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Information technologies and the evolution of the digital divide in Mexico: a public policy approach

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Abstract

The rapid diffusion of Information Technologies (ITs) has noticeably influenced the ability of societies to stimulate economic growth and development. Among these technologies, the Internet stands out due to its contribution to the advancement of education, learning and knowledge. Hence, the commitment of some developing nations like Mexico to the diffusion of the Internet has become a top issue in their policy agendas. However, the country's promotion of this technology has undergone a number of setbacks, mainly due to a misinterpretation of the factors causing the so-called 'digital divide'. Hence, the purpose of this paper is to analyze the rationale for governmental intervention regarding the diffusion of the Internet in Mexico.

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Introduction

In the last twenty years or so, the continuous progress of Information Technologies (ITs) has produced visible changes in the world economy. As a general-purpose technology, IT has impinged upon many activities, changing drastically the way they were performed.[1] As a result, new jobs emerged, some others changed and many others disappeared. Examples abound in the industry, the services and the public sector. These trends –which stem from the growing use of ITs– have been identified under the generic tag of "New Economy" (OECD, 2000; Eliasson *et al*., 2004).

As a result, some countries have been better able to respond and benefit from these changes than others. In this regard, it is noteworthy that the relationship between ITs' technological progress, industrial innovation and economic growth is a relatively recent phenomenon that appears to have developed in the 1990s (Eliasson *et al*., 2004).

Several studies have explored the effect of IT on economic growth and productivity. For example, the Organization for Economic Cooperation and Development (OECD) has identified three main effects of IT on economic growth. First, IT investment helps raise labor productivity by means of augmenting the capital-labor ratio (i.e., capital deepening). Second, rapid technical change in IT goods and services add to more rapid multifactor productivity (MFP) growth in the IT-producing sector. And third, greater use of IT may help the productive sector increase its overall efficiency (OECD, 2004).

From the array of technologies that are grouped in the IT set, the Internet is one of the most prominent. For example, Castells (2000) prize the Internet as one of the major technological innovation of the twentieth century because of its large impact on economic, social, political and cultural relationships. The Internet's impact is already very visible on the education, business and public sectors in the form of the multiple types of electronic services, i.e., e-learning, e-commerce, e-government, etc. (Litan, 2001; OECD, 2003 and 2009; UNCTAD, 2008).

It is not surprising, therefore, that given the Internet's growing impact on the global economy many developing nations are seeking to encourage the adoption and diffusion of ITs to spur economic growth. Although many governments have handled many approaches and actions to this goal, their interest has increasingly been expressed in the form of public policies, governmental initiatives and the instrumentation of institutional programs, most of them in coordination with interna-

[1] A General Purpose Technology (GPT) is a term used to describe a new method of producing and inventing that tends to have a protracted aggregate impact (see, for example, Jovanovic and Rousseau, 2005).

tional development bodies, such as the World Bank, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), and the InterAmerican Development Bank (IADB) (UNESCO, 2005; World Bank, 1998 and 2008).

Yet, the widespread diffusion of new technologies, and especially of the Internet, is posing new challenges to policy-makers as well. Although ITs can help modern societies solve long standing economic and social problems, they still call for a number of pre-requisites to be fulfilled before the advantages of new technologies can be seen. First, there is the infrastructure issue, which is related to the necessity of having a physical network to support the Internet's operation, an area in which in many developing nations are very limited or simply do not have any. Second, there is the capability issue, which means that the benefits derived from the introduction and diffusion of ITs are fully harnessed when citizens have a better level of education and computing skills. And third, there is the technical change issue, which is related to the fact that ITs experience a continuous and permanent process of innovation which demands from users an equivalent continuous and permanent upgrading attitude, as we can now witness by the growing importance of social networks and new IT platforms such as smartphones and tablets.

In spite of the necessity to cope simultaneously with all of these three structural conditions, most governmental initiatives have preferred to focus only on the infrastructure issue, as Tengtrakul and Peha (2011) report for the case of Thailand.

