Mexico: industrial policies and the production of information and communication technology goods and services

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ABSTRACT

This study investigates the extent to which the digital boom has had repercussions on productive activity, in terms of both manufacturing (ICT goods) and services (ICT services), in addition to its potential ramifications in the rest of the Mexican economy. Input-output matrices are used and compared to those of Brazil and the United States. Mexico has fallen behind, particularly in the production of ICT goods, and the productive chains of this activity have weakened. The ICT services sector offers much greater potential than has been exploited thus far, with the advantage that it involves comparatively more value added and has major diversification possibilities. It is considered essential to find more effective industrial policies targeted on the ICT goods and services sectors; but the experience of countries such as Brazil, which have applied more proactive approaches with mixed results, suggests that this will be challenging.

KEYWORDS Communication technology, trade in services, consumer goods, industrial production, industrial policy, Mexico, Brazil

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I
Introduction

Information and communication technologies (ICTs) play a central role in the current global trend towards interpersonal connectivity, the storage of ever larger volumes of information in a smaller space, the facilitation and diversification of financial activities, the enrichment of recreational activities, simpler and more accessible government procedures, and the extension of health and education services, among other contributions.

There is a wide-ranging debate on the repercussions that ICTs can have on economic development and their potential for enabling less advanced countries to progress towards development more quickly (Niebel, 2014). The main interest of the current study is to analyse the extent to which the digital boom has stimulated productive activity in the manufacturing sector (ICT goods) and in the services sector (ICT services) in Mexico. More specifically, by using input-output matrices, it investigates whether the productive system has made the most of the characteristic dynamism of the ICT sector and its potential ramifications in the rest of the economy. This analysis used the experiences of Brazil and the United States as comparisons, although more specific references are also made to other countries including China. The study also examines whether the public policies implemented in Mexico have played a relevant role in empowering the effect of the spread of ICTs on productive activity, for which purpose, the Brazilian experience is considered. The hypothesis is that progress in the production of ICT goods and services in Mexico has been relatively slow, while the demand for them by other production sectors has also lagged behind, which suggests that the industrial policy model followed has been inadequate.

From the production standpoint, the electronics industry is the largest manufacturer of consumer goods in the world; and the production equipment used in firms has an increasingly large digital component. Alongside the hardware industry, the information services industry is developing even faster —including the design of operating systems, telecommunications, data processing, cloud services, and data mining among other activities (Sturgeon and Kawakami, 2010).

In the productive sphere the ICT revolution has changed the way manufactured products and services are designed, organized, processed, distributed and marketed. During the production process itself, ICTs facilitate interconnection between the different stages of production, including the optimization of distribution and transport systems, or support in the design and testing of the product, including computer-aided manufacturing (CAM).

The widespread incorporation of ICTs in the economy can also be appreciated in the huge variety of ICT products and services that are embedded in other products: robots, global positioning systems (GPS), video cameras, bluetooth, videos, video games, among others. ICT content is increasing even in traditional industries such as textiles and agriculture (McNamara, 2008).

If this topic is viewed in terms of input-output matrices, ICTs should form an increasingly large part of productive linkages. In a globalised economy, these increasing sectoral interactions may not be recorded in the domestic economy, but instead at the international level, reflecting a larger volume of trade in the components and parts of ICT goods and services. Nonetheless, if a country succeeds in developing a large ICT goods and services producing sector, this could have a dynamic effect on the national economy.

Section II of this study will analyse Mexico's position in the production of ICT goods and services compared to that of other countries; section III examines the role of these sectors in generating value added and employment in the Mexican economy (compared to those of Brazil and the United States). Section IV will review the role of these sectors in the economy's intermediate operations, again in contrast to Brazil and the United States. The forward and backward productive linkages generated by the analysed sectors will also be examined within the Mexican economy, compared to the aforementioned countries. Section V of the study will review some of the industrial policies that have been applied to the ICT goods and services sectors in Brazil and Mexico. Lastly, the sixth section will offer some concluding remarks.

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II

Mexico's production of ICT goods and services compared to other countries

1. Access to ICTs

When contextualizing the development of the ICT sector in Mexico it is important to consider the specific conditions this sector faces in that country, compared to other nations, while also taking into account the dynamic of the global market in ICT goods and services.

The first thing that comes to mind is that ICT access in Mexico is relatively poor, both for individuals and for firms, and this restricts the breadth and depth of the ICT markets. Mexico has not made sufficient investments to ensure adequate access to these technologies. For the productive sector, access to broadband, and hence to Internet, is essential if the aim is to optimize competitiveness to gain access to markets, make technological innovations and upgrade training and financial services, among other advances. A study by ECLAC (2013) shows, for example, that backwardness in the use of mobile broadband in Mexico is mainly due to a deficient supply of investments in 3G networks.

Infrastructure problems are also revealed by the fact that Mexico does not offer access to fixed-line broadband Internet at speeds comparable to those available in other members of the Organization for Economic Cooperation and Development (OECD), where, in 2011, over 70% of Internet access was at high or very high speed. In Brazil, the equivalent figure was 40% in that year, but in Mexico, that access speed did not exist at all (ORBA, 2011).

A broadband subscription (fixed and mobile) has historically also been more expensive in Mexico than in the vast majority of OECD countries (OECD, 2014).

The shortcomings mentioned, compounded by a lack of digital skills in a large proportion of the population, explain why Mexican firms' access to broadband is the lowest among all OECD countries: only 50% of firms with 10 or more employees had such access in Mexico in 2012 (OECD, 2014).[1]

Compared to another 148 countries worldwide, in 2014 Mexico was ranked a lowly 79th in terms of its capacity to benefit from ICT development, as measured by the countries' Networked Readiness Index (NRI), published by the World Economic Forum (WEF). The contrast is particularly acute with its neighbour, the United States, which is ranked seventh, and with several Nordic countries of Europe which occupy the top places.

Nonetheless, Mexico's ranking is not very different from those of other developing countries —slightly below Brazil (69th) and China (62nd), but above India (83rd)—. The aforementioned source explains Mexico's specific situation by the lack of a holistic digital agenda, compounded by the high cost of telecommunication services and low education standards. India, which has become the main global exporter of ICT services, has a major infrastructure deficit; and, although it is the country where ICT access is most internationally accessible, its individual use is among the lowest in the world. Although Brazil and Mexico have similar NRIs, Brazil has comparatively better infrastructure and reports considerably higher use of ICTs by the population and firms, which suggests that the Brazilian domestic market is comparatively larger, as will be seen in the following sections. China, on the other hand, displays several subindicators that are similar to Mexico's, but it has higher skills and a more widespread use of ICTs, particularly by firms (comparable to Brazil).[2] Nonetheless, the value added in global final demand for ICT goods from China and Mexico was very low compared to those obtained from Germany, Japan and the United States, at least until 2009, according to information published by the OECD (2014).

