OECD Digital Economy Papers No. 191

Estimation of Loss in Consumer Surplus Resulting from Excessive Pricing of Telecommunication Services in Mexico

Marta Stryszowska

https://dx.doi.org/10.1787/5k9gtw51j4vb-en

OECD

OECD DIGITAL ECONOMY PAPERS

The OECD's Directorate for Science, Technology and Industry (STI) undertakes a wide range of activities to better understand how information and communication technologies (ICTs) contribute to sustainable economic growth, social well-being and the overall shift toward knowledge-based societies.

The OECD Digital Economy Papers series covers a broad range of ICT-related issues, both technical and analytical in nature, and makes selected studies available to a wider readership. It includes *policy reports*, which are officially declassified by an OECD committee, and occasionally *working papers*, which are meant to share early knowledge and elicit feedback. This document is a working paper.

Working papers are generally only available in their original language – English or French – with a brief summary in the other. The opinions expressed in these papers are the sole responsibility of the author(s) and do not necessarily reflect those of the OECD or of the governments of its member countries.

STI also publishes the OECD Science, Technology and Industry Working Paper series, which covers a broad range of themes related to OECD's research and policy work on knowledge-based sources of economic and social growth and, more specifically, on the translation of science and technology into innovation.

OECD Digital Economy Papers and
STI Working Papers are available at:
www.oecd.org/sti/working-papers

OECD/OCDE, 2012

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Applications for permission to reproduce or translate all or part of this material should be made to:
OECD Publications, 2 rue André-Pascal, 75775 Paris, Cedex 16, France; e-mail: **rights@oecd.org**

ESTIMATION OF LOSS IN CONSUMER SURPLUS RESULTING FROM EXCESSIVE PRICING OF TELECOMMUNICATION SERVICES IN MEXICO

Marta Stryszowska
Microeconomix, France

ABSTRACT

The present study evaluates the loss in consumer surplus caused by the low degree of competition in the Mexican telecommunication sector which results in relatively high prices, and also leads to lower levels of consumption across the range of telecommunication services. Econometric techniques are used in order to estimate the prices for telecommunication services and the corresponding numbers of subscriptions to telecommunication services that would have been observed in Mexico if there had been more competition in the Mexican telecommunication sector. The estimation relies on cross-country panel data from OECD countries. Estimates are undertaken for mobile and fixed telecommunication services and broadband services. The consumer harm in Mexico is estimated at USD 129.2 billion, or an average of USD 25.8 billion per year in terms of purchasing power parity over the period 2005-09. The latter amount is equivalent to 1.8% of Mexican GDP per year.

RÉSUMÉ

Cette étude consiste en une évaluation de la perte de surplus du consommateur due à la faible concurrence dans le secteur des télécommunications au Mexique, qui se traduit par des prix relativement élevés, et qui entraine également une baisse des niveaux de consommation de toute la gamme des services de télécommunications. Elle a recours à des techniques économétriques pour estimer les prix des services de télécommunications et le nombre des abonnements à ces services qui auraient été souscrits au Mexique si le secteur national des télécommunications avait été soumis à une concurrence plus rude. Ses estimations ont été établies sur la base de données de panel internationales émanant des pays de l'OCDE, et concernent les services de télécommunications fixes et mobiles, ainsi que les services à haut débit. Les atteintes au consommateur au Mexique sont estimées à 129.2 milliards USD, soit une moyenne de 25.8 milliards USD par an en termes de parités de pouvoir d'achat sur la période allant de 2005 à 2009. Ce deuxième montant équivaut à 1.8 % du PIB du Mexique par an.

EXECUTIVE SUMMARY

The present study evaluates the loss in consumer surplus caused by a supposedly low degree of competition in the Mexican telecommunication sector. Econometric techniques are used in order to estimate the prices for telecommunication services and the corresponding numbers of subscriptions to telecommunication services that would have been observed in Mexico if there had been more competition in the Mexican telecommunication sector. The estimation applies the 3SLS technique to OECD telecommunication pricing data (price baskets for the mobile and fixed telecommunication and the evolution of a representative broadband subscription over time for broadband), OECD data on the number of subscriptions (number of fixed paths, number of mobile subscriptions and number of broadband subscriptions) and OECD/World Bank data concerning various factors affecting the number of subscriptions or the costs of those subscriptions (such as for example size of the population, age distribution, level of education, degree of urbanisation and population density).

The study estimates the loss in consumer surplus resulting from a potentially low degree of competition in the Mexican telecommunication sector using a three-step approach. It first estimates the demand function and the price function using the available data for all the countries except Mexico. Second, it extrapolates the estimated demand function and price function to Mexican telecommunication sector in order to estimate prices and numbers of subscriptions that would have occurred in other OECD countries if they have had market conditions similar to Mexico. Third, it estimates the loss in consumer surplus in the Mexican telecommunication sector by comparing the estimated prices and numbers of subscriptions to the actual values observed in Mexico.

The average loss in consumer surplus in the Mexican telecommunication sector in 2005-2009 is estimated at USD PPP 25 835 million (1.8% of Mexican GDP). The estimated loss in consumer surplus consists of two components: loss in consumer surplus caused by overcharging existing consumers and loss in consumer surplus caused by unrealised subscriptions. The first component of the estimated loss in consumer surplus (consumer overcharge) constitutes 52% of the total loss in consumer surplus (USD PPP 13 386 million). The second component (lost subscriptions) amounts for 48% of the total loss in consumer surplus (USD PPP 12 449 million).

The average loss in consumer surplus in the Mexican fixed telephony sector in 2005-2009 is estimated at USD PPP 13 549 million (0.9% of Mexican GDP). The average estimated loss in consumer surplus in the Mexican mobile telephony sector in 2005-2009 amounts to USD PPP 10 007 million (0.7% of Mexican GDP). The average estimated loss in consumer sector in the Mexican broadband sector in 2005-2009 is USD PPP 4 988 million (0.3% of Mexican GDP).