From the policy-makers' point of view, the lack of universal access to the Internet has represented, so far, the most critical issue (van Dijk and Hacker, 2000; Ryder, 2007). Hence, most public plans and programs regarding the promotion of ITs seem to have been devised bearing in mind the reduction of the so-called 'digital divide'.[2]

In the case of developing countries, the instrumentation of IT policies has mostly attempted to level the playing field for their citizens. For example, in the case of Mexico, an IT program called "e-Mexico" sought to bridge the Internet rift between urban and rural communities by means of establishing IT nodes, called telecenters (CTCs) in the smallest towns and villages. However, this initiative has not lived up to its expectations because of misunderstanding of the structural factors determining the diffusion of this technology, as well as a result of several

[2] According to the OECD (2001: 5), the term "digital divide" refers to the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access ITs and to their use of the Internet for a wide variety of activities. As regards the objectives of this paper, this will be the standard definition of "digital divide".

unforeseen infrastructural deficiencies and human resources weaknesses, as it will be discussed below.

Therefore, this paper aims at analyzing the rationale for governments to support the diffusion of ITs, and especially the diffusion of the Internet. In doing so, it assesses the case of Mexico. Then the following section reviews the literature regarding the digital divide.

1. The analysis of the digital divide

1.1 The origin of the digital divide Issue

It seems interesting to show that the debate on the digital divide issue begins with the accuracy of accounting for the origin of the term itself. There are at least two different versions of who first coined it. On the one hand, Rogers (2001: 96) contends that the term digital divide was probably coined by Larry Irving, formerly Assistant Secretary of Commerce for Communications and Information during the Clinton administration. On the other hand, Hoffman *et al*. (2001: 48) have identified Lloyd Morrisett, the former president of the Markle Foundation, as the mastermind behind this term.

Whoever its true creator was, the concept seemed to have emerged as the rationalization of a symptom appeared in the mid-nineties: the increasing differences in the use of ITs by individuals. In those years, it became clear that ITs were playing a key role in implementing the shift from an industrial age to a network age (Castells, 2000). Few years later, we have realized that we already live in a society in which the production, acquisition, and flow of knowledge are crucial to compete and in which global information networks drive the economy (UNCTAD, 2008; World Bank, 2008; OECD, 2009).

However, the ITs' apparent ability to help improving almost every economic activity rapidly aroused the suspicions of some analysts. For them, ITs were actually exacerbating social, economic and cultural differences, rather than ameliorating them (Hoffman and Novak, 1998; Katz and Rice, 2002). In this perspective, the Internet altered the way some important activities such as commerce, education, government, and communications used to be performed.

Nonetheless, not all perceptions of the Internet are negative. Lisa Servon, for example, argues that the Internet can help society to bridge the gap in some key areas such as education or health. In her view, the Internet can connect people to a wide range of opportunities; thus demonstrating the potential of this technology to serve as a tool of social change (Servon, 2002: 1).

The real trouble with the Internet is, however, that its diffusion, both within and between countries was, and has been, extremely uneven (see, for example, OECD, 2001, 2006 and 2009). So this process has been labeled by several scholars as the gap between the information "haves" and "have-nots" (see, Hoffman and Novak, 1998; Compaine, 2001; Rogers, 2001; Servon, 2002).

According to Mariscal (2005), the debate on the digital divide has taken place along a spectrum that argues, on the one extreme, that the market alone will take care of any perceived disparities (see, for example, Fink and Kenny, 2003) and, on the other extreme, that governments should implement policies that subsidize access in some fashion (see, for example, Simons, 2001).

In any event, if the digital divide persists, the danger is that the Internet will finish affecting the construction of, and the response to social problems such as poverty and inequality, as Fuchs and Horak (2008) report as happening in Africa, for example.

Given these contrasting views, one can ask whether in fact there is a substantial policy issue regarding the digital rift, and if there is, what policies can bridge the gap, and even more important, how to address it. The following section shall describe this issue's current situation.