Institutional arrangements have not fostered adequate development of the ICT sector in Mexico owing to the monopoly practices prevailing in this sector (particularly telecommunications) and the fact that the public sector has had few tools to prevent them. Significant progress has been made in terms of legislation, particularly the new Telecommunications Act, which creates a new institution with responsibility for adequately overseeing competition in this market. Nonetheless, even this new law has significant shortcomings in terms of the independence of the public bodies operating in this domain.

[1] See OECD Broadband Portal [online] http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm.

[2] See World Economic Forum, 2014 [online] http://www3.weforum.org/docs/WEF_GlobalInformationTechnology_Report_2014.pdf.

III

ICT production in Mexico, Brazil and the United States

The behaviour of the ICT goods and services producing sectors in each country is not immune to what happens around the world. Relevant phenomena include the displacement of ICT manufacturing activities from OECD countries to Asia, and the reduction in the specific weight of ICT goods compared to other products, owing to the fall in their relative prices. The ICT services sector, in contrast, has gained special momentum in OECD countries as a result of the increased demand for applications and the management of information technology infrastructure (OECD, 2014).

It is increasingly difficult to distinguish between the production of ICT goods and the production of ICT services. Business service providers, hardware manufacturers, and telecommunications and software developers are tending to converge; and the distinction between these two large groupings of goods and services is becoming blurred in line with the dynamic of technological innovation: in practice, all are tending to produce more services.

This section will analyse the production of ICT manufactures and services for three countries: Mexico, the main focus of this study; Brazil, the largest producer and consumer of ICT goods and services in Latin America and the Caribbean; and the United States, Mexico's main trading partner and the world's second largest international exporter of ICTs after China. In the future, it would be interesting to be able to compare Mexico with other emerging countries, apart from Brazil, to contrast the performance of ICT-producing sectors and the policies that accompany them; but the availability of disaggregated information in the national accounts, particularly for ICT services, makes this exercise very difficult at the present time.

The information used comes from the national accounts. The figures used are comparable for the three countries analysed in the case of ICT goods, but they are not comparable in the ICT services sector, so the comparison is performed bilaterally: Mexico-Brazil and Mexico-United States. The production of ICT services is probably underestimated, particularly in Mexico and Brazil, since many of these services are produced within firms, so they are not sold in the market and their real value is frequently not imputed; otherwise they are exported over the Internet, without being recorded in national output accounts, particularly if the transaction is processed in the informal sector.

In the Mexico-Brazil comparison, the ICT goods sector includes the manufacture of computer, communications, measurement and other equipment; while the ICT services sector includes segments such as Internet; information, data processing and telecommunications services; the film and video industry; the sound industry; radio and television, other than over the Internet; and other telecommunications. In the Mexico-United States comparison the ICT goods sector is the same as in the Mexico-Brazil comparison, but ICT services include the design of computer systems and related services, the creation and dissemination of content exclusively over the Internet; the provision of Internet access; network search services, and information processing services, among others —in other words a much more targeted universe than in the previous case (see appendix 1).[3]

Apart from the shortcoming encountered for standardizing the matrices for the three selected countries, the lack of a second input-output matrix in the same year for the three countries means that two of them were in a context of international crisis —Brazil and United States in 2009— compared to Mexico in 2008. In 2009, gross domestic product (GDP) in the United States shrank by 3.5%, while GDP in Brazil remained broadly flat (-0.3%), whereas it grew by 1.2% in Mexico in 2008.[4] Counterintuitively, Mexico suffered a sharp contraction in ICT goods production (dragged down by the United States), even though its GDP grew in 2008. In Brazil, the sector performed well, despite that country's economic stagnation in 2009; and in the United States the sector suffered a sharp contraction, but scaled up technologically in the latter year.

[3] Appendices 1, 2 and 3 can be consulted (online) at http://analisisestructural.mx/wp-content/uploads/2014/07/Ap%C3%A9ndiceTIC_SchatanEnriquez.xlsx.

[4] See [online] http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG.

1. ICT goods

The digitalization of communications among people and firms has permeated all countries throughout the world. Given the backwardness of developing countries in this domain, growth in that market is outpacing that of industrialized countries, which have already achieved a very high coverage rate in mobile telephony, Internet and other services (International Telecommunications Union-ITU). Nonetheless, the degree to which digitalization is stimulating the national productive sector of the countries in question is another matter. For many developing nations, the greater demand for ICT goods and services resulting from digitalization may not have a direct effect on local economic production if these goods and services are imported. In other countries, the stimulus to the production of ICT goods is generated by the incorporation of electronics products into the global value chains (GVCs), such as the case of Mexico, although the value added (VA) which they contribute tends to be limited if they specialize in the lower value links in that chain, such as the manufacture of generic inputs, assembly, and packaging.[5] According to the United Nations Commodity Trade Statistics Database (COMTRADE), although Mexico is the world's fifth largest exporter of operating and data processing systems, telecommunications, parts and accessories, and the world's second largest exporter of television screens, its value added was just 12% in 2008, having fallen in absolute terms since 2003 (see table 1).

Brazil's strategy is different, in that it has promoted the expansion of the domestic ICT market (the world's third largest market for computers); and it has promoted national integration of the sector, so that it contributes with greater value added to the GVCs; the proportion of gross value of production (GVP) was 25% in 2009 (see table 1). On the other hand, it relies heavily on imports and it is not a competitive exporter. One of the problems it has had is its specialization in traditional cell phones and, as these get replaced by smart phones, Brazil has switched from being a large exporter to a large importer, and its sector-specific trade balance has reversed sharply (it is more competitive in electronics related to health-care activity, industrial equipment and the automotive industry (Sturgeon and others, 2013)).

The United States is integrated into GVCs, but it has positioned itself in the higher value added links. The proportion of that value in the GVP of the ICT goods sector increased from 38% to 63% between 2003 and 2009; and, although in 2009 GVP fell in absolute terms, value added rose by 30% (see table 2). After the crisis of the global electronic sector in 2001, many ICT goods manufacturers with little value added relocated from the United States to China to cut costs (Economic Intelligence Unit, 2011).