TABLE OF CONTENT

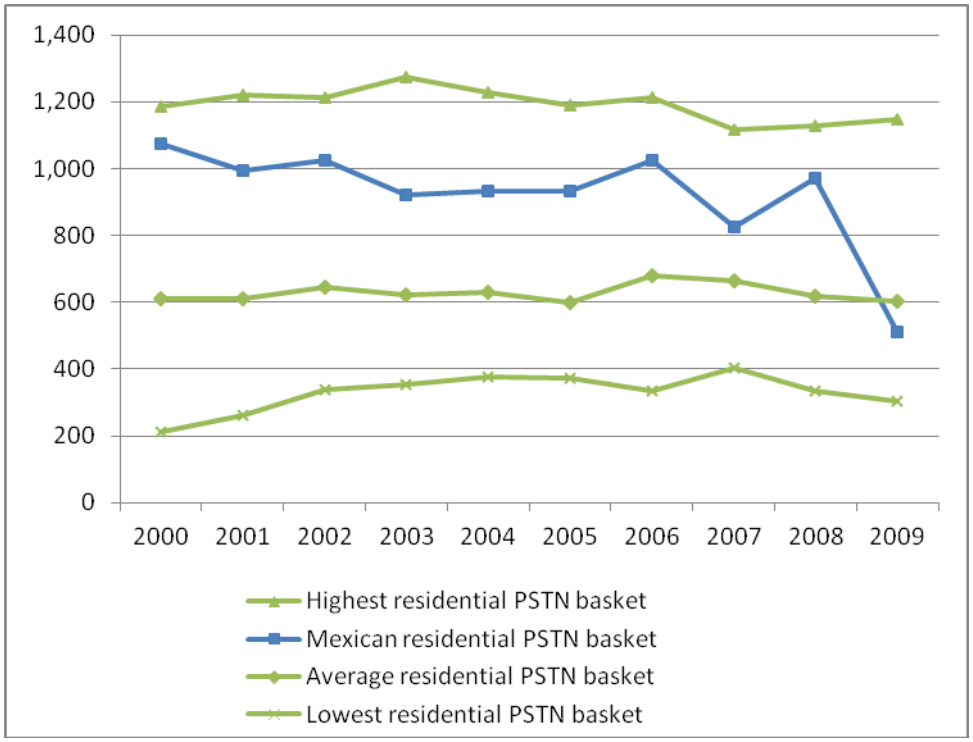
INTRODUCTION AND SUMMARY OF MAIN FINDINGS 6
1 THE METHODOLOGY 13
2 THE DATA 17
2.1 Pricing data 17
2.1.1 Fixed telecommunication 17
2.1.2 Mobile telecommunication 18
2.1.3 Broadband 20
2.2 Volume data 22
2.2.1 Fixed telecommunication 22
2.2.2 Mobile telecommunication 22
2.2.3 Broadband 23
2.3 Variables affecting volume of subscriptions to telecommunication services 24
2.3.1 Population 24
2.3.2 GDP per capita 25
2.3.3 Age distribution 25
2.3.4 Education 26
2.3.5 Female rate 27
2.4 Variables affecting expenditures related to the subscriptions to telecommunication services 27
2.4.1 Geographical variables 27
2.4.2 Level of potential competition 29
2.5 Other control variables 31
2.6 Overview of all variables 36
3 ESTIMATION OF LOSS IN CONSUMER SURPLUS 37
3.1 Estimation of lost consumer surplus in Mexican fixed telephony sector 37
3.1.1 The methodology to estimate prices of fixed telecommunication services in Mexico 37
3.1.2 The methodology used to estimate the fixed telecommunication penetration in Mexico . 38
3.1.3 Estimation of price and demand equations 40
3.1.4 Estimated but-for prices 43
3.1.5 Estimated but-for volumes 46
3.2 Estimation of lost consumer surplus in Mexican mobile telephony sector 50
3.2.1 Estimation strategy for price for mobile telecommunication services 50
3.2.2 Estimation strategy for number for mobile telecommunication services 51
3.2.3 Estimated price and demand equations 52
3.2.4 Estimated but-for prices 55
3.2.5 Estimated but-for volumes 58
3.3 Estimation of lost consumer surplus in Mexican broadband sector 61
3.3.1 Estimation strategy for prices of broadband subscriptions 61
3.3.2 Estimation strategy for broadband penetration 62
3.3.3 Estimated price and demand equations 64
3.3.4 Estimated but-for prices 66
3.3.5 Estimated but-for volumes 68
ANNEX A 73
ANNEX B 85
ANNEX C 93

INTRODUCTION AND SUMMARY OF MAIN FINDINGS

The Mexican telecommunication sector appears to be characterised by high prices and low penetration rates. As illustrated by Figure 1, the average OECD residential PSTN basket (in USD PPP) in Mexico was well above the OECD average in years 2000-2008 and dropped below the average in 2009. Similarly, as illustrated by Figure 2, the average mobile basket (in USD PPP) in Mexico exceeded the OECD average in 2000-2009. Last but not least, as illustrated by Figure 3, average prices for broadband (DSL and cable) subscriptions in Mexico appear to be also far away from the OECD minimum.

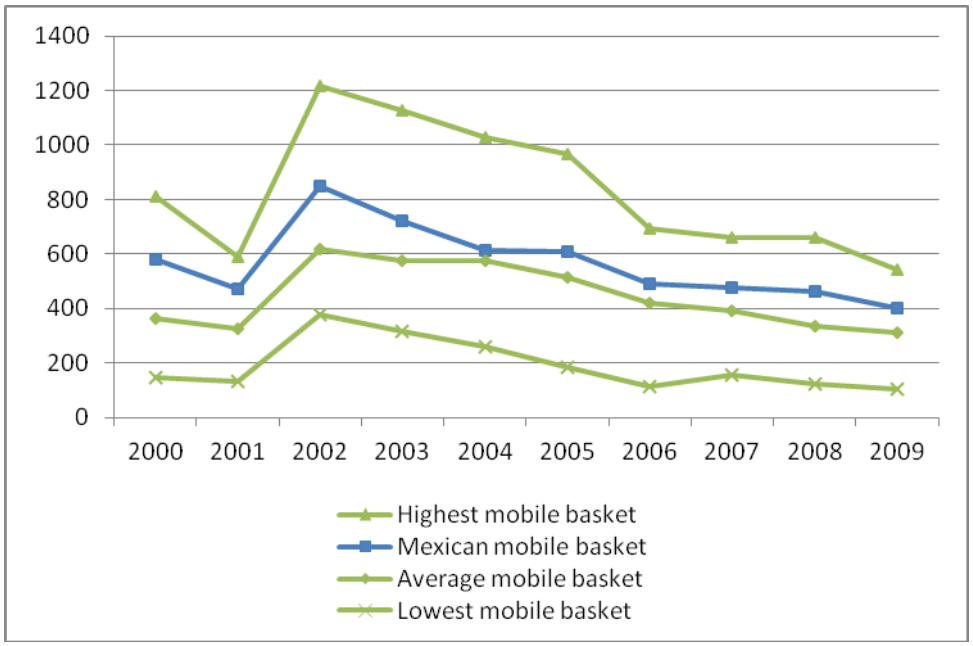
The penetration of telecommunication services in Mexico appears particularly low as compared to the other OECD countries. As illustrated by Figure 4, the number of fixed access paths per capita in Mexico was quite close to the lowest observed level among OECD countries in 2000-2004 and constituted the OECD minimum in 2005-2008. Similarly, as illustrated by Figure 5, the number of mobile subscriptions per capita in Mexico constituted the OECD minimum in 2000-2006 and was slightly above the OECD minimum in 2007-2009. Last but not least, as illustrated by Figure 6, the number of broadband subscriptions (DSL and cable) was almost identical to the OECD minimum in 2000-2009.

