

# Telecommunications, Universal Service and Poverty in Mexico: a Public Policy Assessment (1990–2008)

Cristina Casanueva-Reguart and Antonio Pita S.

**Abstract**—This article analyzes the design and implementation of telecommunications service policies targeted at the poorest regions of Mexico (1990–2008). It begins by defining universal access and service policies, their economic and social rationale. Secondly, it discusses the scope of public policies on universal service provision designed by Mexican authorities to achieve the goal of universal access. Thirdly, the paper analyzes the distributive effects of this set of policies among the poorest sectors of the population. The sources on which this research was based were two national surveys: the *Household Income and Expenditure Survey* (2008), and the *Household Survey of the Access and Use of Information Technologies* (2007). The additional information on regional economic development was based on the poverty indexes by the national population council and economic information given by Mexico's Census Bureau. Additional use was made of the annual reports prepared by Ministry of Communications, statistics published by the Federal Telecommunications Commission and official documents prepared by the government agencies. Finally, a series of in-depth interviews was conducted with the former representatives of the Office of Rural Telephony. Finally, the article discusses, in the light of available evidence, possible explanations for the apparent failure of the universal service policy that was implemented to bring at least basic voice services to Mexico's neediest.

**Keywords**—*development, digital divide, market power, regulatory capture, social inclusion, universal service.*

## 1. Introduction

The telecommunications services infrastructure is an important factor for economic development and social inclusion, and a crucial component leading to greater equality when services are available to and affordable to any person, irrespective of levels of income and geographic location.

In developing countries gaps remained in the market mainly because of regulatory failure, combined with exceptionally challenging geography and extremely low population densities, isolation and extreme poverty [1]. Government, institutions and public policy design have been faced with a situation where authorities had a social obligation to ensure that their people had access to basic telecommunications, but the ability to enforce these obligations entailed increasing difficulties. Some of these difficulties are related to the asymmetry between the government regulatory bodies and the power of the operators, particularly in the case

of an incumbent operator with market power in the supply of almost every telecommunications service<sup>1</sup>.

This article analyzes the design and implementation of telecommunications service policies targeted at the poorest regions of Mexico (1990–2008). It begins by defining universal access and service policies, as well as their economic and social rationale. The article then discusses the scope of public policies on universal service provision designed by Mexican authorities to achieve the goal of universal access, namely:

- Monitoring by the regulatory authorities of compliance on the part of the incumbent telecommunications operator, Teléfonos de México (Telmex), in fulfilling its social obligations as the dominant operator, following the company's privatisation (1990);
- Government policy aimed at providing connectivity – basic telephony services – to rural communities. This article presents the main research results, which focus on basic (voice) telecommunications services, both land-line and wireless<sup>2</sup>. This policy was deployed by private operators, mainly the incumbent. The participation of operators was based on a public tender processes organized by the government, which has resulted in an additional profitable business for the incumbent operator, with limited results in terms of access to these services by the poor.

Thirdly, the paper analyzes the distributive effects of this set of policies among the poorest sectors of the population. Finally, the article discusses, in the light of available evidence, possible explanations for the apparent failure of the universal service or social coverage policies that were implemented to bring at least basic voice services to Mexico's neediest, as well as the difficulties faced by the regulatory bodies behind the design and implementation of these policies.

<sup>1</sup>Almost 20 years after Telmex's privatization (1990) in 2009, Telmex operated the 84.8% of the total the number of fixed line connections, and 72.3% of cellular lines. "The Competitive Intelligence Unit" (CIU), <http://octavioislas.wordpress.com/2009/07/23/3236-mexico-the-competitive-intelligence-unit-competencia-en-mexico-%C2%BFque-20-anos-no-es-nada-telecomunicaciones/>

<sup>2</sup>The results and the discussion, presented in this article, are part of a larger project on Universal Access and Service which include telecommunications services and bandwidth in the provision of Internet, data and video transmission.

The sources on which this research was based were two national surveys: the *Household Income and Expenditure Survey* (2008), and the *Household Survey of the Access and Use of Information Technologies* (2007). The additional information on regional economic development reported in this article was based on the poverty indexes drawn up by the national population council and economic information given by Mexico's Census Bureau National Institute for Statistics, Geography and Information (INEGI), Bank of Economic Information (BIE), and housing and population counting, 2005. Additional use was made of the annual reports prepared by the Communications and Transport Secretary (Ministry of Communications), statistics published by the Federal Telecommunications Commission (COFETEL) and official documents prepared by the government agencies in charge of designing and monitoring the universal service telecommunications policies, principally the Ministry of Communications. Finally, a series of in-depth interviews was conducted with the former representatives of the Office of Rural Telephony, who were in charge of monitoring the implementation of social and universal telecommunications policies.

## 2. Access to Telecommunications Services as a Fundamental Right; Definitions of Universal Access and Universal Service: its Economic and Social Rationale

The recent literature on the universality of telecommunications services states, as a fundamental principle, that every citizen has the right to access telecommunications services with high quality standards. This implies fulfilling three basic conditions: universality, equality and continuity, defined as follows:

- universality: every citizen has the right to have access to telecommunications services with a high standard of quality;
- equality: universal access, irrespective of income levels and geographic location;
- continuity: ensuring that the service continues to maintain high quality standards, in an uninterrupted manner.

Regarding universality, the literature on this subject distinguishes between universal access and universal service:

- Universal access is when everyone has the right to use the service somewhere, in a public place. This service is also defined as communal or shared access. In general there would be at least one point of access per settlement over a certain population size, within a convenient and reasonable distance.

- Universal service is when every individual, household, business or institution can be provided with a service, using it privately, either at home or in an increasingly mobile variant, carried with the individual through wireless devices [2].

The rationale for a universal access or universal service policy is both economic and social. The economic rationale is based on the market's inability to provide infrastructure, connectivity and services on a universal basis. Thus, universal access and service policies are justified in the face of market gaps, so as to guarantee equality of economic opportunities, since telecommunications services are a critical component in the production of goods and services, as well as for social inclusion and, increasingly so, for political participation.

The social rationale consists of the will of the public policy makers who, as representatives of the state and its citizens, must guarantee social inclusion and avoid the exclusion of parts of the population, irrespective of income levels and geographic location.

Furthermore, the three defining characteristics of universal access and universal service are:

- availability: the service is accessible to inhabited parts of the country through public, community, shared or personal devices;
- accessibility: all citizens can use the service, regardless of location, gender, disabilities and other personal characteristics;
- affordability: the service is affordable to all citizens.