In short, Mexico, Brazil and the United States have experienced major changes in the ICT goods sector, with Brazil being the most dynamic (albeit starting from very low levels) while rising to more sophisticated links in the productive chain. The United States, meanwhile, made a giant leap to the much higher value added niche in 2003-2009, but with a regression in terms of gross value added. Lastly, Mexico fell back both in value added terms and in GVP (see tables 1 and 2).

[5] The segments with highest value added are those at the beginning of the chain: research and development (R&D), new product design, manufacture of strategic inputs; and in the final segments of the chain: manufacture to order, after-sales services, and brand development (PRODUCEN-Centro de Inteligencia Estratégica, 2006, cited by Peres and Hilbert, 2009).

TABLE 1

Value added (VA) and gross value of production (GVP) of ICT goods and services
(US$ million at 2005 prices)

	Mexico		Brazil	
	2003	2008	2003	2009
VA of goods		5 472	4 021	12 305
GVP of goods	44 916	44 988	19 787	48 879
VA/GVP of goods (%)	17	12	20	25
VA of services*	19 263	28 287	25 987	72 021
GVP of services	31 628	44 337	51 405	155 785
VA/GVP of services (%)	61	64	51	46

Source: Prepared by the authors, on the basis of each country's input-output matrix.

Note: ICT services* encompasses a larger number of segments than the ICT services considered in the comparison between Mexico and the United States. See appendix 2 (footnote 3).

TABLE 2

Value added (VA) and gross value of production (GPV) of ICT goods and services
(US$ million at 2005 prices)

	Mexico		United States	
	2003	2008	2003	2009
VA of goods	7 554	5 472	145 638	189 091
GVP of goods	44 916	44 988	380 213	298 545
VA/GVP of goods (%)	17	12	38	63
VA of services*	682	874	184 149	226 455
GVP of services	986	1 309	281 915	345 818
VA/GVP of services (%)	69	67	65	65

Source: Prepared by the authors, on the basis of each country's input-output matrix.

Note: ICT services* encompasses a larger number of segments than the ICT services considered in the comparison between Mexico and the United States. See appendix 2 (footnote 3).

2. ICT services

As the digitalization of communication has advanced, economic and social activities and the demand for ICT services have grown tremendously. Although these services are related to the operation of ICT goods, they also reflect the public's demand, expressed through mobile communications, the growth of social networks and the expansion of cloud computing activities (UNCTAD, 2012).

It is worth noting that the domestic ICT services sector accounts for a much larger proportion of VA with respect to GVP than that of ICT goods (except in the case of the United States in 2009). In fact, the VA of ICT services is several times larger than that of ICT goods in Brazil and Mexico, and grew particularly rapidly in Brazil during the period analysed.

This is not the case when considering the targeted version of services in Mexico (compatible with that of the United States), since Mexican VA is very small and contrasts sharply with that of the United States. Greater connectedness through broadband and information technology services are a core feature of the development of the digital economy; and ICT services thus become an important productive sector, although an incipient one in Mexico.

It should be clarified that the software segment[6] is not included in the ICT services sector shown in tables 1 and 2. This is because the classification used in the comparison between Mexico and Brazil incorporates software production in the professional, scientific and technical services sector, which is much broader than merely software, making it hard to identify specifically. Something similar happens in the comparison between Mexico and the United States.

Emerging countries' increasing incursion into the software and other ICT services segment opens a door for an expansion of a high-technology and high-VA activity, in contrast to the manufacturing assembly sector. In 2011, the software sector alone was still very small in Mexico (US$ 1,513 million); proportionally it was also small in Brazil (US$ 3,069 million), but in the United States it amounted to US$ 138.491 billion (UNCTAD, 2012). The most important segment in software production in Mexico is that generated within firms (63%), which easily surpasses the custom software produced by the sector's specialized firms (8%). The remainder of software production is mainly "packaged" (29%) (Hualde and Mochi, 2009). In terms of its international performance, the United States appeared as the world's fourth-largest exporter, while Mexico and Brazil were not among the top 15 (UNCTAD, 2012).

3. Employment and productivity in ICT goods and services

The behaviour of employment in the ICT goods sector is consistent with the way the three countries analysed have integrated into the changes in the ICT industry worldwide. As noted above, the 2008-2009 economic crisis caused ICT production to become concentrated

[6] The United Nations Conference on Trade and Development (UNCTAD) defines software as follows: "Software consists of a set of instructions that enable different hardware (computers, mobile phones, smart phones and tablets, and the like) to perform the operations required. In this sense, it can be seen as the 'brain' of ICT devices" (UNCTAD, 2012, p. xiii).

in the most valuable links of the value chain in the United States, which meant that this sector lost 30% of its employment in the period under analysis, although sector wages and capital gains improved. Mexico, highly integrated into the ICTs and linked to the United States market, lost jobs (14%) and was affected by the global economic crisis; but unlike its northern neighbour, it did not have the flexibility to increase its productivity and value added.

Brazil, meanwhile, which is less dependent on the international market and has sector stimulus policies, managed to increase employment (38%) and productivity per worker (125%) between 2003 and 2009, although it started from much lower productivity levels than Mexico in 2003. Despite the advance, value added per worker was still four times smaller than that of United States workers, although by then it had surpassed Mexico's productivity in this segment (see tables 3 and 4).

In line with the international trend, employment in the ICT services sector grew very strongly in the three countries studied between 2003 and 2008-2009; and by the end of the period this activity employed more workers than ICT goods production (except for the limited version in the case of Mexico). In fact, comparing Mexico and Brazil, the latter country is seen as a large employer: 1.8 million people in 2009, whereas Mexico employed 300,000 people in 2008 (albeit with a VA per worker nearly three times higher than in Brazil in 2009). In the United States, despite the much more limited definition of ICT services, this activity generated 1.8 million jobs in 2009, easily outweighing employment in its ICT goods sector. Productivity per worker in ICT services also increases in the three countries in the period under study, except in Mexico in the restricted version of these services, which includes a smaller group of services than that used in the comparison between Mexico and Brazil (see tables 3 and 4).

TABLE 3

Personnel employed in ICT goods and services sectors

(Number of persons)

	Mexico		Brazil		Mexico		United States	
	ICT goods	ICT services	ICT goods	ICT services	ICT goods	ICT services*	ICT goods	ICT services*
2003	312 763	232 874	200 289	1 399 560	312 763	25 356	1 341 000	1 620 000
2008-2009	267 088	299 758	276 205	1 822 993	267 088	34 605	1 125 000	1 778 000

Source: Prepared by the authors, on the basis of each country's input-output matrix.