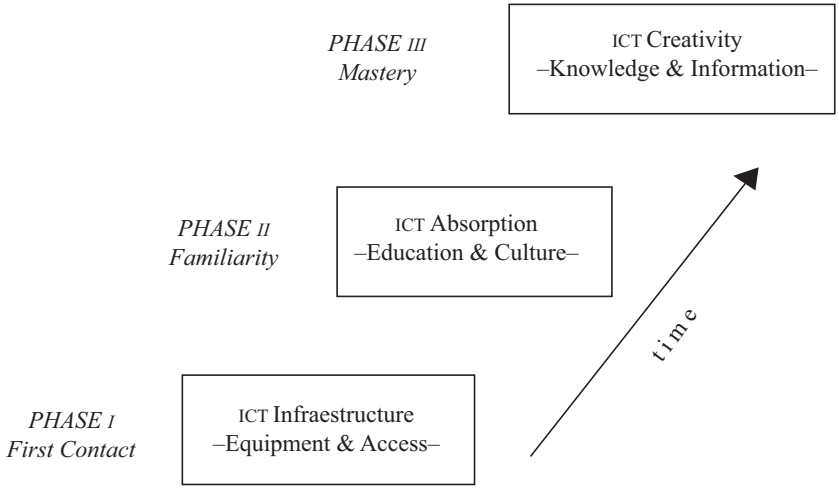
1.2 Current Trends in the Analysis of the digital divide

The literature dealing with the digital divide issue is already very large and growing, though at a decreasing rate. For example, according to the ISI Web of Knowledge, up to May 2011 there were 430 papers registered in the ISI database related to the digital divide topic.[3]

Interestingly, the first paper concerned with the analysis of the digital divide sought to identify the main hurdles faced by the Internet's users (Katz and Aspden, 1997), and afterwards, it started a growing interest in this issue that peaked between 2003 and 2005 when 157 papers were published, as the ISI database reports. From that year on, the number of papers dealing with the digital divide has experienced a declining trend, as the next graph shows.

[3] ISI Web of Knowledge is a registered trademark of Thomson Reuters, and its site is at the following URL (http://www.isiwebofknowledge.com/).

Figure 1
Phases in adoption of ITs



Although someone may think that these data demonstrate that the topic was only a trendy scholar topic, there also exist the possibility that the analysis of the digital divide is evolving toward more specialized themes, such as the impact of the Internet on the social behavior of selected groups: i.e., children and teenagers, for example. In that case, these possibilities would prove that the digital divide is not a temporary phenomenon,[4] which has tended to dwindle at the same rate as the adoption of the Internet, but a deeper and long-lasting fact.[5]

1.3 The Determinants of the digital divide

The analysis of the determinants of the digital divide has demonstrated to be very complex. As discussed above, this difficulty arises because the term "digital divide" tends to include both the imbalances in physical access to technology and the imbalances in resources and skills needed to interact in the digital world. In this respect, de Haan (2004) argues that research on the digital divide has been mainly

[4] The possibility that the so-called "digital divide" is only a transient state was first mentioned by Compaine (2001) and Rogers (2001).

[5] For a more comprehensive analysis of these themes, see Jackson *et al*. (2007).

descriptive, starting from a too simple criterion of access and failing to consider the many origins and consequences of differences in Internet access. And because the term "digital divide" hints at several interpretations, it has tended to generate different perspectives upon the causes of the phenomenon.

Nonetheless, an exhaustive review of the literature (including those papers registered in the ISI database) served for identifying and classifying the most recurrent factors blamed for causing this digital gap (see the bibliography at the end of this paper for further references).

By inspecting the literature, it appears that two streams of analysis exist. There is a group of scholars focused on analyzing the digital divide in the OECD area, to whom a set of recurrent factors seems to be causing the divide; whereas a group of analysts interested in studying ITs' impact on the developing world, have pinpointed other factors as determinants of the divide.

One can classify those factors affecting developing countries as "primary factors" because of the physical infrastructure needed to access the Internet, i.e., electricity power, telephone lines, personal computers, Internet Service Providers, etc.; whereas the factors affecting industrialized nations can be classified as "secondary factors" because of their order of preeminence. Both sets are reported in the two following tables.

Table 1
Summary of Primary Factors Affecting the Diffusion of the Internet

Affecting Factor	*Type and Direction of the Influence*
1 GDP per capita	Positive: the more affluent the society, the more likely the citizens have access to the Internet
2 Market Competitiveness	Positive: the more competitive the economy, the lower the cost of accessing the Internet
3 Government Regulation	Negative: the more public rules and permits, the less provision of ICT services
4 Foreign Direct Investment	Positive: the more foreign investment, the more business opportunities to Internet services
5 Basic Skills in Computing	Positive: the more skilled the individual, the more likely he/she have access to the Internet
6 Literacy	Positive: the more educated the individual, the more likely he/she have access to the Internet

Source: Kiiski and Pohjola (2002); Ho and Tseng (2003); Mariscal (2005); Wallsten (2005) and Pick; Azari (2008).