Thus, the policy of a universal telecommunications service consists of an explicit, direct and focused public policy, aimed at offering telecommunications services at prices that are affordable to the poorest sector of the population. The fulfilment of this policy requires a subsidy, since this sector of the population cannot afford these services at market prices. The subsidy may be applied on the supply or demand side of these services. On the supply side, it is usually applied through development and/or optimisation of the infrastructure (investment), which allows connectivity and thus takes into account the difficulty of infrastructure provision given the level of geographical dispersion of these communities, as well as the cost of providing the service.

On the demand side, the affordability of the provision of these services must be addressed, because the population currently without service generally lives in conditions of poverty, sometimes extreme, and thus their income does not allow them access to these services at the market price. Hence, when supplying these services is not profitable for the service operators, provision depends on various forms of subsidy [3].

### 3. Public Policies on Universal Service Provision in Mexico under the Responsibility of the Telecommunications Regulatory Bodies

According to the population counting of 2005, there were 184,748 rural communities in Mexico with a population of fewer than 2,500 inhabitants, and 197,479 communities of fewer than 5,000. These communities are inhabited by over 30 million men and women, which represented 29.1% of the Mexican population. In addition, a notable feature of these communities was their high level of dispersion, with 92.5% having fewer than 500 inhabitants.

Thus, in order to increase the social coverage of telecommunications services, a set of policies was drawn up and implemented. They represented the main public policies that have been put into practice to provide access and universal service in Mexico and among them, the most important were:

- Monitoring of Teléfonos de México's (Telmex, the incumbent operator) compliance with its obligations to provide a universal service, as set out in Telmex's licence of 1990, at the time that the public telecommunications operator was privatized. This licence was granted by the Ministry of Communications and Transport (Ministry of Communications<sup>3</sup>), which has acted as a regulator and has the authority to monitor Telmex's compliance with its obligations regarding universal service, rural telephony, as well as the modernization and expansion of the public network, contained in Telmex's licence.
- Rural telephony (1995–2007), aimed at offering services to communities with fewer than 500 inhabitants, with a direct subsidy from the Ministry of Communications.
- The creation of the *Social Coverage Fund* (Fondo de Cobertura Social, FONCOS: 2002–2007) by the Ministry of Communications aimed at increasing the coverage of rural telephony in communities with a population of between 400 and 2,499 inhabitants. For this purpose the regulator organized went out to public tender, calling for bids from telecommunications operators. The conditions of the tender included

<sup>3</sup>In Mexico there are two main regulatory agencies directly involved with telecommunications, the Subsecretaría de Comunicaciones (Ministry of Communications), which is part of the Secretary of Communications and Transports (Ministry of Communications and Transport). The second regulatory agency is the Comisión Federal de Telecomunicaciones (Federal Telecommunications Commission), which is an autonomous government agency. In the case of universal service and universal access, the agency in charge of designing these policies is mainly the Ministry of Communications. This ministry has performed the major role in the design of universal telecommunications policy and in the surveillance of the implementation universal services by the operators.

the provision of non-returnable monetary resources, which were originally allocated by the Ministry of Finance. In addition, the regulator allocated frequency bandwidth resources that were reserved for the purpose of social and universal service coverage, with a ten year licence (renewable) to use these frequency bands.

#### 3.1. *Telmex Licence: Universal Service Obligations and Network Growth*

The design of the universal service obligations included in the incumbent operator's licence should have addressed the main challenges posed by the gaps in the market, mainly in small rural communities generally located in remote and isolated areas and where the poorest people of the country live. This section deals with the context in which Telmex was privatized, which explains the scope of the clauses relating to universal service and rural telephony included in the licence. The scope of both the content and schedule for its implementation, as well as their impact on bringing connectivity to the neediest communities, was shaped to some extent by the context in which the privatization of Telmex took place. This section begins by describing this context, then briefly presents the content of the clauses relating to universal service obligations, namely, regarding network expansion, rural telephony and public telephones. It then presents the main results of an analysis of the impact of Telmex's fulfilment of these licence clauses.

In order to understand the government policy makers' limited leverage on the definition of the clauses relating to universal obligations or social coverage in Telmex's franchise agreement(1990), it is useful to analyze the specific juncture at which this process took place. During the 1980s, with the economy severely indebted, the burden of foreign debt and fiscal deficit had a major effect on the process of privatization of public companies and specifically on the approach adopted in the privatization of Telmex. Between 1965 and 1980 the economy had been growing at an average rate of 6.7%, but during the 80s this slowed to a yearly average of 1.8%. In this context, government policy makers embarked on an aggressive privatization program of public companies, with two purposes in mind: to increase the efficiency of Mexico's economy and to improve Mexico's public finances.

In the case of the public telephone company in Mexico, the potential revenue gain from this privatization and the public finance argument prevailed. The decision to privatize the public telecommunications operator in Mexico took place in 1989. During the privatization of Telmex, emphasis was placed on expected revenues. In fact, the privatization process was chaired by the Ministry of Finance and not by the Ministry of Communications and Transport [4]–[6].

To maximize revenues from privatization, the government sold to a single set of investors a package that included Telmex and Telnor, in addition to the only nationwide mobile network franchise, as mentioned above, the Federal

Microwave Network, as well as an ample bandwidth allocation. Thus, overnight, the emerging company became a formidable player in the sector. It was allowed to offer all types of telecommunications services with the exception of television broadcasting services. Thus, Telmex became a horizontally and vertically integrated telecommunications service provider with a nationwide network for all its services. Furthermore, it was guaranteed little or no competition in key services for several years. The new private owners of Telmex were given a *de jure* monopoly over the long distance markets (national and international) for six years. They inherited the monopoly over local telephone services. By creating a horizontally and vertically integrated telecommunications company, the government could receive a higher price for privatizing the firm and reach a short-term public finance goal. For potential buyers, the company was very attractive [4], [5]. They were allowed to buy a stream of excess profits sustained by a monopoly, more valuable than a stream of revenue generated under competitive conditions [7].

In the negotiation process that accompanied the privatization of Telmex, government policy makers let the collection of revenues from privatization preside over other goals such as economic efficiency, well-being and social inclusion. This context explains the lack of leverage or bargaining power of the authorities, specifically on the subject of social coverage. Although Telmex’s license included clauses governing universal service obligations, rural telephony and public telephone booths, as well as network expansion, Telmex’s commitment to these clauses ended in 1994 and the results lagged very much behind the objective of providing a basic universal telecommunications service to rural areas.