Figure 1. Average OECD residential PSTN basket (in USD PPP) in Mexico vs. the observed price level in OECD countries



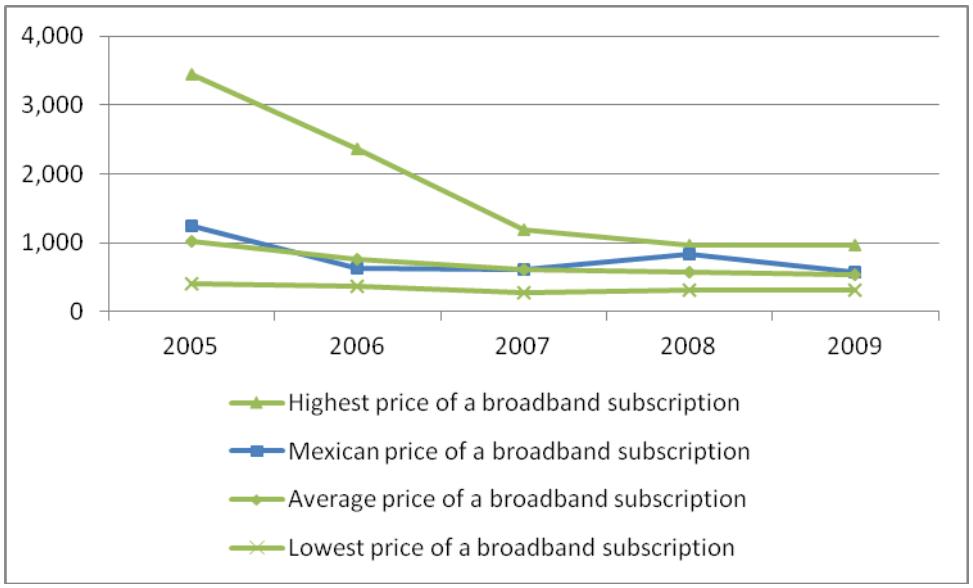
Source: OECD and World Bank data analysed by Microeconomix

Figure 2. Average OECD mobile basket (in USD PPP) in Mexico vs. the observed price level in OECD countries



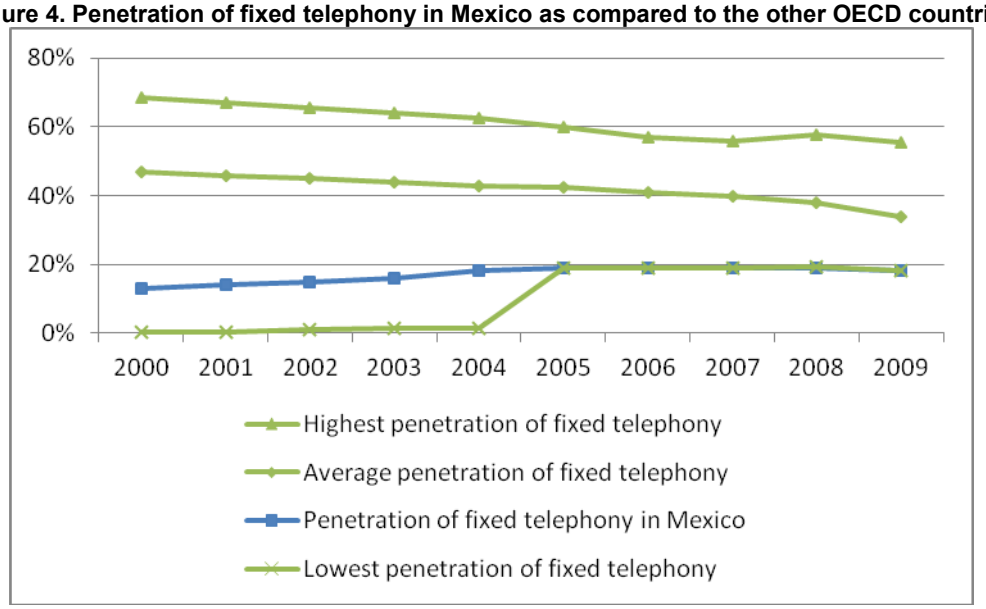
Source: OECD and World Bank data analysed by Microeconomix

Figure 3. Average OECD prices for broadband subscriptions (DSL and cable) in Mexico vs. the observed price level in OECD countries in USD PPP