Table 2
Summary of Secondary Factors Affecting the Diffusion of the Internet

Affecting Factor	*Type and Direction of the Influence*
1 Income	Positive: the more affluent the individual, the more likely he/she has access to the Internet
2 Ethnicity	For Whites: Positive; For Blacks: Negative
3 Geographic Location	For Urban Residents: Positive; For Rural Residents: Negative
4 Education	Positive: the more educated the individual, the more likely, he/she is a user
5 Age	An inverted U-shape: that is, the older the individual, the more likely he/she is a user (up to a certain age threshold: <45 years)
6 Gender	For Men: Positive; For Women: Negative

Sources: Hoffman and Novak (1998); van Dijk and Hacker (2000); Compaine (2001); Rogers (2001) and Servon (2002).

According to the information provided in Tables 1 and 2, the determinants of the digital divide differ according to the type of society one is looking at. For developing countries, their traditional weaknesses in infrastructure seem to directly affect their citizens' access to the Internet, while for developed nations the obstacles appear more related to sociodemographic conditions. However, one needs to bear in mind that the mutual interaction of these factors produces a highly dynamic phenomenon. Therefore, the next section presents a simple model of the digital divide as a dynamic process and the implications of this for public programs.

1.4 The digital divide as a Dynamic Phenomenon

In analyzing the determinants of the digital divide, the first obstacle to tackle is the multifaceted concept of Internet access.[6] According to van Dijk and Hacker (2000), this concept is so freely used in everyday meanings that it ends being used in very different contexts because of a lack of uniformity in the concept itself. To some extent, the meaning of having a computer and a network connection is the most common one in the sphere of the IT adoption. However, this only refers to the second of four successive kinds of access, which van Dijk and Hacker (2000) call "barriers" for the information and network society. According to van Dijk and Hacker there are four (sequential) barriers:

[6] It is worth mentioning that the analysis of the digital divide poses additional problems in the case of many developing nations because it asks for data on Internet diffusion patterns, which are not amply available (see, for example, Lam *et al*., 2004).

1) Lack of any digital experience caused by individual (or collective) apathy, computer fear and unattractiveness of the new technology.
2) No possession of computers and network connections.
3) Lack of digital skills caused by insufficient user-friendliness and inadequate education or social support.
4) Lack of significant usage opportunities.

These barriers correspond to an equal number of types of access, namely, psychological access, material access, skills access, usage access

In spite of the sequential order of these barriers, the lack of computers and networks (second in order) occupy a center place in several studies dealing with the digital divide. According to these views, low-income populations in developing countries should take advantage of cost reductions in IT hardware and software, affordable combinations of open-source and commercial software, donated computers and free networking, "if they are to make any discernible progress towards overcoming the digital divide that currently separates them from the developed countries" (James, 2001: 391). Moreover, John Simons suggests that "for the poorest of the poor (in America), government might consider subsidizing public street-corner Internet kiosks, as it did with public telephones" (Simons, 2001: 291).

However, the real issue is not whether investing in ITs can help development, but whether the overall benefits of doing so outweigh those of investing in education or health, instead. Therefore, for developing societies the true value of the Internet needs to take into account the respective investment costs, which is something that makes people such as Bill Gates, former boss of Microsoft, so skeptical of the applicability of the Internet to the developing world.[7]

Nonetheless, many specialists and policy-makers think that the problem of information inequality related to the Internet will be solved as soon as everyone can have a computer and a connection to the net.[8] But, the first kind of access barrier (described above) is generally neglected, or viewed as a temporary phenomenon, touching only old people, some categories of housewives, illiterates, and unemployed people, in spite of being much more pervasive than the general public think is, as van Dijk and Hacker (2000) have argued.

[7] For an account of Gates' views of the effects of the adoption of ITs in the developing world, see *The Economist*, "Behind the digital divide", 10 March, 2005, p.72.