The following paragraphs give a summary of the main clauses relating to Telmex’s universal service and network growth obligations. The result of an empirical analysis is also presented, showing the outcomes of the implementation of these policies, reflecting the achievements of network growth, rural telephony and public telephone services or telephone booths (1990–1998).

From a regulatory perspective, Telmex’s licence made this company operate as a regulated monopoly. The company was given a set of operational goals that it was required to meet:

- to expand the number of basic telephone lines by a minimum of 12% per annum, until the end of 1994;
- to continually reduce the waiting period for the basic telephone service in localities with automatic switching capabilities to a maximum of one month by the year 2000;
- to provide a public payphone service to every locality with more than 500 inhabitants by the end of 1994, and to increase the penetration of public telephone booths from 0.5 per thousand inhabitants, to five per thousand by the end of 1998;

- to provide a public payphone service to every locality with more than 2,500 inhabitants (less than 5,000 inhabitants, according to the definition of rural community), if there were at least 100 applications from potential end users, and an up front payment equivalent to three months’ line rental. *“After these conditions were fulfilled (...) Telmex would deliver the service within a time frame of not more than 18 months”*<sup>4</sup>;
- to publish a four year (network) expansion and modernization programme, in accordance with the goals set by the licence, and to agree with the Ministry of Communications on programmes for rural telephony and public telephone booths.

### 3.1.1. To Expand the Number of Basic Telephone Lines by a Minimum of 12% per Annum

The 12% telephone line expansion requirement ended only four years after the 1994 privatization of the sector. Quantitative goals for a longer period would have conflicted with the goal of revenue maximization at the time of privatization. The results shown in Table 1 tend to support the view that the quantitative line expansion requirement set out in the concession or Telmex licence was an effective regulation. In fact, during the years 1991 to 1994, Telmex’s average annual line expansion was 11.8%, and thus close to meeting the 12% requirement. However, once such an expansion requirement ceased to exist, average line expansion fell to only 6.8% in the period 1994–2000 (see Table 1).

Table 1  
Five year average growth in telephone lines and GDP (1965–2000)

Period	Telephone lines [%]	GDP [%]
1965–1970	12.8	6.9
1970–1975	12.9	6.5
1975–1980	10.5	6.7
1980–1985	6.4	1.9
1985–1990	7.6	1.7
1990–1994	11.8	3.6
1994–2000	6.8	3.5

Source: SCT, Anuarios Estadísticos (1965–2000).

### 3.1.2. Rural Telephony: Basic Telephone Service to Communities with More than 500 Inhabitants (1990–1998)

As a result of the negotiations between government policy makers in the field of telecommunications and the group of investors, Telmex’s licence freed them from their obligation to serve communities with fewer than 500 in-

<sup>4</sup>SCT, Modificación a Teléfonos de México, 1990, [http://www.cft.gob.mx/work/sites/Cofetel\\_2008/resources/LocalContent/3964/1/10ago90.pdf](http://www.cft.gob.mx/work/sites/Cofetel_2008/resources/LocalContent/3964/1/10ago90.pdf)

Table 2  
Telephone service to communities with more than 500 inhabitants

State	Lines per 1,000 inhabitants towns 500 to 2,499	Lines per 1,000 inhabitants towns 500–4,999	Rural communities communicated by Telmex, 1990–1994	Total population towns 500–2,499	Total population towns 500 to 4,999	GDP per capita
Chiapas	1.00	0.44	950	951,521	2,136,825	37.8
Oaxaca	1.24	0.65	1,362	1,095,547	2,102,278	39.8
Tabasco	1.31	0.78	678	517,227	863,855	47.6
Guerrero	1.27	0.63	932	732,388	1,470,855	47.8
Tlaxcala	0.77	0.37	109	141,396	294,861	47.9
<b>National</b>	<b>1.35</b>	<b>0.65</b>	<b>16,738</b>	<b>13,339,307</b>	<b>27,937,529</b>	<b>83.2</b>
Campeche	1.43	0.70	135	94,653	193,781	121.7
Quintana Roo	1.54	0.74	122	79,123	164,691	126.4
Coahuila	1.65	0.70	238	144,448	337,934	129.8
Nuevo León	3.30	0.79	232	70,211	293,812	173.5
Distrito Federal	0.00	0.00	0	13,268	26,550	188.0

Source: SCT, Annual Reports, INEGI, Census 1990.

habitants, which according to the census of 1990 represented 21.16 million people or 47.2% of the inhabitants in rural communities in Mexico [8].

An analysis of the impact of Telmex's rural telephony operations points to very limited results. The impact on telephone density, following Telmex's compliance with requirements on basic telephone service provision in rural towns, was extremely low, even when telephone density was estimated as the number of lines per thousand inhabitants<sup>5</sup>. This estimate shows that the country's average telephone density was 1.35 lines per 1,000 inhabitants in rural communities (500 to 2,499 inhabitants), and if the definition of rural communities included "enlarged rural communities" (from 500 to 4,999 inhabitants), the telephone density estimate drops to half the previous figure, or 0.65 lines per thousand inhabitants. Based on this analysis it is possible to assert that fulfilment of overall requirements, provision of rural telephony and the installation of public telephone booths in rural areas, had very much fallen behind in relation to the goals set by Telmex's licence (see Table 2, which presents the telephone density, according to our definition, in the five more prosperous states and in the five poorest states in Mexico).

Thus, in spite of the fact that public telephone booths were the strategy mostly used by Telmex to fulfil its universal or social obligations, compliance with the commitment of providing public access through public telephone booths was insufficient. At the end of 1998, Telmex admitted that it had only installed 3.19 public booths per 1,000 inhabitants. Taking into account that Mexico's population at the time was 96 million, Telmex would have had to install at least 480 thousand public booths in order to comply with the social obligation dictated by its licence. Unfortunately,

<sup>5</sup>See Caslon analytics, metrics and statistics, <http://www.caslon.com.au/metricsguide8.htm>

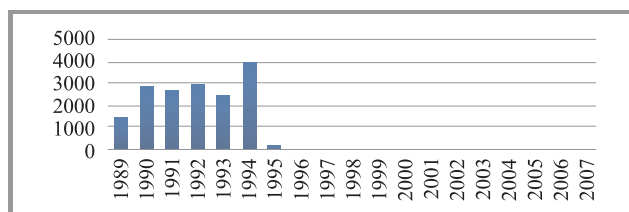


Fig. 1. Number of rural communities with more than 500 inhabitants, communicated by Telmex with at least one telephone line (1990–2007).

according to the definition of universal service set out in Telmex's licence and because of the government's lack of leverage at the time of privatization, the universal service obligation ceased and areas that were served with at least one public booth increased slightly in 1995 and 1996 and ceased to grow indefinitely from 1997 (see Figure 1 and Table 3).