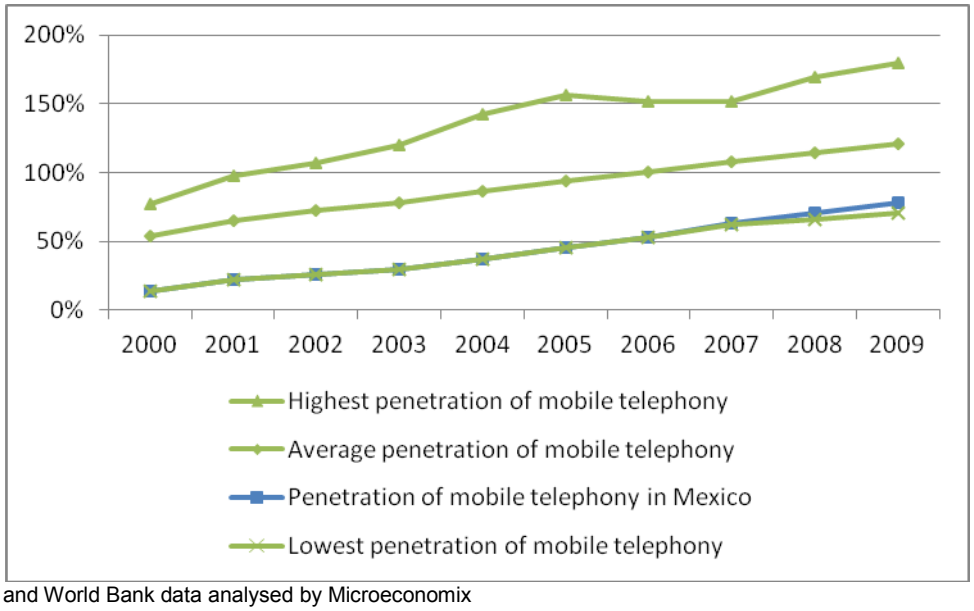
Source: OECD and World Bank data analysed by Microeconomix

Figure 4. Penetration of fixed telephony in Mexico as compared to the other OECD countries



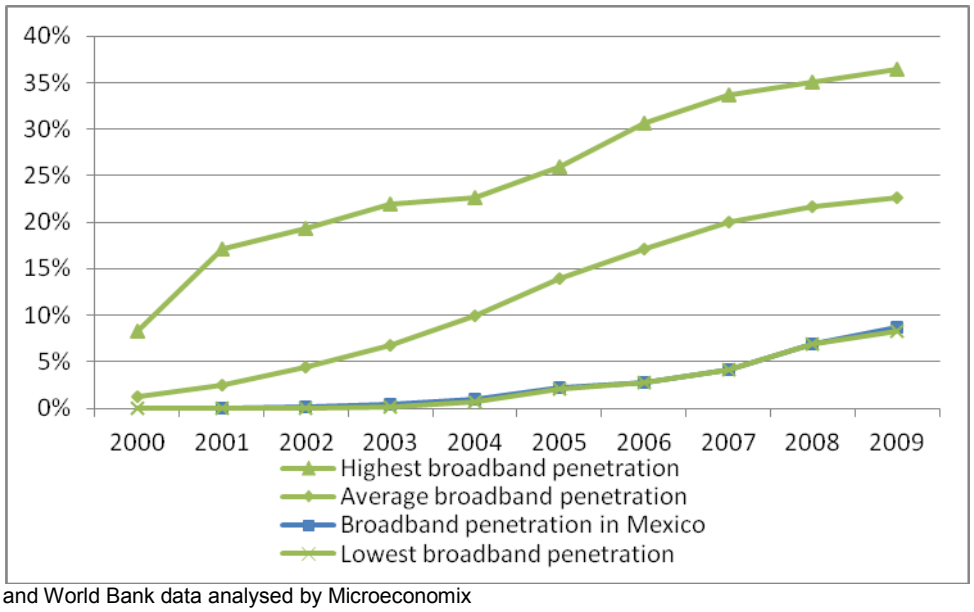
Source: OECD and World Bank data analysed by Microeconomix

Figure 5. Penetration of mobile telephony in Mexico as compared to the other OECD countries



Source: OECD and World Bank data analysed by Microeconomix

Figure 6. Broadband penetration in Mexico as compared to the other OECD countries



Source: OECD and World Bank data analysed by Microeconomix

Simple international comparisons may be insufficient to evaluate whether prices for telecommunication services in Mexico were excessive and whether penetration rates of telecommunication services in Mexico were too low. Prices and volumes depend on a myriad of factors that are often country specific. For example, prices of telecommunication services may depend on local geographic conditions and the number of subscriptions to telecommunication services may depend on the education level in a given country. Therefore, differences in prices and penetration rates between Mexico and other OECD countries could at least be partially explained by differences in relevant characteristics of these countries.

This project goes further than simple international comparisons in order to estimate the loss in consumer surplus inflicted on consumers by high prices for telecommunication services observed in Mexico by employing econometric regression techniques. In particular, by estimating volumes of telecommunication services and prices of telecommunication services that would have been realised under local Mexican market conditions if there had been more competition in the Mexican telecommunication sector and, comparing them to the actual values of prices and volumes, it evaluates whether prices were indeed excessive and numbers of subscriptions were indeed low and estimates the corresponding loss in consumer surplus.

The present study estimates two components of the loss in consumer surplus: *i)* the loss in consumer surplus incurred by existing consumers; and *ii)* the loss in consumer surplus resulting from unrealised subscriptions. The first component is related to the consumer overcharge experienced by the existing users of telecommunication services in Mexico. The second component concerns the unrealised telecommunication penetration because of the potential anticompetitive behaviour in the Mexican telecommunication sector.

The estimation method consists of applying a 3SLS technique to data concerning all countries but Mexico in order to estimate a system of equations including a demand equation and a price equation. The estimated equations are next extrapolated to the data concerning Mexico in order to estimate prices and numbers of subscriptions that would have been observed in Mexico if there had been more competition in their telecommunication sector. The loss in consumer surplus is then estimated by comparing estimated prices and volumes with actual prices and volumes.

In this method, more competitive prices and corresponding numbers of subscriptions are estimated for Mexico by supposing that the level of actual competition in the Mexican telecommunication sector would be similar to the average level of competition in telecommunication sector in any other OECD country. Estimated prices and volumes do not hence correspond to prices and volumes that would have been obtained in Mexico, if there was perfect competition in Mexican telecommunication sector, but indicate the prices and volumes that would have been achieved in Mexico in a given year if its telecommunication sector had been characterised by the average achievable level of competition.

