the service IT segment has been extremely important and has represented about 25-32 percent of the IT industry. So it is valid to argue that the Brazilian and Mexican IT industries have been growing and making headway not only in their national markets but also in international ones, and especially in Latin American markets. The importance of this trend in those two economies has

also been growing. However, as some commentators and scholars have argued, the production structure of the hardware industry has not yet generated enough backward links with the rest of the manufacturing industry so that more inputs and services are needed from other production sectors. To the extent that hardware IT becomes more and more integrated with machines and tools used in the production of goods and services, the national IT hardware industry can reach higher levels of development with powerful (backward and forward) links to other economic sectors.

3.2 The IT Industry in Costa Rica and Six Latin American Countries

The hardware and software IT industries in the remaining countries of Latin America are relatively smaller than in Brazil and Mexico and relevant data is scant. However, Costa Rica has recently developed a modern IT industry with the arrival of Intel, the giant chip processor, in 1998. Thanks to the impetus from Intel,[9] Costa Rican exports of integrated circuits and electronic microstructures went from US$862 million in 2009 to US$2,243 million in 2012, about 30 percent of total exports (see Figure 7). Although no data is available on production, the amount of exports gives a good estimate of the size of the Costa Rican IT industry.

Figure 7 Costa Rica IT Export (US$ million) and Share of IT on Total Exports

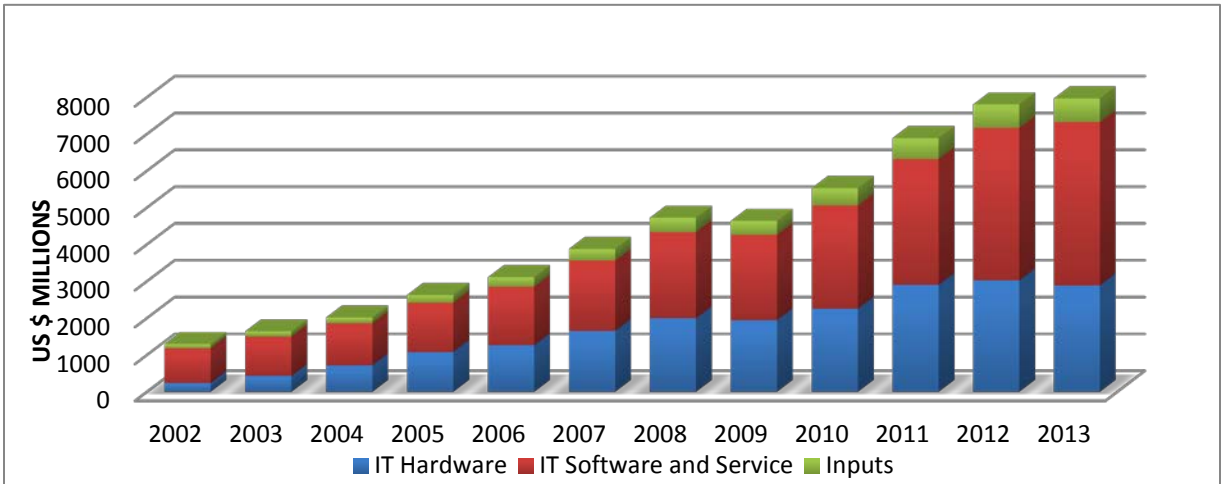


Source: Authors calculation from PROSIC, 2013.

[9] Sadly, Intel announced in 2014 that it was closing its operations in Costa Rica. (See http://www.economist.com/news/americas/21600985-chipmaker-shuts-factory-slicing-away-one-fifth-countrys-exports-intel-outside). However, despite this negative news, by December 2014, Intel had inaugurated a "megalaboratory of R&D" where all types of Intel products will be tested.

Other countries in the region that have important IT segments are Argentina, Chile, Colombia, Ecuador, Peru, and Uruguay. The IT industry in Argentina[10] has progressed well in the last decade, especially in the aggregate segment of software and IT service, as shown in Figure 8. The growth rates of the three IT segments have been greater than the growth of the overall Argentinean economy. The IT market was estimated at about US$8 billion in 2013, the third largest in the region.

Figure 8 Argentinean IT Industry (US$ million)



Source: CICOMRA http://www.cicomra.org.ar/cicomra2/asp/estadistica_nota-sb.asp?id_template=6, & World Bank Development indicators- the official exchange rate.

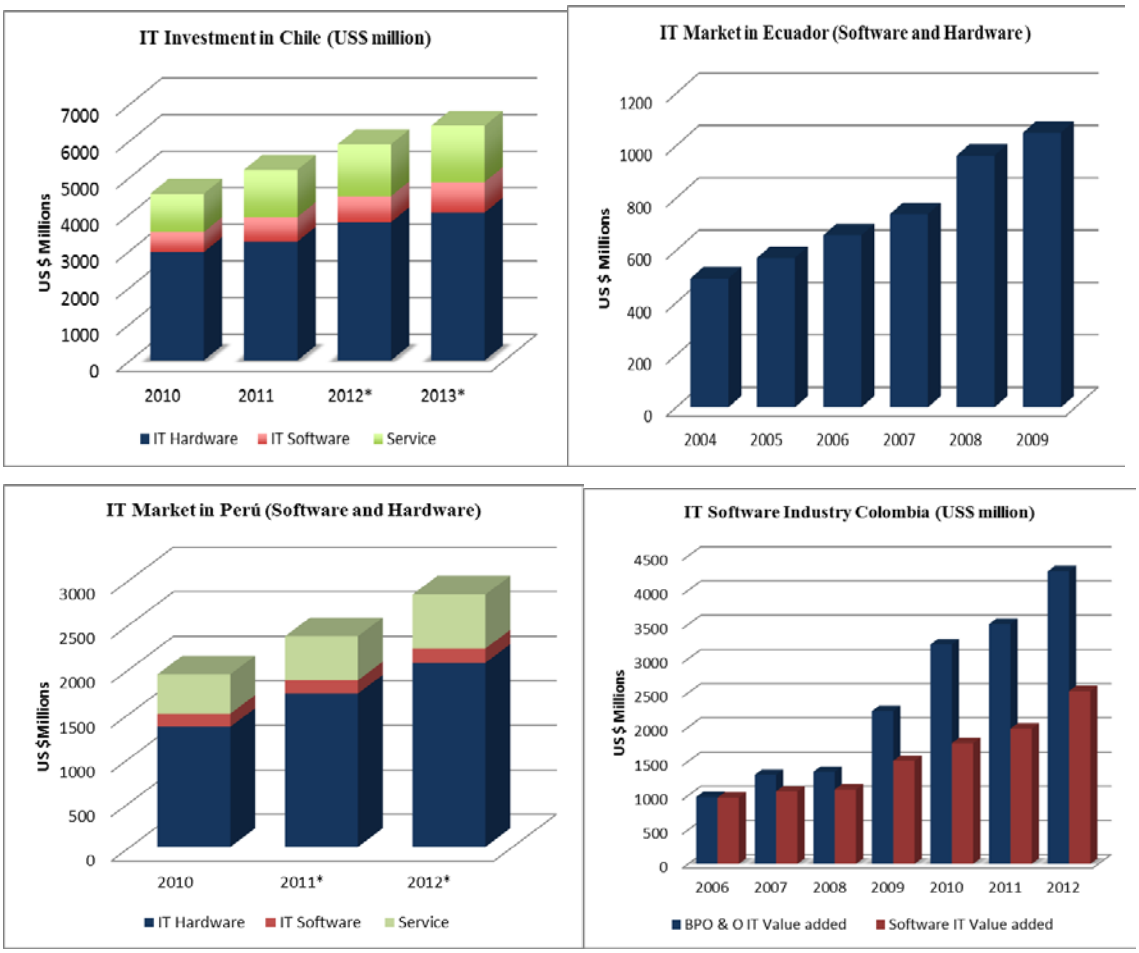
For the remaining five Latin American countries considered, the data sometimes seems to refer to IT *market* size and not necessarily to the size of IT production. Figure 9 shows the state of the IT industries in these countries. For Chile, data is taken from reports by ACTI, the Chilean ICT trade association, since official information is not available. One report of this association provides data on recent IT *investment* in Chile but what the investment means or involves is not clear. As in the other countries already analyzed, the hardware segment represents about 63 percent of the total IT industry, reaching an estimated US$6.4 billion in 2013. The software industry is relatively small, with a level of investment at US$830 million in 2013.