Table 3  
Telephone lines provided by Telmex in communities with a population of 500 or more inhabitants

Acumulated	Annual [number]	Annual [%]
4,350	2,854	190.8
16,542	4,006	32.0
<b>Average annual growth: 1990–1994</b>		<b>93.4253</b>
16,735	193	1.2
16,738	0	0.0
16,738	0	0.0
16,738	0	0.0
<b>Average annual growth: 1994–2007</b>		<b>0.0014</b>

Sources: SCT, Annual Reports (2000 and 2007).

Table 4  
Teledensity and level of development in different states in Mexico, 2008

State	Lines per households [%]	Non residential lines <sup>1</sup> [%]	Mobile lines <sup>2</sup>	GDP per capita	Poverty index
National	52.2	12.7	71	96.8	
Chiapas	19.1	4.2	41.1	37.8	Very high
Oaxaca	26.4	4.6	39.8	39.8	Very high
Tabasco	28.1	6.7	75	47.6	High
Guerrero	40.6	7	44.8	47.8	Very high
Tlaxcala	40.3	4.4	44.1	47.9	Medium
Campeche	32.7	6.4	71	121.7	High
Quintana Roo	38.0	16.1	95.9	126.4	Low
Coahuila	63.3	12	86.6	129.8	Low
Nuevo León	79.9	22.2	91.8	173.5	Very low
Distrito Federal	104.6	40.5	102.7	188	Very low

<sup>1</sup> lines per one thousand employed people, <sup>2</sup> lines per one hundred people.  
Sources: Cofetel, 2008; INEGI, 2005 and 2008, National Population Council, 2005.

According to Telmex's license, the commitment to provide a basic service under the premise of universal access through public booths in Mexico is far outweighed by the challenge of providing services to the poorest communities

Table 5  
Average revenue per capita in selected developing countries, 2007

Latin America	Country	ARPU	GDP per capita	ARPU/GDP per capita <sup>1</sup>
	Colombia	131.0	7,400	1.8
	Mexico	178.0	12,400	1.4
	Brazil	17.2	9,500	0.2
	Chile	17.0	14,300	0.1
	Argentina	12.2	13,100	0.1
Emerging Europe	Hungary	26.5	19,300	0.1
	Czech R.	28.5	24,500	0.1
	Poland	17.0	16,200	0.1
	Ukraine	7.0	7,000	0.1
	Russia	10.0	14,800	0.1
Africa/Middle East	Turkey	13.7	12,000.00	0.1
	Iraq	12.3	3,700.00	0.3
	South Africa	20.7	9,700.00	0.2
	Egypt	9.7	5,000.00	0.2
Emerging Asia	India	8.6	2,600	0.3
	China	10.8	5,400	0.2
	Korea	45.0	25,000	0.2
	Taiwan	23.0	30,100	0.1
	Singapore	348.0	49,900	0.7
	Hong Kong	22.5	42,000	0.1

<sup>1</sup> ARPU – average revenue per user: the estimation gives ARPU as a percentage of GDP per capita, in each country.  
Sources: Merrill Lynch, 2008, CIA World Factbook, 2008, and Office of Rural Telephony, 2009.

of Mexico. This is true more particularly in the context of a large deficit of telecommunications services in the country as a whole: on average, there is provision to only 5 households out of every ten (52.2%) and 12.7 non residential lines per one thousand employed people (see Table 4).

Most likely the deficit of connectivity has been compensated for by the use of cellular or mobile services, at market prices. A comparative analysis of revenue per minute from wireless services suggests that Mexico has one of the highest tariffs for mobile services (see Table 5).

The following section presents information relating to the "agreements" between Telmex and the Ministry of Communications, which according to its licence, were supposed to continue after 1994.

### 3.1.3. Telmex Agreements with the Ministry of Communications on Programmes for Network Expansion, Rural Telephony and Public Telephone Booths (1995 to date)

In 1995, according to Telmex's licence, the company was required every four years to establish a programme for network expansion and provision of rural telephony and public telephone booths. However, in spite of the fact that an exchange of documents took place between Telmex and the Ministry of Communications in 1995, this exchange did not materialize into an action programme. It was not until 1998 that this took place, when Telmex set up a rural telephony programme, supposedly in an agreement with the Ministry of Communications, retroactive to 1995 (1995–1998).

In December 1998 Telmex sent a report on the fulfilment of the goals of this programme. The main goal achieved was the additional coverage, compared to 1994, of 4,288 communities, through public telephone lines or public booths.

However, strictly speaking, the service provided to these additional communities was part of a rural telephony project undertaken by the Ministry of Communications. Telmex was involved as the winner of a public tender in which they were chosen as the provider, but the project was financed by the Ministry of Communications (the results are presented below of the universal service policy undertaken by the Ministry of Communications).

It was only in July 2006, when Telmex delivered its results on network expansion and rural telephony for the periods 1995–1998, 1999–2002 and 2003–2006. The documents handed over by Telmex to the Ministry of Communications were accompanied by an appeal for confidentiality and the Ministry of Communications accepted the condition of confidentiality requested by Telmex. Nevertheless, the annual reports published by the Ministry of Communications (2001–2006) showed that since 1994, Telmex made a very small contribution in this area.

The privatization of Telmex and the attempts to regulate the monopoly through this company's license did not bring a strengthening of the regulatory authority's monitoring and enforcement capabilities. This had a severe effect on achieving the goals set by the universal service or universal obligations defined in Telmex's licence following privatization. Studies on telecommunications reform suggest that privatization by itself, without a strong regulator, does not yield significant performance improvements in the telecommunications sector [5], [7], [9].

#### 4. Rural Telecommunications Services for Communities of Fewer than 500 Inhabitants: Direct Government Subsidy

This section analyzes the policy directly implemented by the Ministry of Communications, aimed at providing telecommunications services to rural communities of between 100 and 499 inhabitants. These programmes originally focused on small towns and villages with fewer than 500 inhabitants (1990–2002), but later on, with the establishment of the *Social Coverage Fund* (FONCOS), the focus of these programmes shifted to communities of between 400 and 2,500 inhabitants.