The estimated values of the loss in consumer surplus are presented in the tables below. In 2005-2009, the average annual loss in consumer surplus resulting from the low degree of competition in the Mexican telecommunication sector is estimated at USD PPP 25 835 million (1.8% of Mexican GDP) including the loss in consumer surplus suffered by the existing consumers, estimated on average at USD PPP 13 386 million (0.9% of Mexican GDP), and the average loss in consumer surplus due to unrealised transactions, estimated on average at USD PPP 12 449 million (0.9% of Mexican GDP). The average estimated loss in consumer surplus in Mexican fixed telephony amounts to USD PPP 13 549 million (0.9% of Mexican GDP). The estimated average loss in consumer surplus incurred in the market in the Mexican mobile telecommunication sector accounts for USD PPP 10 007 million (0.7% of Mexican GDP). The estimated average loss in consumer surplus for Mexican broadband (DSL and cable) is equal to 4 USD PPP 988 million (0.3% of Mexican GDP).

Table 1. Estimated average annual loss in consumer surplus (in million USD PPP) resulting from excessive pricing of telecommunication services in Mexico in 2005-2009

Type of telecommunication	Overcharge of existing consumers	Unrealised subscriptions	Total
Fixed telecommunication	6 510	7 039	13 549
Mobile telecommunication	7 260	2 747	10 007
Broadband	918[1]	4 070	4 988
Total	13 386	12 449	25 835

[1] The present study does not quantify the loss in consumer surplus suffered by the existing consumers because of low broadband speed. Low competitiveness of Mexican broadband is mainly reflected in broadband speed. While prices for broadband subscriptions in Mexico do not appear very high as compared to the average level observed in OECD countries (see Figure 3), the offered broadband speed in Mexico appears to be the lowest among the OECD counties. Therefore, the increased competiveness of Mexican broadband would have likely translated into significantly increased broadband speed and somewhat lower prices for broadband subscriptions. The loss in consumer surplus suffered by the existing consumers thus decomposes into two components: (1) loss suffered by the existing consumers because of excessive prices of broadband subscriptions and (2) loss suffered by the existing consumers suffered by the existing consumers because of very low broadband speed. The present study quantifies only the first component.

Source: OECD and World Bank data analysed by Microeconomix

Table 2. Estimated average annual loss in consumer surplus (expressed as a percentage of Mexican GDP) resulting from excessive pricing of telecommunication services in Mexico in 2005-2009

Type of telecommunication	Overcharge of existing consumers	Unrealised subscriptions	Total
Fixed telecommunication	0.4%	0.5%	0.9%
Mobile telecommunication	0.5%	0.2%	0.7%
Broadband	0.1%	0.3%	0.3%
Total	0.9%	0.9%	1.8%

Source: OECD and World Bank data analysed by Microeconomix

Table 3. Estimated total loss in consumer surplus (in million USD PPP) resulting from excessive pricing of telecommunication services in Mexico in 2000-2009

Year	Fixed telecommunication	Mobile telecommunication	Broadband (DSL and cable)	Total
2000	14 763	11 116	na	25 879
2001	14 173	10 339	na	24 512
2002	14 855	20 548	na	35 403
2003	13 530	16 043	na	29 573
2004	13 818	14 344	na	28 162
Average 2000-2004	14 228	14 478	na	28 706
2005	14 276	13 678	6 880	34 834
2006	15 507	10 470	5 055	31 032
2007	11 313	7 815	4 426	23 554
2008	13 102	7 288	5 165	25 555
2009	na	10 783	3 415	14 198
Average 2005-2009	13 549	10 007	4 988	25 835
Average 2000-2009	13 926	12 242	4 988	27 270

Source: OECD and World Bank data analysed by Microeconomix

Table 4. Estimated total loss in consumer surplus (expressed as a percentage of Mexican GDP) resulting from excessive pricing of telecommunication services in Mexico in 2000-2009

Year	Fixed telecommunication	Mobile telecommunication	Broadband (DSL and cable)	Total
2000	1.5%	1.1%	na	2.6%
2001	1.4%	1.0%	na	2.4%
2002	1.4%	2.0%	na	3.4%
2003	1.2%	1.4%	na	2.7%
2004	1.2%	1.2%	na	2.4%
Average 2000-2004	1.3%	1.4%	na	2.7%
2005	1.1%	1.1%	0.5%	2.7%
2006	1.1%	0.7%	0.4%	2.2%
2007	0.7%	0.5%	0.3%	1.5%
2008	0.8%	0.4%	0.3%	1.6%
2009	na	0.7%	0.2%	0.9%
Average 2005-2009	0.9%	0.7%	0.3%	1.8%
Average 2000-2009	1.2%	1.0%	0.3%	2.2%

Source: OECD and World Bank data analysed by Microeconomix

Table 5. Estimated loss in consumer surplus (in million USD PPP) suffered by existing consumers of telecommunication services in Mexico in 2000-2009

Year	Fixed telecommunication	Mobile telecommunication	Broadband (DSL and cable)	Total
2000	6 331	3 184	na	9 515
2001	5 999	5 697	na	11 696
2002	6 391	12 274	na	18 665
2003	5 717	5 980	na	11 697
2004	6 373	6 528	na	12 901
Average 2000-2004	6 162	6 733	na	12 895

2005	7 432	7 077	700	15 209
2006	7 858	6 685	0	14 543
2007	4 214	5 585	0	9 799
2008	6 536	6 171	2 615	15 322
2009	na	10 783	1 274	12 057
Average 2005-2009	6 510	7 260	918	13 386
Average 2000-2009	6 317	6 996	918	13 140

Source: OECD and World Bank data analysed by Microeconomix

Table 6. Estimated loss in consumer surplus (expressed as a percentage of Mexican GDP) suffered by existing consumers of telecommunication services in Mexico in 2000-2009

Year	Fixed telecommunication	Mobile telecommunication	Broadband (DSL and cable)	Total
2000	0.6%	0.3%	na	1.0%
2001	0.6%	0.6%	na	1.2%
2002	0.6%	1.2%	na	1.8%
2003	0.5%	0.5%	na	1.1%
2004	0.5%	0.5%	na	1.1%
Average 2000-2004	0.6%	0.6%	na	1.2%
2005	0.6%	0.5%	0.1%	1.2%
2006	0.5%	0.5%	0.0%	1.0%
2007	0.3%	0.4%	0.0%	0.6%
2008	0.4%	0.4%	0.2%	0.9%
2009	na	0.7%	0.1%	0.8%
Average 2005-2009	0.4%	0.5%	0.1%	0.9%
Average 2000-2009	0.5%	0.5%	0.1%	1.1%