Data for the Colombian IT industry concerns total value added for the software segment and the Business Process Outsourcing and Offshoring IT segments. The amount of value added for both segments was about US$960 million in 2006, growing to US$2.5 billion and US$4.3

[10] For a deeper understanding of the Argentinean IT industry, see López and Ramos (2013), Novick and Rotondo, (2013) and CICOMRA (2014).

billion in 2012. This put the Colombian IT industry in the third or fourth place in the regional ranking. Next is the Ecuadorian IT market, with information from AESOFT, the ICT trade association in Ecuador. The size of this market is smaller than the previous markets analyzed, amounting to US$1 billion in 2009. Unfortunately, data on the different segments of the IT industry is not available. The IT market in Peru falls between the Chilean and Ecuadorian ones and was estimated at about US$ 2.8 billion in 2012.

Figure 9 IT Industries in Chile, Colombia, Ecuador and Peru



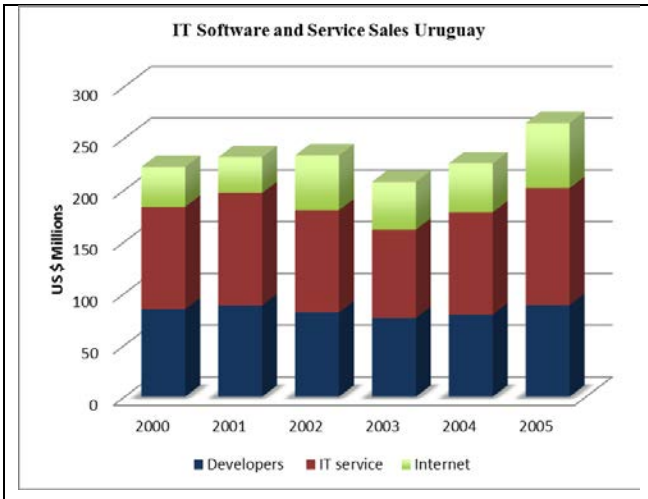
Source: Chile, ACTI 2012, Revisión de la Actividad de TI en Chile. Colombia, PTP 2014, Sector Software y TI. Ecuador, AESOFT 2011, Estudio de mercado del sector de software y hardware en Ecuador. Perú, APESOFT. Mercado Peruano de Cómputo 2011 y Perspectivas 2012.

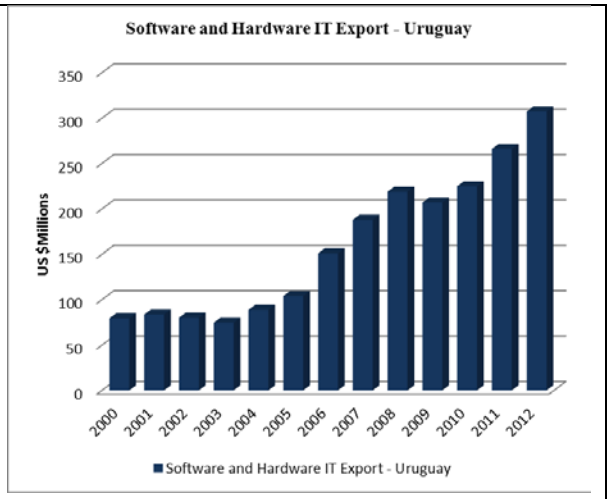
Last is the Uruguayan[11] IT industry, presented in Figure 10. As the left part shows, total sales in the industry from 2000 to 2005 averaged US$230 annually. The volume of IT software export, shown on the right, has been remarkable. From exports of US$79 million in 2000 it rose

[11] For more about the IT industry in Uruguay, see González and Pittaluga (2007) and González (2013).

by almost four times in 2012 to reach US$307 million. By 2005 exports represented almost 40 percent of total sales and in 2012 total sales were US$923 million.

Figure 10 IT Industry in Uruguay





Source: Uruguay, Uruguay XXI, La Industria TIC en Uruguay, 2012, and RedMercoSur 2007.

3.3 The Latin American IT Industry: Summing Up

The UNCTAD (2012) report discusses the importance of a well-developed IT software industry and presents useful data for comparison across countries. Why is a well-developed IT industry important, and what path should LAC countries follow in this regard? Complete answers are beyond the scope of the report; however, the following arguments strongly support the development of this industry in the region. First, in the last decade or so, IT industry productions in Latin America have grown at rates greater than that for the overall economies, and the impressive annual growth of world exports of computer and information service during 2005-2013 (WTO, 2014) signals that a strong IT industry can promote social and economic development in LAC countries. A second important issue is that, on average, in the developed economies where the IT industry generally has not only a high share of the exports but also represents an important fraction of the GDP, this industry has a greater business R&D to value added ratio (OECD, 2014). Therefore, one can conjecture that having an advanced IT industry (software and hardware) can help to boost R&D investment and innovation in Latin American firms. A third point is that as an economy becomes more networked, in the sense that individuals,

households and firms are more active users and have more access to Internet and new ICT technologies, a national IT industry can flourish and develop. All these factors are currently present in the region to some extent.