Table 6  
Rural telephony supplier

Cellular company	Lines	%
Telcel	8,358	25.1
Iusacell	11,012	33.1
Telecomm	13,772	41.4
Others	100	0.3
<b>Total</b>	<b>33,242</b>	<b>100.0</b>
Source: Office of Rural Telephony.		

The programme was directly financed by the Ministry of Communication (1995–2006) and was aimed at communities with fewer than 500 inhabitants. It involved the main providers of mobile telecommunications services, including Telcel, the mobile company part of the same group as Telmex (25%), and the public satellite company, Telecomm (41.4%, see Table 6).

The size of these targeted communities confirmed that the policy successfully focussed on the poorest towns of Mexico and even in cases where regions of higher income were served, the subsidy focussed on the neediest rural communities that are generally located in remote and isolated areas (see Table 3). Nevertheless, telephone density in these small towns remained extremely low, as was the case of the services provided by Telmex in larger communities, where the estimated telephone density is 0.45 lines per 100 inhabitants when population data for these communities is taken from the 2000 census and 0.44 with population data is from 2005 (counting of population and housing, 2005, see Table 7). It is also likely that the actual telephone density in these small towns was higher because of the use of mobile technology, when it was available in these regions.

An additional source of information consisted of in-depth interviews with the former representatives of the Office of Rural Telephony, part of the aforementioned Ministry of Communications, where data compiled by this office is based on their fieldwork aimed at verifying the correct operation of the installed lines. This information complements that of the previous analysis<sup>6</sup>.

The information provided by the Office of Rural Telephony showed that 33,242 lines were installed between 1995 and 2006. An analysis of this information also showed a very rapid growth in the number of installed lines between 1995 and 2000 (135.42% yearly average growth) and that the pace of growth declined considerably over the following years, where the yearly average growth observed between 2001 and 2005 was only 1.16%. There was no evidence of growth between 2006 and 2009.

The results of the former analysis are even more dramatic considering the outcome of the fieldwork aimed at verifying the correction operation of the equipment. Here the data showed that only 41.5% of the installed lines were in operation and out of these, 58.5% of the lines were out of service and abandoned. The interviews with the former representatives of this office suggested that the people of these communities were gradually shifting to mobile technology, where this service was available, in spite of the higher costs involved in the use of mobile communication.

The former observations raise doubts over the commitment made by the government for bridging the connectivity gap in the smallest and poorest communities of Mexico. It also

<sup>6</sup>Is worth mentioning that there is an inconsistency between the information accounted by the Annual Report (2007) and the Office of Rural Communication, the first source reported 34,676 installed lines, and the Office of Rural Telephony accounted for 33,242, the difference between the two sources is 1,434 installed lines.

Table 7

Rural telephony, lines installed by Secretary of Communications, towns between 100 and 499 inhabitants, 1995–2007

	Communities	Lines 2007	Teledensity /100, 2000	Teledensity /100, 2005	GDP per capita
<b>Total</b>	<b>184,748</b>	<b>34,676</b>	<b>0.45</b>	<b>0.44</b>	<b>70.88</b>
Chiapas	19,237	3,560	0.48	0.42	28.6
Oaxaca	10,025	2,540	0.41	0.37	32.5
Tlaxcala	1,138	117	0.41	0.41	37.3
Michoacán	8,965	1,861	0.45	0.45	39.9
Chihuahua	12,095	896	0.43	0.53	102.9
Quintana Roo	1,800	177	0.46	0.44	107.5
Campeche	2,595	240	0.49	0.35	121.7
Baja California	3,918	248	0.56	0.56	93.0
Campeche	2,595	240	0.49	0.35	121.7
Nuevo León	5,169	561	0.50	0.57	133.1

Source: INEGI, Censo de Población y Vivienda, 2000; Conteo Población y Vivienda, 2005; Ministry of Communications, *Annual Report* (2000–2007) and Bank of Economic Information (BIE), 2007.

raises questions over the nature of the agreements signed by the Ministry of Communications and the operators undertaking the installation of the telephone lines, specifically operation and maintenance in accordance with acceptable quality standards. The personnel interviewed agreed

Table 8

Number of new telephones installed in communities with less than 500 inhabitants 1995–2008

1995	4,000
1996	9,369
1997	10,545
1998	20,208
1999	23,063
2000	31,083
<b>Average annual growth 1995–2000</b>	<b>135.42</b>
2001	31,083
2002	31,453
2003	31,820
2004	32,326
2005	32,841
2006	33,240
2007	33,242
<b>Average annual growth 2001–2008</b>	<b>1.16</b>

Source: Ministry of Communications, Office of Rural Telephony.

that the contracts included maintenance and quality clauses, which pose additional questions on the strength of the ministry as a regulator capable of enforcing these clauses.

## 5. Social Coverage Fund (FONCOS)

In 2002 the *Social Coverage Fund* (FONCOS) was established as a trust fund with an allocation of 75 million

US dollars<sup>7</sup> provided by the Ministry of Finance to the Ministry of Communications. Its main purpose was for the funding of social telecommunications services, focussed on serving communities of between 400 to 2,500 inhabitants. The Ministry of Communications designed two different public tender processes. The first, *Basic Telephony 1* (STB-1 to use its Spanish acronym), was aimed at installing public telephone lines in communities of extreme poverty. The second, *Basic Telephony 2* or STB-2, focussed on communities with higher levels of income. For STB-1, the subsidy for the chosen operator consisted of both financial and bandwidth resources for 10 years (renewable), which were reserved by the government for social coverage purposes. The subsidy to the end user included all expenses relating to the installation and rental of the equipment, so that the end user had only to pay for call traffic, charged for via prepaid cards.

For STB-2, the subsidy to the winning operator consisted of bandwidth resources only. The end user was charged for installation costs and call traffic, exonerating them from payment for the rented equipment. In this case, the subsidy for the chosen company consisted only of the licence to operate bandwidth resources for 10 years (also renewable). Although in the first round four companies participated, two of them were Telmex and Telcel. The latter is a mobile service provider belonging to the same consortium as Telmex. In the second round of the tender process, Telmex was the only bidder. In both public tenders Telmex, the incumbent operator, was chosen. The contract with this incumbent operator was signed on February 2005 with the target of serving 5,979 communities.