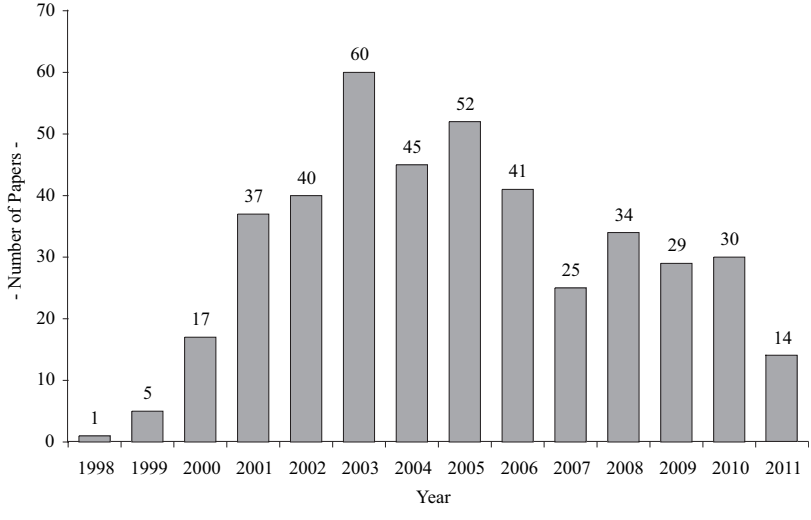
[8] See, for example, the initiative led by MIT's professor Nicholas Negroponte to bring down the cost of a laptop to a hundred US dollars to promote the adoption of ITs among the poorest children in the less developed nations (*Newsweek*, 12 February, 2007: 34-35).

Moreover, the problem of inadequate digital skills is viewed as a lesser evil and normally analyzed in terms of the skills of IT operation; so, it tends to be thought of as a function of the time elapsed to master the new technology (Huerta and Sandoval, 2007).

Finally, differential opportunities from the usage of computers and network connections still need more theoretical analysis from scholars. This is because differential usage is presumed to be a citizens' free choice in a differentiating post-modern society (Katz and Rice, 2002). Nonetheless, the lack of significant usage opportunities calls for deeper insights because of its importance to social and educational policies (Servon, 2002).

Drawing on the framework proposed by van Dijk and Hacker (2000), the following figure summarizes the digital divide as a evolving process which tends to gradually shift from the first two barriers to the last two. According to this approach, once the mental and material access barriers are pulled down, the problems of structurally different skills and uses come to the fore, and then, it is the time to face the challenges these barriers posed on public policy. If solved, the would-be internaut will then be in possibility of finally mastering the new technology.[9]

Figure 2
Number of papers reported by the ISI web ot knowledge database that deals with digital divide issue, by year



[9] According to van Dijk and Hacker (2000), digital skills not only are related to the skill to operate computers and network connections, but also to the skill to search, select and process information from multiple sources.

The phases shown in the Figure 1 indicate the process required to learn the use of ITs (i.e., the Internet). In phase I, the equipment and access becomes a necessary condition. In phase II, the level of education and culture helps users to harness ITs' potential. In phase III, accumulated knowledge and information serve for empowering users in more creative stances within the realm of the Internet. Therefore, any policy attempting to bridge the digital divide probably will find that this objective involves fighting a moving target, as Kubicek (2004) reports in the case of Germany.

2. The Internet in Mexico[10]

In Mexico, as in some other countries, the Internet was first adopted by universities and research centers, which also became the first nodes of the network. According to Fernández (1995), the main interest of these institutions was to establish a reliable Internet connection between Mexico and the United States, in the first place, and then with the rest of the world.

In historical terms, as Thomasson *et al.* (2002) argue, the diffusion of the Internet in Mexico can be described in four distinct phases: an introductory phase, a developmental phase, a concentrated phase (duopoly), and a competitive phase. The transition from one phase to the next was determined by special circumstances that help explain the current state of the Internet in Mexico.

During the introductory phase (1989-1993), the first Internet connections were established and the regional backbones were created. It is noteworthy that growth of the Internet during this period was spurred primarily by universities and similar academic users.[11] The first direct connection to the Internet was established in 1989 at the Monterrey campus of the ITESM (Instituto Tecnológico y de Estudios Superiores de Monterrey). In the following years, several regional networks were also established to connect the nations' major universities such as University of Guadalajara (UDG), Autonomus University of Yucatan (UAY) at Merida and University of The Americas-Puebla (UDLAP). Due to technical reasons, no national backbone existed at that time, so the regional users were unable to share information and many services were duplicated (Fernández, 1995).