A last aspect is related to what a software industry requires. As UNCTAD (2012, p. 4) argues, "IT services, particularly software development, are more knowledge- and skill-intensive. The required capital investment, including hardware and software development tools, is comparatively low and does not constitute an entry barrier as in other parts of the ICT sector (notably ICT manufacturing or telecommunication services)." Human capital in the region, while not abundant in excess, is present.[12] Hence, public support for the IT industry through well-designed programs and focused funding can foster the growth of firms, employment and exports.

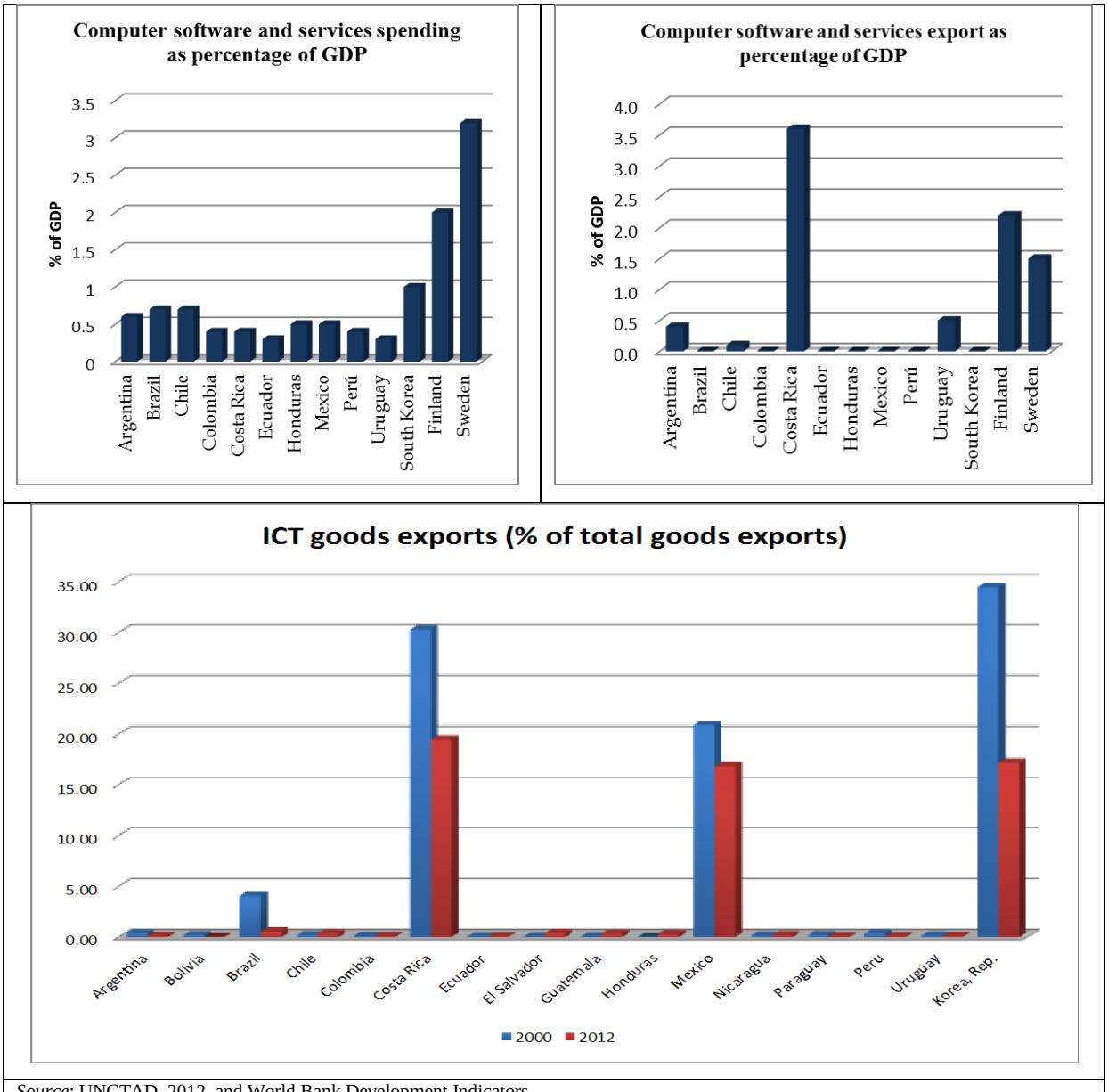
Previous subsections have shown that countries in the region share some features. First, most of the IT industry is dominated by the hardware segment followed by the service IT segment. Second, with the exception of Costa Rica and Uruguay (and perhaps more recently for the Mexican industry) the production of both hardware and software is directed mainly toward the internal market. This underlies the fact that IT industries tend to be larger in larger economies and more populated countries, e.g., Brazil, Mexico, Argentina. Last, most exports of IT items are directed toward neighboring countries. However, in the cases of Uruguay, Costa Rica, and Mexico, the main destination for exports is the United States. For instance, in the case of Uruguay, CUTI (2014) reports that 37 percent of the IT software produced was exported to the United States.

Figure 11 presents information that allows comparison of the regional IT industry and that of other economies, including South Korea. The first observation that should be highlighted is that in developed economies, the IT software and service industry represents a much higher share of GDP, although with different components. Economies like those of Sweden and Finland have a very large IT software industry directed mainly to international markets. South Korea has a smaller software industry but a strong hardware industry. Its hardware production is oriented to international markets and highly intensive R&D; its small software industry covers the internal market and is arguably less intense in R&D. Latin American countries follow the Korean IT pattern on a smaller scale, with a stronger hardware industry vis à vis software With the

[12] A.T. Kearney (2014) has calculated and issued the sixth edition of its Global Services Location Index which, as they say, offers "rigor to companies' decision where to locate offshore operations" in back and front office software. One of the components of that index is "people skills and availability". In this component, Brazil, Mexico, and Argentina obtained fairly high scores while those of Colombia, Costa Rica and Uruguay are about average for countries in its sample. This backs our assertion in the main text.

exception of Costa Rica and Uruguay, IT software exports represent a small proportion of total export.

Figure 11 Comparative Indicators of IT Development - 2010



Source: UNCTAD, 2012, and World Bank Development Indicators.

4. Institutional Arrangements Promoting ICT Adoption and IT Industry Development

Latin American countries share many cultural and social factors, and most share the same language as well. However, their geographic, historical, political and economic environments differ, which helps explain the high heterogeneity in the region. This section gives a brief overview of how governments in the region have implemented public policies and institutional arrangements to promote firms' access and usage of ICT and the development of the IT industry.[13] We focus on those countries for which better information is available: Chile, Colombia and Uruguay.