Note: ICT services* encompasses a larger number of segments than the ICT services. See appendix 2 (footnote 3).

TABLE 4

Value added (VA) per worker in ICT goods and services sectors

(US$ thousand)

	Mexico		Brazil		Mexico		United States	
	ICT goods	ICT services	ICT goods	ICT services	ICT goods	ICT services*	ICT goods	ICT services*
2003	24	83	20	19	24	27	109	114
2008-2009	20	94	45	40	20	25	168	127

Source: Prepared by the authors, on the basis of each country's input-output matrix.

Note: ICT services* encompasses a larger number of segments than the ICT services. See appendix 2 (footnote 3).

IV

Analysis of the ICT sector based on input-output matrices

It is of particular interest for this study to analyse the economic interrelations between the ICT sectors and the other productive sectors, both domestically and internationally. As the economies become increasingly digitalized, these segments strengthen their presence in the countries' supply and demand and have both direct and indirect effects in other sectors.

1. Methodology

Input-output matrices were used to explore intersectoral relations both domestically and internationally. The analysis will reveal those relationships and the productive linkages, including the forward and backward knock-on effects that these sectors have within the economies.

First, the direct intersectoral relations of intermediate consumption or input purchase by a sector, as those of intermediate demand or sales from one sector to the others.

In order to perform the analysis, the domestic matrices and total matrix of sectoral inter-relations were chosen. The domestic matrices include the domestic intermediate consumption matrix (MCII) and the domestic intermediate demand matrix (MDII). The MCII records the value of a sector's purchases from the other productive sectors in the domestic market (excluding imports); the MDII records the sector's sales of domestic products to other productive sectors (not including imports). The total sectoral inter-relations matrix reflects domestic transactions plus imports; in other words the total intermediate consumption matrix (MCIT) and the total intermediate demand matrix (MDIT). The larger the proportion of imports in the total intersectoral relations matrix, the smaller that sector's impact on the domestic economy will be, because the stimulus to other productive sectors provided by those imports occurs in their economies of origin.

Secondly, the study uses the Dietzenbacher productive linkage methodology (Dietzenbacher, Van der Linden and Steenge, 1993; Dietzenbacher and Van der Linden, 1997)[7] to see how the ICT sectors induce knock-on effects within the MCII and MDII matrices, taking account of both direct and indirect effects. A twin approach is used to measure them: the backward linkage is determined using the Leontief (1930) model with the input absorption matrix; and the forward linkage is identified through the Ghosh (1958) supply matrix. To calculate the impact of demand and supply variations on the other productive sectors, the structure of technology and hence of the intermediate inputs required by each sector is assumed to be stable. The two approaches used make it possible to evaluate the linkages as impulses, induced by demand in the one case and supply in the other.

For the comparative analysis between countries, the sectors of the domestic economy and total input-output matrices of Brazil and Mexico were firstly standardized at the 36-sector level; and then those of the United States and Mexico were standardized at the 57-sector level. There is an input-output matrix for all three countries for 2003, and an input-output matrix for 2009 for Brazil and the United States, whereas the most recent matrix for Mexico is for 2008. Not having a second input-output matrix for the same year for all three countries means that two of them were in a situation of international crisis —Brazil and the United States in 2009— compared to Mexico in 2008. In 2009, in GDP the United States experienced shrank by -3.5%, while Brazil's GDP remained broadly flat (-0.3%), and in Mexico it grew by 1.2% in 2008.[8]

2. Analysis of sectoral inter-relations in the input-output matrix

(a) *Role of the ICT goods and services sectors in the domestic and total inter-relations in the input-output matrices of Mexico and Brazil*

The electronic goods GVC is widely dispersed internationally, and the fact that trade in its intermediate inputs is growing faster than final products means that the chain is continuing to spread (Sturgeon and others, 2013). At the same time, the geographical location of the production of the different links of the GVC has been changing, so the national integration of ICT goods

[7] The calculation can also be made for the MCITs and MDITs; but as the inclusion of imports does not generate greater national linkages, which is the main interest in this section, it was not done.

[8] World Bank indicators [online] http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG.

has limits in nearly all countries. Nonetheless, there are significant differences in the specialization of this industry in each country, which also makes a difference in terms of the VA contributed in each case. As will be seen below, ICT services offer greater possibilities for national integration than ICT goods. This study will investigate the role of the ICT goods and services sectors in the domestic and total inter-relations of the input-output matrices of Mexico and Brazil.

The analysis of those input-output matrices firstly shows that while the intermediate consumption of ICT goods had a similar weight in the respective matrices in 2003, the situation changes radically during the period analysed. The domestic intermediate consumption of ICT goods decreased in absolute value terms in Mexico in 2003-2008, but in Brazil it grew by about 100% during the same period. When imports are taken into account (MCIT and MDIT), the importance of the ICT goods sector grows considerably in Mexico in both years, but its link with other sectors is very limited (see tables 5 and 6). This contrasts with the case of Brazil, where the national component plays a more important role in the great expansion of intermediate consumption and demand (see table 5). The latter is a more integrated market nationally, but still forms part of the GVC, while the imported component has grown, particularly since 2009 (according to COMTRADE data).

As a counterpart to the above, Mexico has a much stronger position as an exporter of ICT goods, which represented around 20% of its total exports in 2003, although the percentage had decreased by 2008, as also happened with its surplus. In contrast, Brazil's exports represented one tenth of Mexico's in the years considered, and its trade deficit quadrupled in 2003-2009 (Guilhoto and Sesso Filho, 2010).

The sectoral inter-relations of the ICT goods sector in the input-output matrices are very modest in terms of domestic intermediate transactions in Mexico and Brazil; and the sector is the largest demander of its own intermediate goods, and to a lesser extent those of technologically sophisticated sectors (see tables 1.A and 2.A of appendix 3).[9]

In the case of the ICT services sector in Mexico and Brazil, which is very vast, the analysis of the input-output matrices shows, among other things, that ICT services play a more important role than the ICT goods in the MCII in both countries. This activity has the advantage of being more nationally integrated, because the imported component is much smaller in the MCIT of services than in that of goods for both countries (see tables 5 and 6). The ICT goods sector make substantial purchases of ICT services within the MCII in Brazil, but this relation is weaker in the case of Mexico. Moreover, the ICT services sector is an important destination for ICT goods in both countries in the years considered (see tables 1.A and 2.A

[9] See footnote 3.