The developmental phase was lead by the combined efforts of government and academia. This phase lasted through 1994 and 1995. In 1994, the Mexico's

[10] This section draws on the report prepared by Thomasson, Foster and Press in 2002 to the University of Arizona regarding the diffusion of the Internet in Mexico (for further details, see the bibliography at the end).

[11] This phase keeps strong similarities with those trends reported for the United States and the United Kingdom, where the academic sector led the diffusion of the Internet (see Abbate, 2001).

government agreed to finance the development of the first national backbone. This backbone linked the regional academic networks and provided direct connections to the United States (Thomasson *et al*., 2002).

The concentration (duopoly) phase (1996-98) was sparked by the need to develop commercial applications for the Internet. Joint efforts from the industry, academia and government were needed during this phase. During this stage, the National Technology Network (RTN) was established by the National Council for Science and Technology (CONACYT) to support the development of Mexico's IT infrastructure (COFETEL, 2002). Interestingly, RTN marketed the academic backbone for commercial applications. However, Mexico's monopoly telephone company, Telmex, began commercializing backbone connections and net services. As a result, the telecommunications firm swiftly dominated the market.

The competitive phase was brought about by the desire for increased market efficiencies. The primary drivers of this phase were market demand, industry and governmental deregulation. This phase began in 1999 (Thomasson *et al*., 2002). The first step towards this phase occurred in January 1997 when Telmex was forced to compete with RTN and several new entrants in the growing market of Internet service providers (COFETEL, 2002).

Although some legal barriers to competition were removed during the duopoly phase, several factors impeded the development of a full-fledged competition in Mexico. The most significant of these is the large investments required to set up an operational infrastructure. This barrier quickly loomed impossible to surmount as the two established incumbents (Telmex and the RTN) had already set up national backbones. Therefore, any potential entrant was forced to develop their own infrastructure before being able to compete. Still, with the help of foreign investment, some competing backbones sought the way to develop quickly. By 1999, Alestra and Avantel had established themselves as strong competitors in the larger markets, whereas smaller competitors were keen to enter the market as well (Thomasson *et al*., 2002; COFETEL, 2002).

As regards the speed of connection, the amount of bandwidth offered in Mexico grew considerably during those years. However, the cost of access did not go down as quickly as desirable, and the quality of service did not increased as much as expected. As a result, Mexico started to fall behind as a Latin American leader in the telecomm industry (OECD, 2009).

Nowadays Mexico is facing far more complex challenges. The largest of which is balancing the need for competitive efficiencies with the desire to provide services for a larger segment of the population. Before the competitive phase, Telmex had a mandate to increase the level of service in poorer, rural areas of

the nation. In doing so, the Internet services should have to be provided at lower profit levels or at a loss. Therefore, communication services had to be subsidized by the more profitable services offered in the larger, urban markets. Clearly, the entry of new competitors has increased rivalry in the larger markets, but it has also hampered Telmex' ability to subsidize the less profitable markets, such as the rural towns of Mexico.

Hence, the national government, seeking to address the challenge of the lack of IT services for the poorer citizens, launched the e-Mexico project in 2001 (Huerta and Sandoval, 2007). In its origins, the initiative managed a $400 million budget to provide Internet access to most of Mexico's population, especially for the most remote and inaccessible villages. At the beginning, both government and industry contribute to the project.[12] However, soon afterwards its launch the program began to suffer from the lack of nationally-wide and well-organized operating structures, capable managers, and skilled human resources.

3. Public policies for the adoption of Internet in Mexico

According to the elements discussed above, the nature of the digital divide revolves around three factors: access to hardware and bandwidth, skills training, and the availability of appropriate content (local, linguistic, and cultural). As the world moves into the knowledge economy, lack of access to the Internet becomes increasingly associated with the persistence of economic underdevelopment and poverty (Servon, 2002; UNESCO, 2005; OECD, 2009).