4.1 Colombia[14]

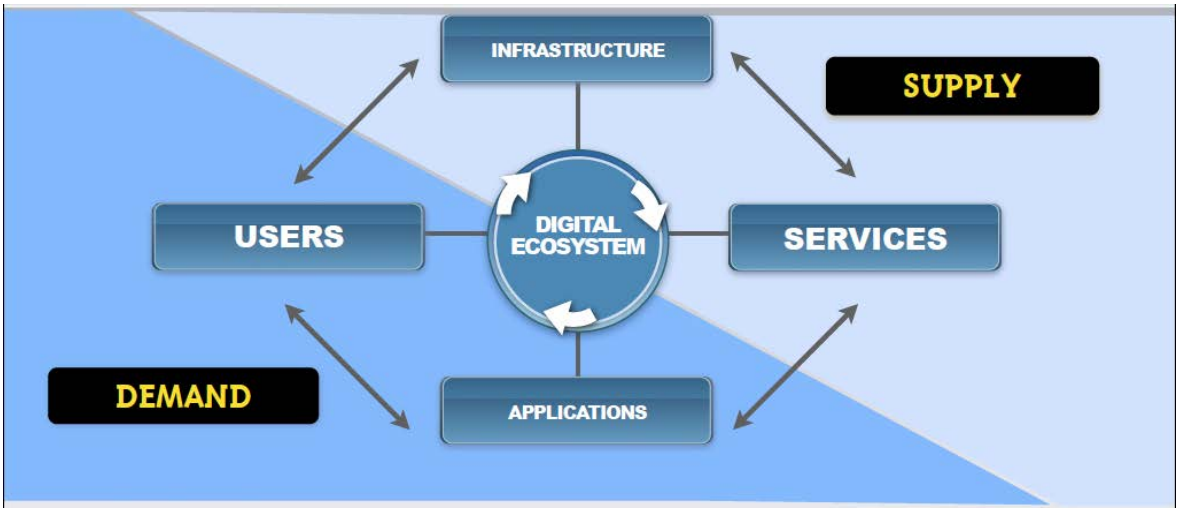
In Colombia the first Digital Agenda was launched in 2000 with the main objective of closing the wide digital gap between urban and rural populations in the country. At that time the only agency responsible for ICT programs and projects was the then Ministry of Communications. Little attention was given to designing programs to support either firms' access and usage of ICT[15] or the Colombian IT industry. Although the FOMIPYME (*Fondo Colombiano de Modernización y Desarrollo Tecnológico de la Micro, Pequeña y Mediana Empresa*) was created in 2000 as an agency inside the Ministry of Commerce, Industry and Trade (MCIT), this initiative did not initially undertake specific ICT programs.

Formal programs of support started in 2008 with the ICT National Plan, with the advent of the MiPyme Digital Program, and with the Transformation Productive Program led by the MCIT that aimed at developing the IT software and the Business Process Outsourcing and Offshoring industries. Little or no institutional coordination was implemented among the ministries involved. With the participation of several institutions, the Vive Digital plan marks the start of formal government support for diffusion of ICTs in micro and SMEs and the promotion of the IT industry. The ICT Ministry[16] designed the ICT programs directed toward the productive sectors and managed the ICT Fund, and MCIT implemented the programs through the iNNpulsa

[13] A deeper analysis of the software IT industry in Latin American countries can be found in Bastos and Silveira (2009).
[14] This section borrows some material from Gutiérrez (2013).
[15] Having said that, one needs to recall the COMPARTEL program of 2003 that introduced the stated goal of "enlargement of the broadband networks with emphasis in MiPymes sector" to help micro, small and medium firms located in rural or distant places gain access to the Internet. Program targets were to ease the access to broadband to 40188 MiPymes and to help with financing 4.940 computers.
[16] The former Ministry of Communications became the ICT Ministry in 2009 by Law 1341. The Telecommunications Law brought important changes in Colombian ICT policy and corresponding institutional arrangements. See Guerra and Oviedo (2011) for a complete overview and analysis of changes..

(*Fondo de modernización e innovación para las micro, pequeñas y medianas empresas*). Other participants have included the educational institutions SENA and COLCIENCIAS.

Figure 12 A Digital Ecosystem



The Vive Digital plan[17] thought of as a digital ecosystem[18] (see Figure 12) was launched at the end of 2010 by the ICT Ministry. This plan introduced explicit action lines favoring the productive sector, including MiPyme Vive Digital, Apps.co, FITI (the Spanish acronym for *Fortalecimiento de la Industria TI*; in English, Strengthening of the IT Industry), and the Digital Content program.

a. The MiPyme Vive Digital program has been the Colombian government's key program to ease access and usage of the Internet and computers by micro, small and medium firms. The budget of US$28 million benefited about 17,000 firms. In 2014, the ICT Ministry reported to the Congress that currently 60.6 percent of micro firms now had Intenet access.

b. The Apps.co has the following objectives: To create and consolidate an ecosystem of innovation in ICT entrepreneurship and venture capital; to contribute in a sensible way to entrepreneurial development in Colombia via the alliance between the ICT Ministry and

[17] At the end of 2014, the Colombia government announced the Vive Digital 2014-2018 Plan. However, no official document has been presented.
[18] The plan purported to expand the infrastructure so more people and firms can be connected, create ICT services at lower prices, develop applications and digital content, and foster ICT adoption and use. The foregoing ecosystem has the purpose of establishing a virtuous cycle, where a better infrastructure will allow more and better services at lower prices, which in turn stimulates the development of content and applications, and thus the growth of demand.

COLCIENCIAS; and to contribute to the consolidation of interesting prospects (entrepreneurships) in order to attract investment to the ICT industry.

The amount of investment allocated to this project was about Colombian $42.1 billion (About US$21 million). Started in 2012, the project's main task was to identify the potential number of trained people able to develop applications, the number of entrepreneurial projects that could be assisted and how many of them could become formal companies. Furthermore, in that year, it was possible to identify ICT firms looking for venture capital or investment. The Apps.co followed the *lean startup* methodology that focused on helping entrepreneurs consolidate their ideas or business model in a short but intense way, providing them with visibility in the business environment.

c. The FITI (*Fortalecimiento de la Industria TI*) total budget allocated between mid-2010 and mid-2014 was Colombian $103 billion (About US$51 million). A basic goal of the program was to increase sales in the IT industry. By mid-2013, the ICT Ministry reported that sales had increased by 79.4 percent.

d. The last initiative, Digital Content, looked to develop and strengthen the value chain of Colombia's digital content industry in an integral way, by focusing on strengthening the human capital and financing mechanisms, promoting innovation, and easing access to both national and international markers. About Colombian $20 billion (US$10 million) were invested to implement this project, and it benefitted about 30,000 people.