Source: OECD and World Bank data analysed by Microeconomix

Table 7. Estimated loss in consumer surplus (in million USD PPP) due to unrealised subscriptions to telecommunication services in Mexico in 2000-2009

Year	Fixed telecommunication	Mobile telecommunication	Broadband (DSL and cable)	Total
2000	8 432	7 932	na	16 364
2001	8 174	4 641	na	12 815
2002	8 463	8 274	na	16 737
2003	7 813	10 063	na	17 876
2004	7 445	7 817	na	15 262
Average 2000-2004	8 065	7 745	na	15 811
2005	6 844	6 602	6 180	19 626
2006	7 649	3 785	5 055	16 489
2007	7 099	2 230	4 426	13 755
2008	6 565	1 117	2 550	10 232
2009	na	0	2 141	2 141
Average 2005-2009	7 039	2 747	4 070	12 449
Average 2000-2009	7 609	5 829	4 070	14 130

Source: OECD and World Bank data analysed by Microeconomix

Table 8. Estimated loss in consumer surplus (expressed as a percentage of Mexican GDP) due to unrealized subscriptions to telecommunication services in Mexico in 2000-2009

Year	Fixed telecommunication	Mobile telecommunication	Broadband (DSL and cable)	Total
2000	0.9%	0.8%	na	1.7%
2001	0.8%	0.5%	na	1.3%
2002	0.8%	0.8%	na	1.6%
2003	0.7%	0.9%	na	1.6%
2004	0.6%	0.7%	na	1.3%
Average 2000-2004	0.8%	0.7%	na	1.5%
2005	0.5%	0.5%	0.5%	1.5%
2006	0.5%	0.3%	0.4%	1.1%
2007	0.5%	0.1%	0.3%	0.9%
2008	0.4%	0.1%	0.2%	0.6%
2009	na	0	0.1%	0.1%
Average 2005-2009	0.5%	0.2%	0.3%	0.9%
Average 2000-2009	0.6%	0.5%	0.3%	1.2%

Source: OECD and World Bank data analysed by Microeconomix

The methodology

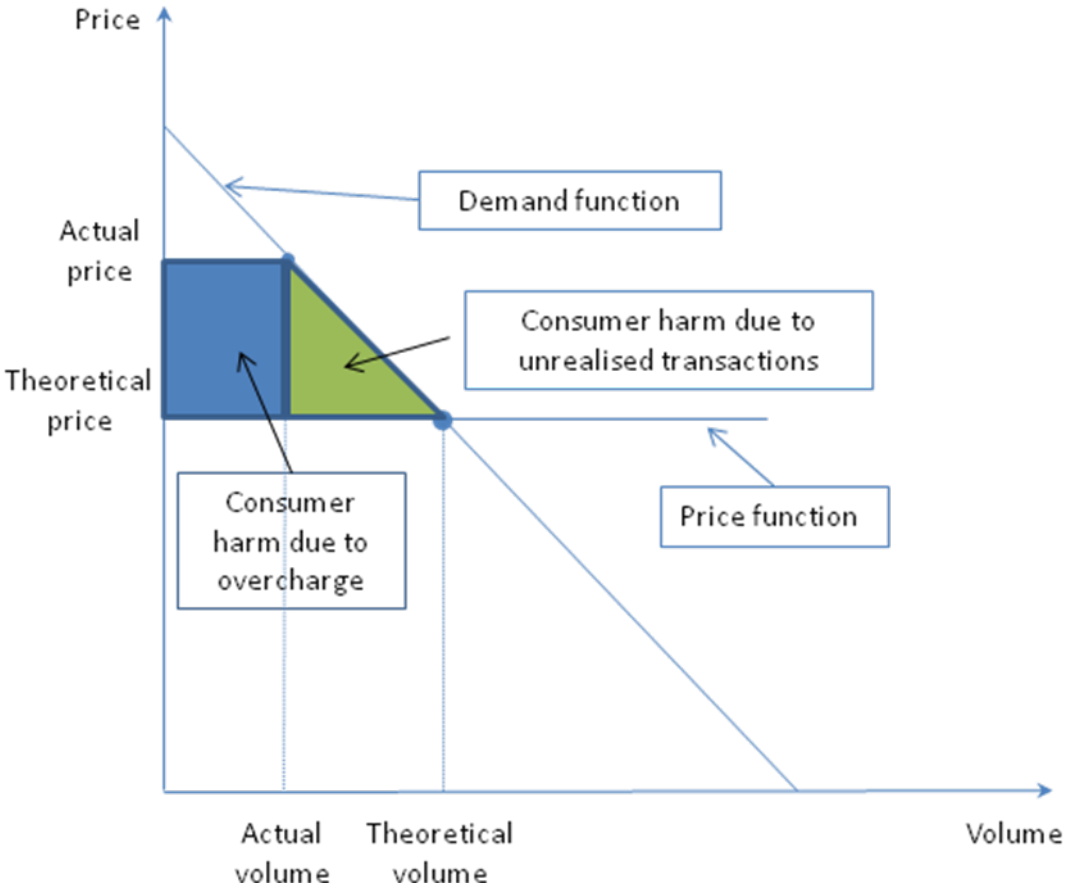
Loss in consumer surplus resulting from excessive pricing can be decomposed into two elements: *i)* overcharge of the existing customers and *ii)* consumer loss related to unrealised subscriptions. The first element corresponds to the savings that existing customers would have made in the absence of excessive pricing. The second element is related to the potential gain that would have been realised by consumers who did not buy a given service, but would have bought it, if its price had been lower.

The present study uses regression techniques to estimate the overcharge of the existing customers by estimating the non-excessive price that could have been implemented under local market conditions and comparing it to the actual price. The difference between this theoretical price and the actual price gives an estimate of the overcharge that applies to a single consumer. The overcharge multiplied by the total volume of realised transaction returns the first element of the loss in consumer surplus.

The consumer loss related to the unrealised subscriptions is estimated by calculating the non-excessive price and the corresponding volume and comparing them to the actual volume and price. The difference between this theoretical volume and the actual volume gives an estimation of the volume of the unrealised subscriptions. The volume of the unrealised combined with the theoretical price returns the second element of the loss in consumer surplus.