There were two changes to the terms of the contact signed between Telmex and the Ministry of Communications. The first was related to the inability to serve 737 communities

<sup>7</sup>The total sum accounted by 750 million pesos, the exchange rate between Mexican pesos and US dollars at the time was around 10 Mexican pesos per US dollar.



due to the fact that these towns lacked an electricity infrastructure or due to difficulties imposed by weather contingencies. The settlement consisted of a time extension granted to Telmex in order to serve 506 communities.

The second change to the original contract consisted of exchanging bandwidth resources reserved by the government for social coverage purposes for bandwidth with high commercial value for Telmex. This change had severe implications for both the implementation of the universal service process and in terms of the dominant control of infrastructure on the part of the incumbent operator. This latter implication had negative consequences due to the lack of competition in the telecommunications services markets, thus affecting the economy and society as whole.

In November 2006, a few weeks before the end of the presidential and ministerial administration of 2000–2006, an exchange of frequency bands took place: its 21 MHz allocation in the 1.5 GHz band, which was originally allocated by the Ministry of Communications to Telmex as part of the Social Coverage Fund, was exchanged for 10 MHz in the 450 MHz band. The Ministry of Communications did not exercise its power to monitor the use of these frequency bands.

The exchange of frequency bands turned out to be commercially convenient for Telmex, since the 450 MHz band was the most appropriate for the provision of wireless services with technology known as CDMA 450. Among the advantages of the use of frequency resources with this technology are:

- The ability to digitalize and interleave calls with a code attached to each one, allowing a large number of simultaneous calls without interference.
- An additional advantage consisted of having a larger coverage per cell, which requires a smaller number of cells, resulting in a more cost-effective technology. Also, the possibility of supplying a wide variety of services, such as Internet, telephony, data transmission, videoconferencing and connectivity between local networks.
- This frequency band also makes use of CDMA 2000 1X and CDMA 2000 1xEV-DO technologies, which allow for high speed data transmission, equivalent to the digital service line (DSL).

The exchange of bandwidth resources dedicated to social telephony for resources with ten years of high commercial value was carried out by the Ministry of Communications and allowed Telmex access to and use of these resources without going through an open public tender. This raised questions over Telmex's interest in participating in the social coverage tender process.

Former representatives of the Office of Rural Telephony argued that Telmex's true interest was to acquire the use of the frequency bandwidth resources, with a potentially high financial return, thus evading the higher transactional and monetary costs involved in taking part in an open public

tender, which has been the allocation mechanism for radio bandwidth resources for commercial use drawn up by the government in accordance with the federal law on telecommunications (1995)<sup>8</sup>.

The former analysis leads us to consider the role of the government authorities in organizing tender processes and allocating public financial and bandwidth resources for social coverage. In this case, the Ministry of Communications played a different role by granting valuable infrastructure resources to be used commercially, at a very low cost for the incumbent operator.

Additionally, and based on fieldwork and remote monitoring performed by the Office of Rural Telephony, the supervision of the services offered by Telmex under the *Social Coverage Fund* (FONCOS) showed that, out of the programme objective of 109,016 telephone lines (75,797 lines under the STB-1 program and 33,219 under the STB-2 program), only 88,791 were actually installed, which implies that 20,225 lines were never installed.

There was a brief period, after 2006, when the new administration of the Ministry of Communications verified the services delivered by Telmex, under the *Social Coverage Fund*. The Ministry Office of Rural Telephony identified numerous irregularities, for example the installation of two land line connections in the same household, which proved less costly for Telmex (19,397 lines). A similar discovery was made of lines that were not connected to any specific household, which obstructed the verification of their operation (6,983 lines). In contrast, before 2006, the Ministry of Communications had punctually paid Telmex, based on the invoices that the company presented. During a brief period of time the Ministry of Communications initiated a process to impose sanctions on Telmex and to suspend payments to the company. However, this process never transcended the boundaries of the ministry because different groups within the ministry restricted the sanctioning process. Furthermore, the group that initiated this process no longer serves in the Ministry of Communications.

Here again, the analysis reveals the role of the regulator, firstly in the tender process, and specifically, in the process of allocating bandwidth resources with a high potential return for Telmex. Furthermore, the regulator did not supervise the use of these resources, which were specifically allocated for social communications coverage. This finding suggests regulatory capture and corruption on the part of the regulator [10], taken to a serious extreme since the regulator did not exercise its power in preventing the re-allocation of resources originally targeted at the poorest people, which in turn strengthened the market power of Telmex. Secondly, the regulator did not impose sanctions on Telmex for its breach of the agreement on social coverage. The role of the regulator was eclipsed, most probably by numerous instances of lobbying, resulting in a failure to

<sup>8</sup>Federal Telecommunications Law: Article 14. The licenses for the use of radiofrequency bands for determined uses will be granted through an open public auction. The Federal Government has the right to receive the agreed monetary resources; <http://www.diputados.gob.mx/LeyesBiblio/pdf/118.pdf>

Table 9  
Telecommunication services distribution according to households' income (deciles), 2008

Service	Deciles									
	1	2	3	4	5	6	7	8	9	10
Line connection	22.6	45.8	56.4	66.5	76.2	78.5	83.4	87.7	91.7	92.6
Mobile service <sup>1</sup>	22.1	42.2	52.0	65.2	70.4	77.7	82.1	87.0	91.1	86.7
Cable or satellite TV	5.0	12.7	17.5	26.2	32.6	41.5	50.3	62.3	72.3	75.8
Internet	0.2	1.7	3.4	7.2	11.4	17.4	27.2	41.4	56.1	60.1

<sup>1</sup> Mobile services are accounted when at least one member of the household has a mobile line.  
Source: INEGI: ENIGH, 2008.

consider the well being and social inclusion of the poorest sector of the population.

So far the limited achievements of the different public policies aimed at providing universal service have been presented as being due firstly to the limited implementation of the clauses set out in Telmex's licence and secondly to the violation of various agreements, including the FONCOS contract with Telmex.

There are then at least three main findings that can be drawn from the previous analysis: firstly, that the provision of universal service or universal access has been extremely limited in addressing the market gaps in Mexico's rural areas and telephone density in the different services continues to be very low. Twenty years after privatization of the public telephone company and 15 years after the liberalization of the telecommunications markets in Mexico, connectivity and telephone density remain a major challenge for public policy in Mexico. The second major finding is the continual breaching by Telmex of its universal access or service commitments, not only as was originally stated as part of its licence, but later as the result of a contract that was signed with the Ministry of Communications making it the main supplier of these services. Finally, the third finding is the limited leverage of the telecommunications authorities and their difficulty in enforcing contracts and agreements, as well as in imposing sanctions.