The most important aspect of the Vive Digital plan and the implementation of previous initiatives has been the coordination among all participant institutions. The ICT Ministry has coordinated actions with other government institutions, basically the MCIT, COLCIENCIAS (the Colombian agency in charge of R&D and investment), SENA and private institutions. The amount of money allocated to the productive sector in the plan was not large enough but counted along with budget allocated by private firms or institutions.

Finally, in 2008 the Colombian government created the *Programa de Transformación Productiva* (PTP, Program of Productive Transformation) with the objective of the country's becoming an exporter of highly value-added and innovative goods and services. Among the chosen sectors were Business Process Outsourcing (BPO), Information Technology Outsourcing (ITO), and Knowledge Process Outsourcing (KPO), and the sector software. The projects that

make up this program support business meetings and promote exports, bilingual projects, and some regional events.

4.2 Uruguay[19]

In recent years, different initiatives were put in place to promote the use of ICTs in firms, particularly SMEs. Worth mentioning among this set are the following:

- Productive SMEs (Pymes ProducTIvas)

  Launched as a result of an agreement between CUTI, the sectorial chamber of software and IT firms, and DINAPYME, (in Spanish, *Dirección nacional de artesanías, pequeñas y medianas empresas*, an agency of MIEM, the Ministry of Industry, Energy, and Mining). This agency was in charge of promoting and supporting SMEs in 2006. The program established an intermediary between potential users and firms producing IT solutions, with the goal of products better customized for the needs of SMEs. At the same time, Pymes ProducTIvas partially subsidized funding by the Banco de la República Oriental del Uruguay (BROU).

- Plan CIPRES

  Launched in 2008 by the National Development Corporation (CND), ANTEL (the National Administration of Telecommunications), BROU, the Direction of Development Projects (DIPRODE) and the software company Memory, a pilot plan to support firms operating outside Montevideo was established. This provided access to funding, specialized basic equipment (computers and ADSL connectivity paid for a year) and IT solutions.

- Dirección Nacional de Industrias (MIEM)

  Developed jointly with the Economic Commission for Latin America and the Caribbean (ECLAC), a pilot project sought to identify common technological solutions for firms operating in specific sectors. This initiative is currently in its implementation stage.[20]

[19] Additional analysis of Uruguay's public and private initiatives are in Aboal, Jung and Tacsir (2015), González and Pittaluga (2007), and González (2009).

[20] It should be noted that these programs provided little impact and were discontinued (see Plottier and others, p. 25). In this respect, evidence shows the need to strengthen the capacity of implementing policies directed toward MSMs.

4.2.1 *Promotion of the Software and IT Sector*

The IT and software sector in Uruguay has its own regulatory framework to promote the development of the sector. In 1999, the government declared the software industry to be of national interest (National Decree 84/99), giving firms operating in the sector investment promotion and protection benefits. This also allowed putting in place a set of incentives aimed at developing the sector and promoting its internationalization. These incentives include waiver of income taxes related to the production of software and related services, waiver of VAT taxes when software or IT services are exported (Decree 386/000), and a more flexible system to allow hiring of university graduates for IT and software activities (Law 18083, National Decrees 241/007 and 258/007).

One of the main programs supporting the IT software industry in Uruguay was the PASS (*Programa de Apoyo al Sector Software*) which had the financial support of the IDB-MIF (Inter-American Development Bank Multilateral Investment Fund) and a budget of US$1.6 million (55% by the IDB). Another initiative is *Programa de Creación de Nuevas Empresas de Tecnología de la Información, la Incubadora de Empresas* INGENIO (Firm incubator INGENIO). This initiative was carried out jointly by LATU and Universidad ORT, with the support of the IDB.

In addition to these incentives, specific instruments for the IT and software sector were put in place. The most important are as follow:

- Innovation projects and entrepreneurship supported by ANII (Agencia Nacional de Investigacion e Innovacion). Competitive funding, implemented as matching grants, supports firms at different stages of their development.
- Uruguay XXI provides grants to SMEs to support their internationalization process.
- Different programs aimed at supporting pre-incubation, incubation and acceleration processes, creation-dedicated incubators and provision of venture capital.
- Attraction of entrepreneurs from abroad to relocate their business operation to Uruguay.
- Inclusion of the software and IT sector as part of the *Programa de Competitividad de Conglomerados y Cadenas Productivas*.

4.3 Chile[21]

As a pioneer in designing and implementing initiatives for enhancing access and the impact of ICTs in the economy, Chile's first public initiative for promoting ICTs dates from 1999. The objective of the Presidential Commission of New Information and Communication Technologies was to initiate discussion of topics related to ICTs in order to generate both short- and long-term development strategies.

Subsequent administrations continued to position the topic at the center of public debate. The responsible director of the Information and Communication Technologies Ministers Committee was the Undersecretary of the Ministry of Economy. In 2003, the Digital Action Group was created as a public-private partnership that sought to "contribute to Chile's development through the use of ICT to increase competitiveness, equality of opportunities, individual liberties, life's quality and the efficiency and transparency of the public sector." With those objectives, the first Digital Agenda was launched in 2004-2006 with 34 specific initiatives oriented to the universalization of ICT access and increased sophistication in ICT use. Among the specific goals of the agenda were the digital development of enterprises, the take-off of the ICT industry and massification of electronic invoice, the consolidation and expansion of the digital public purchasing system and encouragement of e-commerce facilities.

In addition to these general policies, other programs supported innovation and productivity at SMEs. For instance, Technical Assistance Funds offered support in hiring consultants, the Provider's Development Program supported projects to improve provider quality and productivity, and the Projects of Associative Promotions gave support to enterprises that incorporated proposed improvements in management.

As part of the policy related to SMEs, public resources were also allocated to the creation of *Infocentros* (Information Centers), public spaces with Internet connection for people without their own connection. The institutions involved in this project were SERCOTEC (a seed capital program for technical cooperation services) and Chile Innova (CORFO, Productivity, Innovation and Growth Agenda). Furthermore, CORFO, through competitive funding, allocated resources for entrepreneurs learning about efficient utilization of ICTs.[22]

[21] This section borrows material from Álvarez (2015), Bello (2013) and Achá and Bravo (2013).

[22] According to Chile Innova (2005), 712 consulting activities involving the participation of 14 intermediaries were co-financed with these resources. Among the most important intermediaries were CEPRI (Integer Productivity Center), the Chilean Association of ICTs Enterprises (ACTI), and the Santiago Commerce Chamber.