TABLE 5

Mexico and Brazil: intermediate consumption (purchases)

(US$ million at 2005 prices and percentages)

Sector	Mexico							
	2003				2008			
	Domestic		Total		Domestic		Total	
		Percentage		Percentage		Percentage		Percentage
19	5 719.09	1.49	37 340.44	7.10	1 756.91	0.34	39 561.68	5.54
27	10 195.21	2.66	12 276.55	2.33	14 125.44	2.72	16 323.76	2.29
Sector	Brazil							
	2003				2009			
	Domestic		Total		Domestic		Total	
		Percentage		Percentage		Percentage		Percentage
19	10 944.64	1.76	14 195.02	2.07	25 508.41	1.49	32 883.19	1.76
27	21 186.92	3.40	22 968.36	3.34	68 185.45	3.98	72 980.55	3.91

Source: Prepared by the authors, on the basis of input-output matrix of the National Institute of Statistics and Geography (INEGI) for Mexico, and the input-output matrix system of the Regional and Urban Economy Nucleus (NEREUS) of the University of Sao Paulo for Brazil.

Note: Sectors:
19: Manufacture of computing, communication, measurement and other equipment, components and electronic accessories.
27: Internet, information, data processing, publication and telecommunication services.

TABLE 6

Brazil and Mexico: intermediate demand (sales)
(US$ million at 2005 prices and percentages)

Sector	Mexico							
	2003				2008			
	Domestic		Total		Domestic		Total	
		Percentage		Percentage		Percentage	Percentage	
19	2 193.25	0.57	33 008.15	6.28	2 315.51	0.45	40 171.87	5.63
27	13 987.30	3.65	14 531.34	2.76	17 361.49	3.34	17 608.60	2.47
Sector	Brazil							
	2003				2009			
	Domestic		Total		Domestic		Total	
		Percentage		Percentage		Percentage		Percentage
19	5 823.43	0.94	9 743.56	1.42	11 988.42	0.70	21 032.57	1.13
27	34 101.22	5.48	35 896.07	5.23	109 878.82	6.42	113 901.93	6.10

Source: Prepared by the authors, on the basis of input-output matrix of the National Institute of Statistics and Geography (INEGI) for Mexico, and the input-output matrix system of the Regional and Urban Economy Nucleus (NEREUS) of the University of Sao Paulo for Brazil.

Note: Sectors:
19: Manufacture of computing, communication, measurement and other equipment, components and electronic accessories.
27: Internet, information, data processing, publication and telecommunication services.

of appendix 3).[10] The horizontal incorporation of ICT services in productive activities can be seen in their role as a supplier to the other sectors, in both the domestic and the total matrices, in both countries. Lastly, the ICT services sector has a close link with itself in both purchases and sales, but this relation is stronger in Brazil than in Mexico (see tables 3.A and 4.A of appendix 3).[11]

(b) *Role of the ICT goods and services sectors in the input-output matrices of Mexico and the United States, both domestic and total*

The economic crisis of 2009 in the United States caused a contraction in the production of ICT goods and led various firms to migrate their production to other countries to become more competitive. Mexico experienced a similar phenomenon (albeit less acutely) following the onset of the crisis in the United States and worldwide in 2008.

The behaviour of the value of ICT goods transactions in the MCII of Mexico and the United States is consistent with the context described above, since these transactions weakened in the period under study, declining to less than half in United States and to one third in Mexico (see tables 7 and 8) (domestic intermediate sales suffered less). In terms of the MCIT, intermediate consumption also dropped sharply in the United States, but not in Mexico where imports cushioned the fall in this indicator. In terms of intermediate sales, there was a reduction in the demand for ICT goods by the other sectors of the economy, particularly in the MDII of the United States. These results probably reflect the different stages of the business cycle in which Mexico and the United States found themselves in 2008 and 2009, respectively.

The ICT services sector, in the limited classification, has a very incipient role in all of the intermediate interrelations in the case of Mexico, compared to the United States (see tables 7 and 8). Moreover, in the latter country, the ICT services sector was very dynamic between 2003 and 2009, in the intermediate consumption and sales matrices, even though the United States economy was in serious difficulties. It can be concluded that the ICT goods and services sectors in that country displayed opposing behaviour patterns in these matrices between 2003 and 2009. In Mexico, although the ICT services sector grew in the period studied, it did so from a very small base.

The difference in the role played by the ICT services sector in intermediate demand in Mexico and in the United States is very substantial. In the latter country, there was high and rising demand for this type of services from the other sectors, which reflects rapid digital technological innovation in the rest of the economy, whereas Mexico was still very backward in this regard (see tables 7.A and 8.A of appendix 3).[12]

[10] See footnote 3.

[11] See footnote 3.

[12] See footnote 3.

TABLE 7

United States and Mexico: intermediate consumption (purchases)

(US$ million and percentages)

Sector	Mexico							
	2003				2008			
	Domestic		Total		Domestic		Total	
		Percentage		Percentage		Percentage		Percentage
13	5 719.09	1.49	37 340.44	7.10	1 756.91	0.34	39 561.68	5.54
38	273.4	0.07	303.92	0.06	407.41	0.08	437.79	0.06
Sector	United States							
	2003				2009			
	Domestic		Total		Domestic		Total	
		Percentage		Percentage		Percentage		Percentage
13	196 112.59	2.33	238 809.40	2.62	91 283.39	1.05	111 071.57	1.17
38	88 441.25	1.05	92 875.29	1.02	105 730.61	1.22	113 877.88	1.20

Source: Prepared by the authors, on the basis of data from the System of National Accounts of the National Institute of Statistics and Geography (INEGI) and from the United States Bureau of Economic Analysis.

Note: Sectors:
13: Manufacture of computing, communication, measurement and other equipment, components and electronic accessories.
35: Edition of publications and software other than over the Internet.
36: Film and video industry and sound industry.
37: Radio and television, other than over the Internet, and other telecommunications.
38: Internet, information and data processing services.

TABLE 8

United States and Mexico: intermediate consumption (sales)

(US$ million and percentages)

Sector	Mexico							
	2003				2008			
	Domestic		Total		Domestic		Total	
		Percentage		Percentage		Percentage		Percentage
13	2 193.25	0.57	33 008.15	6.28	2 315.51	0.45	40 171.87	5.63
38	798.67	0.21	798.67	0.15	1 021.12	0.20	1 021.12	0.14
Sector	United States							
	2003				2009			
	Domestic		Total		Domestic		Total	
		Percentage		Percentage		Percentage		Percentage
13	122 560.70	1.46	213 700.06	2.34	102 581.32	1.18	173 723.14	1.83
38	182 177.97	2.17	186 091.80	2.04	221 886.91	2.56	229 668.72	2.42

Source: Prepared by the authors, on the basis of data from the System of National Accounts of the National Institute of Statistics and Geography (INEGI) and from the United States Bureau of Economic Analysis.