There is an extremely low density telecommunications infrastructure in rural areas, with the exception of the mobile infrastructure existing in some. This has led end users to rely increasingly on mobile services, which are more costly than regular services. The following section analyzes the distributive effects of this set of policies among the poorest sectors of the population.

## 6. Access and Expenditure in Telecommunications Services by the Poorest Sectors of the Population and their Relation to Income Distribution

In this section, we analyze the distribution of telecommunications services as a function of different levels of household income. The starting point for this analysis is

the decile distribution of households by level of income and their expenditure on telecommunications services as a proportion of their income. The source of information is the *Household Income and Expenditure Survey* for 2008, based on a nationwide representative sample. Each decile comprises the same number of households, which are ranked from the lowest to highest income. Comparing the lowest income decile with the highest, the latter is 30 times higher.

### 6.1. Access to Services

Those households within the lowest income decile (the poorest) have a significantly lower level of access to telecommunications services compared with households with higher income. This finding is consistent with the results previously presented on universal service provision and on the low density of infrastructure presented before. In the lowest decile, only two households in every 10 have a home telephone line connection, while in the highest income decile, nine out of every 10 have a land line connection in their homes. Very similar figures can be found for mobile services (see Table 9).

In the case of cable or satellite TV services, which have the technical capability for supporting telecommunications services and are currently used by many countries for that purpose, including urban areas of Mexico, the distribution of these services is even more skewed than land line connections or mobile services. Thus, in the lowest decile only 5% of households have access to TV based on this infrastructure, while 75% of households in the highest income decile have access to this service. The most dramatic case of this unequal distribution is found in relation to Internet access, where 60.1% of households in the highest income decile have access to the Internet, while in the lowest, only 0.02% have this service in their homes (see Table 9).

### 6.2. Expenditure on Telecommunications Services

The expenditure of the poorest households on telecommunications services as a percentage of their total outgoings is twice as high as the expenditure of the wealthiest households: 4.2% in the lowest deciles and 1.9% in the highest

deciles. These results suggest that the demand for telecommunications services tends to be inelastic, which means that people tend to demand and use these services regardless of their income. The larger proportion of the expenditure of poorest families is explained by the fact that they live in remote and isolated areas and depend more on public telephone booths and mobile services, which tend to be more expensive (see Table 10). As mentioned before, mobile services in Mexico have one of the highest prices compared to other developing countries (see Table 5).

Table 10  
Expenditure in telecommunications as a percentage of total expenses by decil (2006=100)

Decil	Average households income per quarter MEX pesos	Expenditure in telecommunications as a percentage of total expenses
1	3,320	4.2
2	7,174	4.1
3	10,042	4.3
4	12,739	4.3
5	15,845	4.4
6	19,506	4.5
7	24,246	4.2
8	31,472	3.8
9	43,796	3.2
10	99,215	1.9

Source: INEGI: ENIGH, 2008.

An additional factor that induces greater expenditure for the poorest areas is related to the outdated definition of the areas of local service, which has no technical or economic (cost-related) basis and artificially classifies a call as long distance, incurring higher charge. This particularly affects people in rural areas, where the largest share of their traffic consists of long distance calls. The higher expenditure on telecommunications services has an impact on the opportunity for the poorest sectors of the population to spend in other areas like health, nutrition, education, home maintenance, or make a higher investment in productive activities.

These results also suggest that the provision of telecommunications services under the aegis of “universal access” or “universal service” is lagging behind the unfulfilled demand for these services. This leaves the poorest sectors of the population dependent on the supply of services at market prices, and mostly wireless services which are more expensive and difficult for them to afford.

## 7. Conclusions

Almost 20 years after Mexico’s privatization of the telecommunications services by the incumbent operator, Telmex (Teléfonos de México), the premise of universal service is far from being fulfilled. Thus on average, only five out of

every 10 households have access to a basic telephone service and in some states such as Tabasco and Chiapas only three, while in Oaxaca only two (1.9) out of 10 households have access to a telephone line. Similarly, when analyzing expenditure on telecommunications services, the collected data has demonstrated that in contrast to what has been the goal of the universal service policy in Mexico, namely social inclusion and overcoming poverty, the telecommunications policies have become a regressive tax for Mexico’s poorest. These dramatic results are in direct contradiction with the fact that Telmex cheaply acquired radio bandwidth for social services by continually winning their public tenders, because regrettably, they later used them exclusively for commercial purposes.

In explaining the reasons for these poor results, the paper has also pointed out the shortcomings of the regulation in place and of the implementation of this regulation by the authorities, who are directly responsible for the failure to comply with the telecommunications service policies originally targeted at the poorest regions of Mexico. These shortcomings consist essentially of:

- restricting the application of services to communities with more than 500 inhabitants;
- allowing Telmex to choose between serving rural communities either by a public telephone booth or by a land line connection to households;
- allowing a policy far below the standard provided by the International Telecommunication Union;
- providing insufficient direct government subsidies for rural telecommunications services for communities with fewer than 500 inhabitants located in the poorest states in Mexico, who not only lack a basic telecommunications infrastructure but also present the lowest telephone density, seriously jeopardizing their right to use adult distant learning education;
- imposing strong limits on competition by establishing high barriers of entry for competitors in the mobile services market, which has allowed very high prices to be set for the end user and some of the highest among developing countries (as shown in Table 5 above).

These shortcomings show that universal access to telecommunications services in Mexico is a representative case of “regulatory capture” [10], [11], where the regulators and government authorities have been “captured” by the incumbent operator and have subordinated their regulatory power to a monopoly-based profit-seeking behavior.