Regarding the development and strengthening of the ICT sector, the institutions involved in public programs were CORFO, CONICYT (Chilean Commission of Science and Technology), and the Chile Foundation.[23] CORFO, with technological funds from FONTEC and foreign direct

In the case of CONICYT, the financed projects were not directly related to the business sector, but some of the initiatives could have some indirect effect. Matching grants by FONDEF period with a total investment of US$3.5 million.

In 2007, the Ministers' Committee for Digital Development was created by the Ministers of Finance, Education, and the General Secretary of Presidency, Transport and Telecommunications, and was co-chaired by the Minister of Economy. The committee was in charge of the Digital Strategy 2007-2012, which contained general guidelines for future ICT policy. Two action lines of this initiative deserve special mention. The first involved development strategies for the ICT Industry and was intended to promote the country as an informatics and technological services provider supporting the ICT sector through entrepreneurship, competitiveness and productivity promotion.

The second line involved institutional design and was related to consolidation of a framework for the development of long-term digital plans. A board composed of the Committee of Ministers, an executive secretary in the Ministry of Economy, and two consultative councils was formed. One of these councils was national, with members from both the public and the private sector. The other was international.

Unfortunately, according to Bello (2013), this first digital effort was a partial summary of initiatives developed by several government agencies and already in practice. The author argues that its relevant deficiencies have been the lack of metrics for measuring progress, inconsistencies between objectives and instruments, and the absence of leadership in the government.

Later on, three new digital agendas were launched: the Digital Action Plan 2008-2010, the Digital Action Plan 2010-2014, and the Digital Agenda 2013-2020. The first of these had 25 initiatives important for this study:

- ICT application in enterprises and clusters, like the implementation of 15 digitalization plans by the Ministry of Agriculture;
- Enhancement of a global technological services industry;
- Development of entrepreneurial centers;

[23] Most of the resources were destined to complement existing technology funds managed by CORFO and CONICYT. In the case of the Chile Foundation, the resources were allocated to activities of technological monitoring and diffusion, and also to human resources formation in ICTs.

- Promotion and training of entrepreneurs in ICT;
- Promotion of ICT incorporation in productive processes (with the National Corporation of Production Promotion, CORFO, in charge through public tenders made by InnovaChile);
- Promotion of digital skills for specific purposes (ChileCompra's training of 50,000 business personnel); and
- Creation of a continuous platform of online training (implemented by the Ministry of Economy).

The second agenda had several relevant proposals for the business sector, including the creation of 100,000 digital entrepreneurs through the generation and consolidation of online platforms and the duplication of incomes derived from remote global services linked with the ICT industry. The Digital Agenda 2013-2020, has focused more on households and individual citizenships.

Sector initiatives implemented in the agricultural sector have been led by the Agricultural Innovation Fund (FIA) within the Ministry of Agriculture. The main objective has been to reduce the digital gap between firms and producers in this sector. In 2008, jointly with the IADB, FIA initiated the project "Strength of the Competitiveness of Agricultural Small Firms through the Utilization of ICTs."

In conclusion, one can argue that even though Chile was a pioneer in the design of a digital agenda in Latin America, the weakness of its policy was that most of the measures were not well linked to the support programs in public agencies. In fact, as described above, institutions such as CORFO, CONICYT and SERCOTEC received resources for instruments already existing in these agencies, but it is not clear that these were adequate for fulfilling the objectives of the initiatives. Additionally, there is no information or formal evaluations about whether the specific goals of the initiatives were fulfilled.

A positive indirect effect on the adoption of ICTs in Chilean firms could be attributable to efforts in digitalization of public services. In particular, the plan of modernization implemented by the internal tax service has allowed most tax-related procedures to be accomplished using an electronic platform. The development of an electronic system for public purchases (Chile Compras) is another benefit.

The evidence suggests a persistent gap in access and utilization of ICTs between small and large firms, and also that private initiatives have been (more) important in the promotion of ICTs in Chile (Conicyt, 2010). Private associations involved in initiatives include the following:

- The Chilean Association of ICTs Enterprises (ACTI) promotes the development of ICTs and the generation of domestic and external markets for ICT products and services.
- The Country Digital Foundation is a non-profit organization with the objective of research, dissemination, promotion and development of technological sciences. The broad goal is to consolidate the digital culture in Chile.
- The Chile Foundation, a non-profit private institution, seeks to improve human and productive resources through the development and enhancement of innovation and high-technological impact processes, technological transfer and technology management.
- The Chilean Society of Software and Services is composed of more than 100 ICT firms. Its mission is to promote the development of software and related services by helping associated firms consolidate their products and services in Chile and abroad.

4.4 Lessons Learned from Policies and Initiatives Promoting IT Industry and ICT Adoption in LAC Countries

Public policies regarding ICT use and access and the IT industry in Latin America are as heterogenous as the countries are. The two largest and most populated countries in the region, Brazil and Mexico, have seen strong development of the IT hardware industry. The industry in Mexico has benefited from the country's closeness to the United States and the NAFTA agreement, while Brazil has relied on an industrial imports policy and the size of its internal market. The software industries in these countries share some features. First, a wider IT hardware industrial base has served to lever a national industry. Second, private trade associations initially associated with public plans and programs later managed these. Third, programs and plans in both countries featured strong fiscal incentives for R&D in the sector. Fourth, the financial support of a large development bank has been useful. This support has not subsidized credit but has eased availability of funds. Finally, institutions in both countries strongly help by promoting and easing exports.

Governments in the remaining countries in the region have provided fiscal incentives, as in Argentina, and export promotion, as in Chile, Colombia and Uruguay. More recently, some

countries have adopted more explicit policies or programs to promote the software and apps industries, like the Apps.co and FITI plan in Colombia.

In countries such as Colombia, Chile, and Mexico, among others, the public digital agenda involves a so–called digital ecosystem. In this networked economy, the more people, firms and government institutions are connected, the more opportunities for the national IT software industry. However, despite the various digital agendas and the deployment of fiber optic networks, there is a growing gap in ICT access and usage in the society generally. As shown above, a wide digital gap exists between rural and urban populations, between low- and high-income groups, and between micro firms, the largest portion of firms in LAC countries, and the SMEs and large firms.

One lesson from the South Korean experience is that it is necessary to close the digital gap faster and sooner rather than later. With a wider base of users (individuals, households, firms, and government institutions) the probability of a strong and innovative IT software industry increases. Therefore, programs that promote ICT adoption and usage contribute to the digital ecosystem. A second important lesson involves the institutional framework, which should ensure the development of the IT industry in national plans and digital agendas and also support a continous learning process so that change and novel initiatives are considered continuously. A third lesson, and maybe the most important one, concerns active private participation in the process. Governments may have given the first push toward developing the IT industry through national plans and funding, but the private sector has invested heavily in R&D activities in the IT industry. As for government participation, the South Korean state was a leader in the whole process of turning South Korea into a digitized economy, and this leadership was accompanied by continous plans that involved funds not dependent on economic business cycles (See KAIT, 2015).