Note: Sectors:
13: Manufacture of computing, communication, measurement and other equipment, components and electronic accessories.
35: Edition of publications and software other than over the Internet.
36: Film and video industry and sound industry.
37: Radio and television, other than over the Internet, and other telecommunications.
38: Internet, information and data processing services.

3. Linkages of the ICT goods and services sectors

This subsection uses the Dietzenbacher productive linkages methodology to examine the extent to which a variation in the supply of or demand for ICT goods and services is disseminated throughout the economy. This was measured by the direct and indirect effects of an increase in the demand for and supply of ICT goods and services on the other productive sectors, or linkages that exist between these sectors and the others.

To perform this analysis, the figures for Mexico-Brazil and Mexico-United States were reconciled as described in the methodology. The result of the exercise undertaken shows that, in the case of Brazil, there is a significant backward linkage from the ICT goods sector (1.22 and 1.09 in 2003 and 2009, respectively), and forward linkages from ICT services (27) (1.50 and 1.68 in 2003 and 2009, respectively). Nonetheless, the knock-on effect towards other ICT goods in that country weakens in the period analysed. In contrast, forward linkages from the Brazilian ICT services sector strengthen in 2009. As the digitalization process is horizontal, practically all sectors, including agriculture, are increasingly demanding ICT services. The fact that these cannot be imported and applied directly means that local ICT services are needed, so this sector has forward stimulus effects.

Mexico has an ICT goods sector with very weak domestic forward and backward linkages at the two levels of disaggregation used, in both 2003 and 2008. In contrast, the ICT services sector has very strong forward linkages (1.54 in 2003), but they were weaker in 2008 at 1.34. It should not be forgotten that this sector still has a very high value in absolute terms, particularly when using the restricted classification in the comparison with the United States. But its potential effect on the rest of the economy could be important as ICT use spreads throughout all productive sectors.

In the case of the United States, the ICT goods sector had backward productive linkages in 2003 (1.07), but these had become irrelevant (0.64) by 2009, coinciding with the relocation of low value added links in the chain to lower-cost countries, as described above. In contrast, the ICT services sector had forward linkages in 2003 (1.24), and these had strengthened to 1.46 by 2009.

In short, both Brazil and the United States showed significant backward linkages in the face of an increase in the production of ICT goods in 2003; but by 2009 this effect had weakened in both countries, although in Brazil the backward knock-on effect continued to be negative. In the case of Mexico, the backward effect of ICT goods was already very weak in 2003, and it had weakened still further in 2008.

The backward linkages of the ICT services sector are significant in the three countries, and they strengthened as the various productive sectors introduced ICTs into their production cycle and required ICT services to operate. This effect strengthened for Brazil and the United States between 2003 and 2009, while weakening in Mexico (although it remains significant).

V

Industrial policies in the ICT sector

The productive sector linked to ICTs is one of the most dynamic in the world, particularly in the services segment; and it has continued to grow strongly despite the stagnation of the developed economies since 2008. Nonetheless, each country has followed its own path, and public policies have affected performance to some degree.

The United States has been the global leader in the development of information technologies and networks; but in the middle of the decade of 2000, the country was being challenged by others such as Japan, a number of Asian countries and some from the European Union, which were actually growing faster in certain segments of these activities. This situation was taken as a challenge to the United States' leadership in research and development (R&D) on ICTs. The President's Council of Advisors on Science and Technology (PCAST) of 2007 stressed this point, and, in 2012 a strategic plan was put forward to relaunch United States leadership in the sector. The plan consists of expanding the human-computer partnership on the basis of greater capacities, availability and accessibility; developing the skill to design secure and reliable systems; and generating the human capital needed for a workforce of cyber-capable innovators

(NITRD, 2012). This strategy will intensify the United States economy's specialization in generating cutting-edge technologies for ICTs, particularly in the services area, while ICT goods will continue to become more sophisticated. This trend was already visible in the period studied in the foregoing sections, but henceforth it will be driven through a much more active state policy. In line with this, the United States government has increased its infrastructure spending considerably (Obama, 2015).

To a greater or lesser degree, public policies prioritize the development of ICTs in nearly all countries, although in the case of developing ones, such as Brazil and Mexico, actions to encourage the ICT sector are much more modest than those mentioned for the United States. But, precisely for that reason, it is interesting to explore the steps taken by these economies of similar development level, even though they have followed different policies since the 1990s.

Although policies alone cannot fully explain the performance of the ICT goods and services sector, it is undeniable that they have played a relevant role. There are other elements which, undoubteedly, have affected the way the ICT goods and services industry has developed in the three countries analysed here, such as exchange-rate policies, among others; nonetheless, the study will not focus on these elements. The following section will compare Mexican and Brazilian policies targeting the ICT sector, because their economic development level is similar.

1. Policies to promote the ICT goods sector in Mexico and Brazil

To provide a stimulus for the national electronics industry, Mexico and Brazil applied comparable public policies in the 1970s and 1980s, such as protection for the domestic industry and requirements for foreign direct investment (FDI) to incorporate a minimum percentage of national components, in addition to providing a series of incentives for the expansion of local industry. The most important programmes were: in Mexico, the Programme for the Development of the Computing Industry and Other Electronics Industries (1983-1998), and in Brazil, the Information Technology Act (1984) (Peres and Hilbert, 2009).

In the long run, this protected industry, which lacked clear efficiency and competitiveness targets but featured high profit margins and a restricted domestic market, retreated in both Brazil and Mexico. In the early 1990s in Brazil, and even earlier in Mexico, electronic products displayed serious problems: their prices were above international levels and they were unable to compete on the world market. Many firms were forced to close or were taken over by multinationals.

From the 1990s onwards, public policies targeting the ICT goods and services industries changed towards openness in both Brazil and Mexico; but their approach has been very different, even though both countries have had to specialize particularly in standardized products (such as integrated circuit cards and peripheral devices such as monitors and, in the case of Mexico, flat screens).

Despite greater openness, Brazil has maintained an industrial policy targeting the ICT goods sector, whilst also providing incentives for expansion of the domestic market, without integrating into the GVCs. These policies are consistent with some of the results analysed in the foregoing sections: the relatively higher VA in this industry in Brazil compared to that of Mexico, and more intensive sectoral interrelations and stronger knock-on effects from this industry in the first country compared to the second.