The calculation of loss in consumer surplus is illustrated in the following figure. First, the demand function and the price function are estimated. The intersection of these two functions gives an estimation of the theoretical prices and volumes. Next, these theoretical prices and volumes are compared to actual prices and volumes in order to evaluate the loss in consumer surplus due to overcharge and the loss in consumer surplus due to unrealised subscriptions. In particular, the loss in consumer surplus due to overcharge is estimated as a difference between the actual price and the theoretical price multiplied by the volume (grey rectangle in the figure), while the loss in consumer surplus due to unrealised subscriptions is given by the difference between the theoretical volume and the actual volume multiplied by the theoretical price and divided by two (grey triangle in the figure).

Figure 7. Illustration of the estimation technique



The estimation technique uses the expenditure of a representative consumer as a measure of price. Markets for telecommunication services are characterised by a multitude of prices (for example a flat fee for a subscription and a price per minute). These different prices may be aggregated to create a representative expenditure for telecommunication services. The created representative expenditure may be then used to estimate the actual consumption (the representative expenditure multiplied by the number of consumers).

The estimation of the loss in consumer surplus resulting from high prices for telecommunication services in Mexico uses the three-stage least squares (3SLS)[1] regression technique to estimate the representative consumer expenditures for telecommunication services and the corresponding demand. In particular, a system of simultaneous equations (including demand equation and price equation) is jointly estimated. The demand for telecommunication services is estimated as a function of the expenditure of a representative consumer and several control variables (such as for example age, education, size of population), while the expenditure of a representative consumer is estimated as a function of several other control variables (such as for example the measure of barriers to effective competition, urbanisation indicator or population density).[2]

Estimated but-for prices are prices that would have been observed in other OECD countries if they had had the same local conditions as Mexico. In particular, the price level and the number of subscriptions in Mexico are predicted using the model estimated for the other countries and the actual conditions in

Mexico. Mexico is hence not compared to the most competitive telecommunication sectors among OECD countries but to average telecommunication sectors among all other OECD countries. The compared countries include countries in which abuses of dominance or cartels have been detected in telecommunication sectors. The inclusion of those countries allows to better highlight excessive pricing of telecommunication services in Mexico: the fact that estimated but-for prices for telecommunication services in Mexico are lower than the actual prices suggests that prices of telecommunication services in Mexico are very high even as compared to telecommunication sectors in which market power abuses have been observed. The estimation strategy thus appears very conservative.

But-for prices are estimated on the basis of local market conditions including geographical conditions (for example country's size) and market conditions (for example level of regulatory barriers). It seems reasonable to expect that the price function should depend on the costs and the level of competition. Both of those components are incorporated in the price function. In particular, for each type of telecommunication (fixe, mobile or broadband), price is regressed on various combinations of factors potentially determining costs of provision of telecommunication services (such as urbanisation rate, density, country's size and the percentage of landmass used by cumulative 50% of the population), the variable indicating the level of potential competition (for example the OECD Indicator of Regulation Impact for post and telecommunications) and various time effects. The variables identified as best-fitted have been retained in the price equation that is used to predict but-for prices in Mexico.

But-for prices are estimated under the assumption that Mexico maintains its current market structure of the telecommunication sector but observes less anticompetitive behaviour in this market. The factors potentially facilitating market power abuses (such as for example the level of regulatory barriers) are assumed to remain at the same level, but the existing operators are supposed to less abuse their market powers.[3]

In an ideal world, a variable perfectly measuring the level of competition in the telecommunication sector could be used in the price equation. The variable used in the estimation (the OECD Indicator of Regulation Impact for Post and telecommunications or number of mobile operators[4]) likely captures factors affecting potential competition (such as for example presence of entry to barriers) but may be less effective in detecting potential antitrust abuses. It may also be unable to differentiate countries with respect to the enforcement of competition law or efficiency of sector regulation and their consequences concerning deterrence of antitrust violations or price levels. Therefore the inclusion of countries characterised by a low degree of competition in the data used for the estimation of price equation may wrongly upwardly bias the results. On the other hand, the exclusion of the data potentially introducing the upward bias may eliminate useful information on other effects (such as for example the relationship between the country's size and the price). What's more, as the data clearly separating countries according to the level of the competition in their fixed telecommunication sectors may not exist, it may be very difficult to decide which countries to exclude from the sample. The present study takes a conservative approach by taking all the countries but Mexico (which is suspected to be characterised by low degree of competition in fixed telecommunication sector) to estimate the price equation.

Estimated but-for volumes indicate volumes of telecommunication services that would have been observed in Mexico if the actual prices had been equal to but-for prices. They thus illustrate the increased penetration of telecommunication services that would have had taken place in Mexico if there had been less anticompetitive behaviour. They take into account several factors potentially affecting the demand for telecommunication services (such as for example age, education and level of GDP).

The presence of statistically significant time effects affecting the price equation and the demand equation has been tested. In particular, various time variables have been introduced in estimated equations. Their goal is to check for potential changes in the methodology in data collection or trends explained by

the variables not included in the model. Time variables identified as best-fitted have been retained in the system of equations used to estimate but-for prices and volumes in Mexico.

Country dummies have not been used in price equations and demand equations because the estimated system (including the price equation and the demand equation) was identified using the data for all OECD countries except Mexico. Data for Mexico has been excluded from the data used for the estimation, as it is likely affected by the uncompetitive behaviour in the Mexican fixed telephony sector which would bias the estimation results. It has been hence impossible to identify fixed effects for Mexico that would have been needed to extrapolate the identified price and demand equations with fixed country effects to the data concerning Mexico. Therefore, the estimated price and demand equations could not include country dummies.