Looking at the evolution of ICTs, the development of the LAC IT industry, and the lessons from the South Korean experience, we propose the following recommendations:

1. Governments should support plans that allow micro and small firms to access and use ICTs. This includes Internet connection to high speed broadband as well as advanced applications like ERP (enterprise resource planning) and CRM (customer relationship management), adoption of intranet, extranet and creation of a website. One way to incentivize this policy is by strengthening e-government, as in Chile. Another way is by

adopting novel schemes like the Colombian MiPyme Vive Digital. (See the next section for a case study.) The initiative mandates that public funds should be supplemented with private ones. Given the structure of the program, most of the beneficiaries are micro or small firms. An addendum to the project invites participation by IT trade associations. Knowing the software requirements set by a government agency, local software firms can actively participate by not only making recommendations but also by becoming software providers.

2. Recently, in the United States the FCC declared that the Internet is a public utility. In practical terms that means that there should be universal service at the individual's premises and not only indirect access through telecenters, cybercafes, or digital kiosks. Clearly, public funds are scarce and there are other social needs that need to be covered. However, since more and more daily life activities are carried out through digital means (the so-called IoT, Internet of Things), only those individuals (and firms) with direct access to *high broadband connectivity* will be able to attain higher social and economic well-being. Since fiber optic networks have been deployed in Latin America, governments should devise universal high broadband norms to benefit the population not currently connected. Furthermore, governments should work with Internet service providers to subsidize low-income families' access to broadband.[24]
3. In most countries in the region (Uruguay, Chile, and Colombia, among others) public policies mandate that computers be given to students. This is commendable but clearly not enough, as the ICILS (2013) report shows. According to this report, computer literacy among students aged about 14-15 years old is relatively low. Using a special index that has four levels of literacy, 30 and 5 percent of South Korean students achieved the top levels 3 and 4, respectively. . On the contrary, inChile and Argentina, as well as in other developing economies, no students achieved level 4 and most of them reached level 1 or 2 only, being unable to look for and understand information. More and better projects and initiatives are needed to train teachers and so enhance the capabilities of students.

[24] Related to this issue, a recent blog on the Euromonitor web page asks whether Internet access has become a basic human right. In addition, "As much as the web is a human right, it can also be increasingly described as a 'business right'. The benefits of having an online presence and the capability to attract consumers online for a business can provide a beneficial ripple effect across an entire economy. The EU's Digital Agenda, for example, aims at providing high-speed broadband across Europe due to the high economic rewards of well-connected markets. Business broadband Internet use in the EU stood at 92.1% of companies in 2014" Available at http://blog.euromonitor.com/2015/03/has-internet-access-become-a-basic-human-right.html

4. The development of a strong national IT industry must be a priority for LAC governments. As shown above, LAC IT industries are relatively small and mostly oriented to local markets. The UNCTAD report (2013) discusses the benefits of a strong IT industry, and governments' public procurement is an important means of obtaining this.. Although data on the amount of money governments spend in buying IT software and IT services is scant, surveys have shown that it represents a fairly large figure. As the UNCTAD reports (2013, p. 36) states, "The primary aim of public procurement is to obtain the best value for money. The promotion of the local IT services industry, however, does not need to be inconsistent with this objective. On the contrary, the strengthening of the local IT industry increases the number of potential suppliers that can bid for public tenders in the future, thus increasing competition…and…When (and where) domestic capabilities are underdeveloped… the public sector is forced to procure imported solutions, which may be more expensive." The report warns that "[public procurement] is a complex policy instrument and its successful application requires a certain level of capabilities (in both the public and the private sector) as well as open and transparent procurement processes." Bianchi and Brun (2014, p. 24) argue that public procurement of software in Uruguay could have represented about 5 percent of total sales in the local market. The authors are careful in recommending public procurement as an industrial policy but do recognize that "software as the segment where a promotion policy could have greater effects on the national industry and on the national innovation capabilities of that segment." We argue that novel ways of using public procurement of IT goods and services could be another way to develop and stengthen national IT industries.
5. It is clear that some Latin American countries are currently better positioned as a place for BPO, KPO, and offshoring, while others have an IT industry that mostly produces for external markets and some have a strong internal market. Each national IT industry has learned many lessons, and although rivals in the international markets, LAC governments and trade associations should sponsor forums where experiences can be shared. The involvement of international institutions like the IDB and the World Bank is key to the success of such forums.
6. Countries in the region must be able to attract more FDI into the sector, and national capital must also be more actively involved in supporting the IT industries. Governments

could design programs that involve development banks (as in Brazil and Mexico, and more recently in Colombia), financial institutions, and pension funds, among others.

5. Case Studies[25]

5.1 CEMEX al Punto

Public policies in support of ICT in Latin American countries are scant, but Colombia has implemented an interesting program called the MiPyme Vive Digital. This is a modification of the previous MiPyme Digital, described in Section 4.1.. The case study that stems from this program is the CEMEX al punto project, one of 25 approved projects that were carried out between 2012 and 2014 under the umbrella of the MiPyme Vive Digital.

Before setting out the main features of this project, it is worth considering detailed aspects of this program. First, an announcement calling for proposals contained explicit requirements and conditions; for instance, the amount of money the government would allocate (about US$14 millions), the percentage to be co-financed by iNNpulsa MiPyme, 65 percent, and the anchor firm's financial responsibility, the remaining 35 percent. The call also ourlined conditions that proponents of proposals should comply with. Proponents that wanted to develop their own network of retailers or suppliers were called "anchor firms" or "trailblazing companies". The participating retailers or suppliers had to be micro, small or medium enterprises (MSMEs). Chambers of commerce and industrial and service trade unions were thought to be potential proponents, too. There was a detailed list of requirements regarding Internet connections, applications, and training courses that proponents should execute with the benficiaries. This project clearly targeted a large number of potential firms that did not have Internet access.

CEMEX is a well-known multinational cement manufacturer operating in many countries around the world. It has a large network of small clients across Colombia, mostly ironmongers in micro firms, i.e., firms with less than 10 employees. As an anchor firm, CEMEX presented a project they called CEMEX al punto. The objective of the project was to give micro and SME

[25] We thank Diego Andres Triana Jimenez, the general manager of the CEMEX al punto Project, and Ricardo González, general manager of CONSTRURAMA-CEMEX, for their kind help in meeting with the authors and for providing access to data from the project. We also thank Juan Felipe Pacheco, manager of laspartes.com, for his kind invitation to discuss his case. We also thank Claudia Giraldo, former director of the MiPyme Vive Digital program, and Rivier Gómez, officer of the ICT Ministry. We would also like to thank Xiomara Barrera, officer of InNpulsa-MICT.

ironmongers Internet access, train them in the use of computer and software applications, and make them aware of the benefits of the Internet and ICTs in general.