Brazil maintained a public policy targeting long-term technological upscaling. For example, under full openness, Law 8248/91 of 1991, offered tax exemptions to firms that agreed to produce certain goods locally, incorporate local content, or undertake research and development (R&D) (Peres and Hilbert, 2009; Junqueira and others, 1999). Industrial development laws have promoted R&D and the generalized use of ICTs through the 2004 Innovation Act, and the 2005 Goods Act. The latter, among other objectives, has stimulated expansion of the domestic market by reducing taxes on the sale of electronic devices. The *Brasil Maior* plan (PBM) also stresses technological R&D to strengthen productivity and technology within the productive chains of the industrial sector. This country also even requires certain behaviour from the foreign firms in order to strengthen the local market and innovation. For example, in October 2012, it was announced that the introduction of 4G in Brazil would require 60% of the equipment and systems acquired to have been manufactured in the country, and up to 20% with national technology (ST News, undated).

Meanwhile, Mexico has invested in greater openness and export-led industry growth. The ICT goods-producing sector has to some extent been favoured by horizontal public policies such as the Science and Technology Act (2002) and the Special Science, Technology and Innovation Programme (2008-2012), along with the

Innovation Stimulus Programme, which has particularly favoured the ICT (goods and services) sector, according to information from the National Science and Technology Council (CONACYT). In general, despite the fact that public-sector efforts to promote R&D and innovation in the ICT sector have lacked a greater long-term vision, there has been a shift toward strengthening public policy on science, technology and innovation in recent years, which has benefited the ICT sector. The Special Science, Technology and Innovation Programme (2014-2018) is playing a major ICT development role in various domains (production, education, among others).

National industrial policies have been much more vigorous in Brazil than in Mexico. Nonetheless, an analysis at the state level in the latter country shows that public policies have been implemented to promote the ICT goods sector with positive results. The productive cluster in the state of Jalisco is the largest in the electronics sector, specializing in manufacturing computer hardware after it received an initial boost from IBM and Hewlett-Packard. It includes firms that are original equipment manufacturers (OEMs), contract manufacturers and electronic manufacturing services, a large number of design centres and hundreds of specialized suppliers. There are also over 150 software firms. The electronics industry in Jalisco developed from a high-volume/low-mix model to a low-volume/medium- and high-mix one, in other words smaller-scale production of higher-VA goods (Padilla, 2005; Palacios, 2008). The business and the public sectors jointly developed a strategy to enable Jalisco to upgrade from being exclusively an electronics maquila state, to become a generator of technology and knowledge in this field, following the 2001 global crisis in the industry (Science and Technology Programme of the State of Jalisco in 2003). The results were considerable, since original design manufacturing (ODM) emerged in Jalisco, and the state became the leading centre for semiconductor design in Latin America and the Caribbean (Palacios, 2008; Secretariat of Economic Affairs, 2012). Nonetheless, these local efforts were unable to make a significant difference at the national level in terms of the sector's technological progression.

In Brazil, practical steps have been taken to expand the domestic market, such as that developed by the National Broadband Plan which will connect 70 million students, together with measures to reduce the costs of operating systems. If the latter occurs, it is likely to give a major stimulus to the production of semiconductors, which is the target sector of the ICT strategy in the PBM, along with the software segment.[13] In Mexico, recent domestic market expansion measures have also been adopted, although their aim is more to speed up the penetration of digital technology throughout the country, which could provide a stimulus to the productive sector, particularly in relation to ICT services (*IT Decisions*, 2012).

2. Policies to promote the software segment and the ICT services sector in Mexico and Brazil

The activities of software and other ICT services have gained ground since the 1990s in both Mexico and Brazil, because, firstly, the rapid technological innovation of the hardware industry has required growing and changing incorporation of software in its equipment; and secondly, the functioning of a wide range of firms from highly diverse economic sectors requires digital applications or their adaptation. Thirdly, nearly all government institutions are digitalizing their procedures, so that e-government, which encompasses tasks connected to finance, health, education, customs, and others, requires specific programmes that respond to their particular characteristics.

Brazil has the largest software production market in Latin America and the Caribbean, which was created as part of an ambitious stimulus policy in the 1990s. Most of the software is produced in response to domestic demand; but at an early stage Brazil set the goal of achieving competitiveness on the international market. For that purpose, in 1993, it created the Association for the Promotion of Brazilian Software Excellence (SOFTEX), which, in conjunction with the government, has succeeded in giving a major boost to that industry. This programme also includes the formation of regional centres to support collaboration between small and medium-sized enterprises (SMEs) producing software, along with human capital formation and the provision of international links for software export. Since 2008, a new software and ICT promotion policy has been in force, which puts this sector among the government's priorities

In Mexico, as occurred in the hardware segment, the policy on software and ICT services was promoted by public-private partnerships in individual states, particularly Jalisco. This served as an important point of reference for the federal software programme: the Programme to

[13] *IT Decisions*, 2012 [online] http://itdecs.com/2011/08/brazilian-industrial-policy-what-it-means-for-it/.

Develop the Information Technology Services Sector (PROSOFT), which focuses on supporting the software segment, information technology services, business process outsourcing (BPO), and the external contracting of creative digital processes and media.[14]

The emphasis of Brazil's policy has been to enable large population groups to participate in this sector and, at the same time help to improve their capacities and stimulate software creativity. Such is the case of the *PC Conectado* [connected PC] programme of 2005, which supplied one million low-cost computers to students in schools, running on open-code rather than proprietary software, with the aim of stimulating local software development and lowering costs (UNCTAD, 2012). This measure coincides with the strategy for strengthening the domestic ICT market and creating a favourable environment for local software development.

In Mexico, recent steps have been taken to achieve a more inclusive digitalization process, particularly through the 2013 constitutional reform in telecommunications, which recognizes the right of the whole population to gain access to ICTs, including broadband and Internet. The *México Conectado* [Mexico connected] project will empower the national digital strategy, facilitating access to Internet in public spaces, including schools, clinics, town halls, community centres, libraries, parks and squares, among others.