Finally, although it is impossible to go back to the time of privatization, there is a long list of different regulations that have already been implemented by both developed and developing countries, which were created before the described policies for efficient universal access and service were imposed upon the incumbent operator’s licence permit. These policies have achieved a larger density and better distribu-

tion of services and some of the following regulations could thus now be applied with greater chances of success:

- An obligation to provide interconnection on a non-discriminatory basis, according to high quality standards and establishing charge estimates on the basis of long term incremental cost. This applies particularly to those networks with market power: Telmex and Telcel.
- Unbundling the local loop, thus allowing non-discriminatory access to sections of the incumbent operator’s network infrastructure.
- To guarantee a free flow of information on network capabilities, specifically on the points of presence and network architecture. This also applies particularly to Telmex and Telcel. This will contribute to creating incentives for new investment and the participation of new players, increasing coverage in regions previously lacking provision.
- To provide services across networks on a non-discriminatory basis, to high quality standards. It is known that international networks get better roaming services from Mexican networks than the cross-network services that national networks get between one another. This has been a barrier to entry for new players that have prevented investment and coverage in regions lacking coverage. It is worth reiterating that Telcel is the operator holding control of 75% of lines and operating the largest mobile infrastructure.
- To allow mobile virtual network operators (MVNO), which enable new players in the market to provide mobile phone services without necessarily having their own licensed bandwidth allocation, nor does it necessarily require them to have the entire infrastructure required to provide mobile telephone services.
- Re-defining the domain of local services, whose definition currently incurs an artificial increase in prices for so-called long distance calls. Without a technical basis for such a definition, this particularly affects those rural areas whose traffic is mainly long-distance based.
- Enforcing the declaration of Telmex as an operator with (monopolistic) market power and imposing upon it special requirements regarding quality, prices and information, so as to level the playing field by allowing other operators to enter the market and promote healthy competition.
- Closely monitoring Telmex and Telcel, in order to guarantee the proper delivery of telecommunications services to the poorer areas of Mexico.
- To ensure accountability and transparency in all legal processes relating to telecommunications services, regulation and competition. This not only provides legal certainty, but is a potential antidote for regulatory capture and corruption.

## References

- [1] S. Maddens, *Trends in Universal Access and Service Policies: Changing Policies to Accommodate Competition and Convergence*, in “Support for the Establishment of Harmonized Policies for the ICT Market in the ACP”, Geneva, ITU, 2005 [Online]. Available: [http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR09/doc/USPolicy\\_ITUEC.pdf](http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR09/doc/USPolicy_ITUEC.pdf)
- [2] ITU, “Universal access and service”, Module 4. ICT Regulation Toolkit, Section 1.1.2., 2008 [Online]. Available: <http://www.ictregulationtoolkit.org/en/Sections.html>
- [3] UIT, Informe sobre las soluciones innovadoras en materia de gestión y financiación de las políticas de servicio y acceso universales. Ginebra: UIT-D, Comisión de Estudio 1, 3er Periodo de Estudios (2002–2006), 2006 [Online]. Available: <http://www.itu.int/opb/publications.aspx?lang=es&parent=D-STGSG01.07.1&folder=D-STG-SG01.07.1-2006>
- [4] R. del Villar, “Competition and equity in telecommunications”, in *No Growth without Equity? Inequality, Interests and Competition in Mexico*, S. Levy and M. Walton, Eds. Washington: Palgrave MacMillan and The World Bank, 2009, pp. 321–364.
- [5] C. Casanueva and R. del Villar, “Infrastructure regulation difficulties: the basic telecommunications industry in Mexico (1990–2000)”, in *Critical Infrastructures State of the Art in Research and Application*, Wil A. H. Thissen and P. M. Herder, Eds. Dordrecht: Kluwer, 2003, pp. 179–207.
- [6] C. Casanueva, “The opening of Mexico’s telecommunications markets”, in *Telecommunications Reform in India*, R. Dossani. Connecticut: Quorum Books, 2002, pp. 277–296.
- [7] R. G. Noll, “Notes on privatizing infrastructure industries”, in *Conf. Telecommun. Reform in India*, Asia/Pacific Research Center, Stanford University, November 9 and 10, 2000 [Mimeo].
- [8] “Censo de Población y Vivienda de 1990” [Online]. Available: <http://www.inegi.org.mx/est/contenidos/proyectos/ccpv/cpv1990/default.aspx>
- [9] S. Wallsten, S. “Telecommunications privatization in developing countries: the real effects of exclusivity periods”, in *Conf. Telecommun. Reform in India*, Asia/Pacific Research Center, Stanford University, November 9 and 10, 2000 [Mimeo].
- [10] F. Boehm, “Corrupción y captura en la regulación de los servicios públicos”, *Revista de Economía Institucional*, vol. 7, no. 13, pp. 245–262, 2005.
- [11] S. Haber, *Crony Capitalism and Economic Growth in Latin America: Theory and Evidence*. Stanford: Hoover Institution, 2002.



**Cristina Casanueva-Reguart** received her Ph.D. in Development Studies from Stanford University in 1988 and holds an MA from Harvard University and a B.A. in sociology from the Universidad Iberoamericana, Mexico City. She worked in the Federal Government (1992–1998) where she was part of the Federal Competition Commission, Mexico’s anti trust agency. Working in the Economic Regulation Department, she focused on the analysis of telecommunications markets, participating in the interministerial group that defined the rules of interconnection. In the following administration she joined the Ministry of Communications, where she was involved in drafting the Federal Law on Telecommunications. In 1998 she returned to an academic position at the Monterrey Institute of Technology, in Mexico City, where she led the creation of an Interdisciplinary Masters Pro-

gram on the Management of Telecommunications. In 2001, Dr Casanueva joined the Universidad Iberoamericana where she has written numerous articles on telecommunications, regulation and public policy. In 2007–2008, she worked with the Ministry of Communications as a consultant in the field of universal telecommunications service provision.

e-mail: [ccasanueva@stanfordalumni.org](mailto:ccasanueva@stanfordalumni.org)

Universidad Iberoamericana  
Prolongación P. Reforma 880  
01210 Mexico D.F., Mexico



**Antonio Pita S.** obtained his Ph.D. and M.Sc. in solid and fluid mechanics from the University of Iowa in 1967 and 1962, and his B.S.E. from the Johns Hopkins University in 1960. He spent 15 years in teaching and research at the Tecnológico de Monterrey's campus in Monterrey, Mexico

and 25 years in R&D at Vitro, a Multinational Mexican-based glass company, including five years as Director of the Corporate R&D Center, 10 years as Technology Director for one of Vitro's Business Units and 10 years as a Senior Researcher. His last assignment was the establishment of Vitro's new R&D centre in Fribourg, Switzerland. Since then he has been Manager of University Relations for the Global Centre for Technology and Innovation that Cemex, a Multinational Mexican-based cement company, has in Brugg, Switzerland and is also Director of the Swiss Office for International Relations for the Tecnológico de Monterrey. He has published 12 articles, 25 Technical reports and holds 3 US and International Patents on Glass and Pre-Reacted Batches of Raw Materials for the Production of Glass Formulas.

e-mail: [antonio.pita@itesm.mx](mailto:antonio.pita@itesm.mx)

Cemex, Manager of University Relations  
for the Global Centre for Technology and Innovation  
Römerstrasse 13  
2555 Brugg, Switzerland