From a total of 1,232 potential beneficiaries, 437 complied with the requirements set by the ICT Ministry. Among the characteristics of these small business owners were the following: 74 percent were at least 40 years old; 76 percent had only a primary education; 29 percent had no knowledge of computer use, and 48 percent said they had only basic computer knowledge; 23 percent had no computer, although 68 percent did have at least one computer.

5.1.1 *Barriers to the Project*

The socioecomic features of the firms' owners presented great challenges to the project manager. There was fear of the unknown and mistrust of ICTs, no background in using the technology, resistance to change and generally late ages for learning, as well as the high cost of connectivity. To overcome these barriers, the leader of the project first created a section on the Cemex website showing two important elements of the project. The design of the online training courses allowed people to see the material at any time and proceed step by step. Another online program allowed the ironmongers to earn points every time they used the Internet for a training session. These points could later be used to buy cement at a discount. Furthermore, to ease the use of computers and Internet apps, a game was devised to show owners an easy and fun way to use ICTs. CEMEX al punto also bargained with ISPs regarding Internet tariffs and negotiated with these firms to buy computers on credit.

5.1.2 *Results*

No formal evaluation of the project was mandated but some results have been provided by CEMEX al punto. First, a total of 1,276 people from 437 micro enterprises were trained in the use of computers and the application devised for ironmongers. CEMEX al punto paid for 136 broadband Internet subscriptions and bargained with ISPs for another 299. More than 100 e-mail accounts were opened. Regarding performance measures like productivity, sales and the like, there is no information at all. However, testimonials from some beneficiaries show that owners gained time for themselves and were able to spend more time with family and attend other commercial and social activities. An important benefit has been the ability to access information

with the software installed on their computers. This allows them to track sales trends, to have an updated inventory, to know which display items show less turnover, and the like.

5.2 Artech-GeneXus

Artech Consultores S.R.L. was co-founded in 1988 by two Uruguayan computer engineers who at that time were carrying out consultancies abroad (in Brazil and the United States) in the relatively recent field of relational databases. An incidental event that led to the research that resulted in GeneXus was a consulting project developed in 1984. The first version of GeneXus was released at the end of 1989, and since then Artech has evolved from a small company to a large-scale, prosperous business with worldwide trading of its product. Artech has grown from US$10 million (with 2,200 clients) in 1997 to a total turnover of $30 million in 2014 (and more than 8,500 clients). Most of their turnover comes from exports.

Artech's capital is still entirely national, and the founders maintain their position as president and vice-president of Artech as well as of GeneXus Consulting, a firm created to provide consultancy services. The GeneXus discovery is a typical case of exploitation of a proprietary knowledge niche that was generated and maintained through intensive R&D and a clear, long-term product strategy. Since its creation, Artech has been heavily involved in R&D, in the area of relational databases, applications development, computer-aided software engineering, and artificial intelligence.

In its early stages, the discovery did not benefit from any special public support or incentives. However, Artech had the advantage of operating in a technological free trade zone (Zonamerica) with state-of-the-art infrastructure and services and a package of fiscal benefits. Setting the company in the free trade zone produced the additional benefit of an improved image abroad. Nowadays, Artech operates from LATU, the Technological Lab of Uruguay. Located in Montevideo, LATU is a joint effort of the government and the private sector to promote sustainable development in the country and support its international position through innovation and the transfer of value solutions in analytical, metrological, technological and management services. Since January 2007 it also contains the Knowledge Development Center, dedicated to training human resources for the information technology sector. Other facilities include the business incubator Ingenio, an exhibition park and a science museum.

6. Concluding Remarks

Digital agendas were launched in Latin America beginning in 1999 with Chile. Since then, almost all Latin American countries have launched one. Furthermore, many governments in the region have deployed fiber optic networks. Governments have also funded educational programs to enhance digital literacy and capabilities. Despite all these endeavors, digital gaps prevail between rural and urban populations, between low- and high-income groups, and between micro enterprises and medium and large firms. Wider gaps exist when one compares high broadband connectivity between those population segments and when one focuses on advanced ICT use by firms. More assertive digital agenda that promote more active adoption and usage of ICTs by firms and the society at large are needed.

The development of IT software and hardware industries has been determined by the evolutionary path each has followed in particular countries. Past implementation of industrial policies, closeness to large markets, existence of large internal markets, bold private initiatives, and the like are factors. Both software and hardware industries in Latin American are relatively small for the most part, and there is room for an expanding IT industry. One possibility is to use public procurement in novel ways that guarantee good prices and quality and post-service attention. Another is to improve country conditions to encourage the inflow of foreign capital. Reports of specialized IT research firms are good proof of how attractive IT regional industries can be. One such firm is A.T. Kearney, which publishes the Global Services Location Index that, as it says, "seeks to bring rigor to companies' decisions about where to locate offshore operations." Six Latin American countries appeared in the last country ranking: Mexico (4 – 5,9), Brazil (8 – 5.69), Chile (13 – 5.53), Costa Rica (24 – 5.35), Argentina (38 – 5.06), Uruguay (42 – 4.91), and Colombia (43 – 4.9). The first number in the parentheses refers to the country's place in the 51 country ranking; the second is the score. The ranking for Mexico and Brazil is very encouraging and shows that the region can and must keep attracting FDI. However, private national capital is also needed, including more venture capital, special credit lines for firms in IT industries, and the like. Finally, government leadership is needed for bolder digital plans that include bigger budgets, incentivized public-private partnerships and enhanced e-government.

Another goal is to keep enhancing human capital. For this, governments can provide funds via scholarships, soft loans, and the like to strengthen engineering schools in their own countries and to send young graduates abroad for advanced degrees. In addition, the digital

agenda should be more assertive with programs to support ICT adoption by firms and to promote IT industry. There should be more institutional coordination, more continuous lines of actions as one program ends and another begins, and, importantly, more abundant funds and less fluctuation with economic conditions.

Companion papers (works in progress) to this report have carried out research to determine whether ICT investment by firms is correlated with their labor productivity. Using a common framework (the CDM model), researchers in Chile, Colombia and Uruguay have found that firms that invest in ICT are more likely to seek out innovations, both technological and non-technological. These effects are not uniform across manufacturing and service firms, although there is a positive correlation between investment in ICTs and productivity. These results are important from a public policy point of view. It means that initiatives to increase investment in ICTs will end up increasing the rate of innovation and the level of productivity in countries.

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