In the case of Mexico, the digital divide has posed a major challenge to policy-makers because policy-makers need to ensure that ITs actually help citizens to ameliorate their misery. In the current situation, this is not happening because the lack of Internet access is directing many people (especially the less educated) to the margins of society, and thus leaving them unable to contribute to and benefit from the wealth of new opportunities that the digitally rich enjoy. The dangers of widening the digital divide in the case of Mexico have been commented elsewhere (World Bank, 2008; OECD, 2009).

As mentioned above, the Mexican government launched the e-Mexico program as an initiative to provide Internet access to the less developed communities of the country. The program sought to offer universal access to mainly rural inhabitants, who were normally excluded from Internet access given the difficulty to

[12] The e-Mexico initiative was originally envisaged as a six-year project under the President Fox's regime (Rodríguez, 2006).

reach them effectively. As a first stage, the program opened over 3,200 Community Telecenters (CTCs) around the country.[13]

According to Burkart (2007), universal access initiatives are a significant public policy tool because they pursue specific objectives and solutions for broad social problems ranging from economic underdevelopment, to social capital building, the promotion of individual rights and social justice, and community-building, so, the provision of universal Internet access tends to improve the social coherence and raise socioeconomic indicators (Compaine, 2001).

In particular, e-Mexico was conceived as an attempt to update the national consumption norm of ITs so that the country, at large, could fully realize its own digital goals. The objective was to extend modest subsidies to development projects linked to human rights-community telecenters. However, one of the first critiques to this initiative surged from the conservation of traditional economic "system" imperatives, such as the creation of new license commitments for Microsoft, rather than promoting competitive bids through government-led investments into local open source programming ventures.[14] Moreover, the structure and settings of the Community Telecenters were designed and assisted by the telecommunications monopoly Telmex.

However, as Judith Mariscal notes, one of the main shortcomings of the initiative was that the telecenter model for access was not so successful in closing the digital divide, due in large part to the small population that was both in need and also served by each telecenters. An additional drawback was that most telecenters did not provide training in the cognitive skills needed to attain a meaningful access to IT (Mariscal, 2005).

The trouble with the Internet in Mexico is that its use by the general population is still very low under any international standard. For example, in 2005 was 16%, but this proportion was much less in 2001 (3-5%) before the e-Mexico initiative was launched, so given the ambitious scale of the e-Mexico program, it is not surprising that it had mixed success.

Because the large differentials in Internet access among segments of the Mexican population, the country's digital divide keeps on growing in the majority of small towns and villages where most people are rural and poorer (Burkart, 2007).

[13] A Community Telecenter is an Internet kiosk (i.e., *cybercafé*), and was a central piece of the e-Mexico program during the Administration of the former Mexican President Vincente Fox in 2000-06 (Mariscal, 2005).

[14] As regards some early critiques on this program, see a long report from *La Jornada* newspaper from 17-19 May 2004 (available online at http://www.jornada.unam.mx/200/05/19/022n1pol.php), retrieved on 22 May 2011.

It is worth mentioning that, by mid-2011, around only a quarter of the Mexican population uses the Internet regularly.[15]

In order to inspect the impact of the CTCs in the digital literacy of rural IT users, Huerta and Sandoval (2008) conducted a research on the habits of the CTCs' clients. They found that behavioral, infrastructure, and language problems were not solved by the use of the CTCs, and marginalized societal strata was almost absent from these centers, so that the CTCs had to face insurmountable societal divides, which weaken their attempts of reducing their digital oblivion.

Another problem faced by the CTCs was that Telmex provided a slow and minimally necessary build-out of rural payphones and cable networks, while the country continued to experience a protracted and low level of wireline telephone penetration. As a result, Internet penetration in Mexico has not yet reached the 30 percent barrier, even though over 60 percent of the population already carries mobile Internet-ready mobile phones in their pockets and purses (INEGI, 2010).

During the Fox administration another major governmental IT initiative was also launched. It was aimed at encouraging the development of the then nascent indigenous software industry toward a world competitive level; this program was named Prosoft, and it envisaged a 6-year plan (PEF, 2001). Starting in 2002, the Secretariat of Economy marketed the Prosoft Program to specifically strengthen Mexico's software industry. It cited the proximity advantages of being near the U.S. market, which is the largest software industry in the world, and the lack of tariffs and duties from the NAFTA free trade agreement. Under these conditions, the goal of Prosoft was to convert the Mexican software industry into the technology leader for Latin America.