While both Mexico and Brazil have financial support programmes for the sector, the latter country has provided much larger volumes of funding for this purpose. The PROSOFT programme, run by the Brazilian Development Bank (BNDES) provides long-term funding to cover up to 85% of the investment, subject to a certain limit, in addition to other financing mechanisms for this activity. The *TI Maior* [Greater IT] programme of 2012 involves a US$ 250 million fund to develop the software industry, and expects to be able to provide an additional US$ 750 million for R&D in this field. This new programme will stimulate firms to develop software that is relevant for Brazilian industries, such as oil and gas extraction, agriculture, government, the provision of seed capital for software start-ups, and support for efforts to attract FDI that establishes R&D centres in the ICT sphere in Brazil (Newsblog, 2012).

The PROSOFT programme in Mexico can provide financial support in the areas of training, certification, qualification and technological equipment, standards and models, adoption and production of IT, innovation, marketing, studies to develop business strategies, among others. There is also a 30% discount on the annual payment of income tax for any industry that undertakes R&D (CONACYT). The software industry in Mexico can also benefit from the National Entrepreneur Fund of the Secretariat of Economic Affairs, and from financing granted by state governments, which provide different types of support in the form of subsidies to services or infrastructure, but also support SMEs in their computerization process.

As in the case of ICT goods, Brazil's industrial policy strategy for software aims to position the sector as a technologically sophisticated and a nationally and internationally competitive producer. One of the practical ways of surmounting access barriers to technology is through public-private partnerships with firms that are at the frontier in this industry. For example, a partnership between the Brazilian government and Intel will promote R&D in the software sector in 2013-2018. Mexico is also starting to provide more targeted support to the software industry, for example through seed or venture capital channelled through the HIR PYME programme.

[14] PROSOFT 2.0 [online] http://www.prosoft.economia.gob.mx/apoyosprosoft/.

VI
Concluding remarks

The ICT goods and services production sector plays a growing role in the economies as countries advance towards a digital society. Although this phenomenon is occurring at different paces between sectors and countries, it is without doubt a global event.

Mexico is integrated into the ICT GVCs and is a major exporter, particular of ICT goods; but its participation in these chains is generally of low value added, with a few exceptions. At the same time, the domestic sectoral interrelations have been very limited for the ICT goods sector, and its knock-on effect in the other sectors is quite weak. These results, obtained from an analysis of input-output matrices, are consistent with the public policy that has predominated for this sector (although

there are various other elements that have affected its performance). More than an industrial policy targeting the ICT goods sector, efforts were concentrated on attracting FDI, given the country's cost advantages, proximity to the United States, and the signing of the North American Free-Trade Agreement (NAFTA). With the progressive geographic dispersion of the industry's productive chains, many original equipment manufacturers (OEMs) or contract manufacturers (CMs) set up operations in Mexico. This was considered a success, even though they did not bring technologically state-of-the-art production segments into the country or contribute to technology transfer. At the same time, the sector became hostage to decisions made by large multinational enterprises and the world market.

The United States displayed a much more flexible path than Mexico in the ICT goods sector prior to the 2001-2003 sectoral crisis. It repositioned itself in the GVCs to a significant degree, considerably increasing its VA (although losing many jobs while improving their quality). The knock-on effects also weakened in that country. Since the middle of the decade of 2000, the United States have developed a strategy to regain their momentum in R&D activities and innovation in the ICT sector, to maintain their global leadership and strengthen their manufacturing. The fact that the five ICT multinationals originating in the United States account for over 50% of R&D and innovation in ICTs worldwide is also a relevant factor for attracting those firms to develop some of these activities in Mexico.

Brazil's public policy has been closer to that of the Asian countries, which have planned the sector's development step-by-step, with controlled liberalization. But it has not yet succeeded in penetrating international markets or integrating into the industry's more advanced links, although it has made major efforts to integrate its ICT goods industry nationally, without joining the GVCs. In the period studied (2003-2009), Brazil succeeded in considerably deepening domestic intersectoral relations and has significant knock-on effects, while it has also generated more jobs and increased their productivity (albeit starting from very low levels). This country has deployed targeted industrial policies in this sector, fostering domestic market consolidation and providing significant support to local industry. Nonetheless, it has not achieved international competitiveness and suffers from a growing external deficit, despite spending large amounts of fiscal resources on stimulus to the sector.

One of Brazil's aims is to position itself in the most advanced semiconductor niches (the "target" sector), since this is the industry that heads innovation activity in ICT goods internationally, dominated by the United States and Europe. But keeping track of the semiconductor sector may be fruitful, because this currently accounts for 33% of the global electronics market.[15] Moreover, the products in question will face growing demand as the need for microprocessors increases, given the technological convergence of products such as audio and video players and recorders, digital cameras, digital television sets, and cellphones —a somewhat risky gamble, but one that is important for a country such as Mexico to consider.

In the most recent period, Mexico has made substantial changes to its policy in the ICT sector (goods and services). It has adopted measures to improve the infrastructure needed for a much greater penetration of digitalization in society and firms; it has altered the regulatory framework to make the sector more competitive; and it has been designing a policy that is more focused on the ICT sector.

The results of this study reveal that the ICT services sector differs significantly from and is much more promising than the corresponding goods sector in Mexico, and also in Brazil and the United States. Its vigorous growth is consistent with the rapid advance towards a digital society. Demand for ICT services is growing not only because the hardware sector requires an increasing software component and multiple ICT services, but also because, as all the other productive sectors become more technology-intensive through ICTs, they also incorporate these services.

The analysis of the input-output matrices showed that, in Mexico and in the other two countries considered, the ICT services industry has stronger domestic sectoral links than the corresponding goods sector, and has proven to be a growing source of jobs. In the comparison of the ICT services sector between Mexico and the United States, which only focuses on the design of information technology systems and Internet services, there is a huge gap, which goes way beyond the contrasting size of the two economies. Nonetheless, seen as an opportunity, the development of this sector in Mexico is highly promising in terms of the generation of value added and job creation.

The policies implemented by Mexico and Brazil to promote the ICT services sector have been more recent. Brazil's policies have been more wide-ranging and vigorous than in Mexico, albeit at the state level; and it has had major successes in which public-private

[15] Semiconductors, medical and industrial equipment, computing, communications, consumer electronics (Secretariat of Economic Affairs, 2012).

partnerships have played a central role. A much greater impetus is needed however; both Mexico and Brazil need to make a greater effort to improve their competitiveness in ICT services, because their exports are still incipient. The example of India, which has launched a major drive to strengthen its human capital, shows that the potential of a developing country with a robust policy targeted on this sector is much greater than that achieved thus far by those two Latin American countries. It should be noted that this is a sector in which the United States is providing major support to speed up progress, since this to a large degree is what technological ICT upscaling is about.

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