However, almost none of these goals have lived up to the original expectations. In this regard, Ania and Mejía (2007) conducted an extensive survey of business leaders in the Mexican software services industry to study the growth of this sector. Their goal was to elucidate conceptual models of the industry, which is less developed in Mexico than in other middle-developed nations such as Ireland, Brazil, and India, and to analyze empirical findings to ascertain what is distinctive about the Mexican versus U.S. software industry.

Ania and Mejía's main findings are: 1) Mexico's industry is quite small relative to the U.S.; 2) programming is by far the largest service provided by the industry; 3) lack of specialization of services; 4) imbalances exist in the human resources of the firms (companies have been understaffed leading to poor quality results or delays in projects or overstaffed leading to cost overruns and financial

[15] See, for example, a press note released by the Mexico's statistics institute regarding the celebration of the Internet Day on 17 May 2011 (available at the URL: http://www.inegi.gob.mx) retrieved on 22 May 2011.

losses); 5) wide pricing differentials exist across the industry for the same service; and 6) software firms need to improve performance measurement.

In the current administration, the digital agenda has occupied an even lower level of importance, given the priority of the regime to fight the growing narcotics trade and its side effects in the increasing social insecurity as criminality rates have soared.

To some extent, the failure to bridge the growing digital divide in Mexico is driving the government toward a situation where most citizens seem less-and-less capable of participating in the economic and social affairs that are increasingly technology-dependent. So, empirical evidence seems to confirm that the Mexican government has become accustomed to struggle each 6 years to foment internationally competitive industries. The problem is that new opportunities are vanishing. Although this situation needs drastic changes in the national development plan, the current Mexican regime seems to have been more preoccupied with satisfying the financial and macroeconomic requirements rather than the development issues.

Conclusions

Technological factors play an important role in Internet diffusion. However, diffusion of the Internet is contingent upon certain existing technological and infrastructure network factors, which include telecommunications and personal computers. The shrinking of telephone lines in Mexico from 2005 onwards due to the prominence of mobile telecommunications is one the main obstacles that the government needs to meet in order to foster Internet access. Therefore, all measures targeted at increasing the size of the telecommunications infrastructure network imply the extent of inherited network supply capacity, which has been deteriorated by the paucity of investments by the incumbent monopoly.

Under these conditions, it seems mandatory to increase the size of the country's telephone network, which is commonly measured by the number of telephone lines relative to the size of the population, the so-called "network penetration" rate or "teledensity" (i.e., the number of main telephone lines per 100 inhabitants). Similarly, it is necessary to increase the number and quality of the physical devices (personal computer *versus* set-top box) that support the operation of the Internet and that enable individual users to access the Internet. In any case, both actions are critical for the successful diffusion of the Internet in Mexico and elsewhere.

According to Lam *et al*. (2004), the rapid adoption of these devices will profoundly influence how services providers will compete in the consumer market, as we have started to witness in the case of Facebook and Apple.

Additionally, numerous authors have identified a link between economic wealth and the adoption of new technologies. Kiiski and Pohjola (2002), in a 1995-2000 cross-country Internet diffusion study, found that GDP per capita is a significant explanatory factor of the Internet penetration rate. In Mexico, Internet access and equipment costs still represent a substantial share of annual earnings per capita, thus affecting its diffusion. Moreover, in the context of nations where the Internet is just starting to spread, the price level of services (such as connection and access fees) and equipment costs (such as PCs and terminals) are important factors in determining the Internet uptake, as Simons (2001) and James (2001) have already pointed out.

Providing universal Internet access in Mexico through CTCs may not be enough if people cannot afford to pay for the services and equipment or do not have the required skills to use the systems. Besides, in bridging the digital divide in Mexico, one not only needs to take into account the technological factors of the problem but also the socio-economic dimensions of it.

In Mexico, high access costs are to be blamed for the persistent low level of Internet penetration. Empirical evidence shows that access charges have been found to be a significant explanatory factor for Internet diffusion rate (Wallsten, 2005). These established findings suggest that excessive charge rates set by telecommunication regulators and network operators seriously hamper the diffusion of Internet innovation. However, the solution of this situation is still missing in the design of the governmental agenda of Mexico.

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