THE DATA

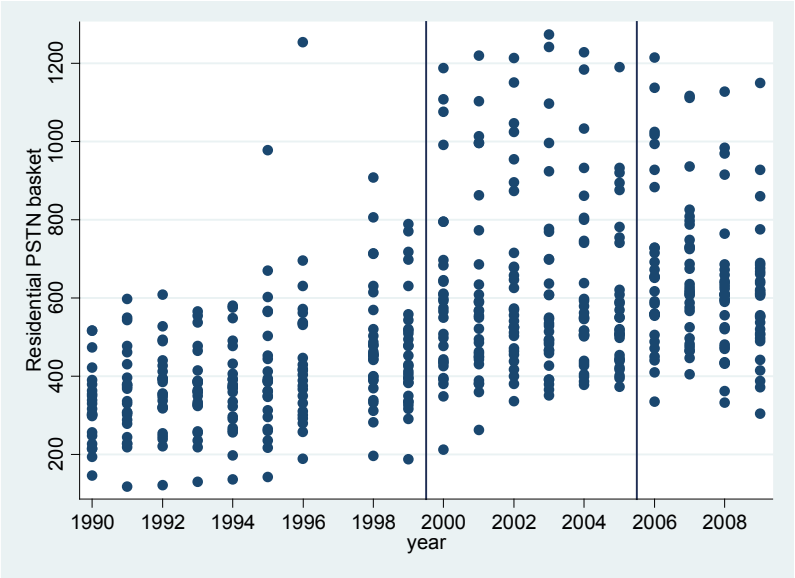
Pricing data

Fixed telecommunication

The estimation of loss in consumer surplus uses the average OECD residential PSTN basket (in USD PPP) for 1990-2009. In particular, the average price basket calculated on the basis of all available baskets for a given year is used. This average price basket is equal to the "OECD telephone tariff basket for residential users" for 1990-1996, "OECD basket of national and international residential telephone charges" for 1998-1999, "OECD composite basket of residential telephone charges" for 2000-2005 and the average of "OECD residential basket, low usage", "OECD residential basket, medium usage" and "OECD residential basket, high usage" for 2006-2009.

As explained in "OECD telecommunications basket definitions as of June 2000", and "Revised OECD price benchmarking baskets 2006", the methodology for collecting the OECD residential PSTN basket has changed several times since 1990. The OECD collected the PSTN basket for a number of calls that was adjusted annually in 1990-1999 and was at a fixed level in 2000-2006. In 2006-2009, the OECD residential PSTN basket was collected for three different consumption levels: low, medium and high. As illustrated in the figure below, the first major change in the basket methodology (in 2000) appears to have a stronger effect on the collected statistics than the second major change in the basket technology.

Figure 8. OECD average residential PSTN basket (in USD PPP) in 1990-2009



Source: OECD data analysed by Microeconomix

The summary statistics for the collected average OECD residential PSTN basket (in USD PPP) are presented in the table below. Before the first major revision of the methodology in 2000, the average PSTN residential basket was at USD PPP 404. After the first major revision and before the second major revision in 2006, it was at USD PPP 619. Finally after the second major revision, it was at USD PPP 641.

Table 9. Summary statistics for the average OECD residential PSTN basket (in USD PPP)

Year	Mean	Standard deviation	Min	Max	N
1990	324	98	147	516	23
1991	354	118	118	598	23
1992	365	109	122	609	23
1993	366	108	131	566	23
1994	370	114	136	581	23
1995	413	175	143	978	24
1996	453	212	190	1253	24
1998	483	156	197	907	29
1999	467	146	189	789	29
1990-1999	**404**	**151**	**118**	**1 253**	**221**
2000	609	237	213	1187	29
2001	609	243	263	1219	30
2002	645	237	337	1213	30
2003	622	252	352	1273	30
2004	629	229	378	1227	30
2005	601	199	373	1190	30
2000-2005	**619**	**231**	**213**	**1273**	**179**
2006	679	223	335	1214	30
2007	663	178	405	1116	30
2008	619	183	333	1128	30
2009	603	170	305	1149	30
2006-2009	**641**	**190**	**305**	**1 214**	**120**
Total	**533**	**220**	**118**	**1273**	**520**

Source: OECD data analysed by Microeconomix

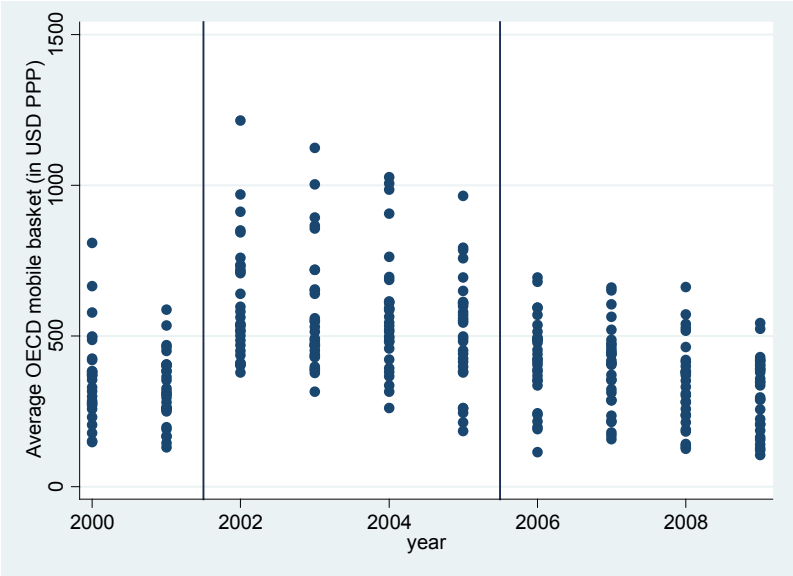
Mobile telecommunication

The estimation of the loss in consumer surplus in mobile telephony is based on the average OECD mobile basket (in USD PPP) for 2000-2009. This average price basket is equal to "Basket of consumer mobile telephone charges" for 2000-2001 and to the average of OECD "Basket of low user mobile telephone charges", "OECD Basket of medium user mobile telephone charges" and "OECD Basket of high user mobile telephone charges" for 2002-2009.

As detailed in the documents "OECD Telecommunications Basket definitions as of June 2000", "A revision of the OECD Mobile Telephony baskets, based on information received at and after the OECD/Teligen meeting on the mobile baskets in October 2001" and "revised OECD Price Benchmarking Baskets 2006", the methodology for collecting the OECD mobile price baskets changed twice (for the first time in 2002 and for the second time in 2006). In the years 2000-2001, the OECD collected only one mobile price basket. In the years 2002-2009, the OECD collected mobile price baskets for three different usage levels (low, medium and high).

As the figure below shows, the introduced changes in the OECD methodology appear to have had a significant impact on the level of the collected statistics on mobile prices in OECD countries.

Figure 9. Evolution of the average OECD mobile basket (in USD PPP) in 2000-2009



Source: OECD data analysed by Microeconomix

The summary statistics for the collected average OECD residential mobile basket (in USD PPP) are presented in the table below. Before the first major revision of the methodology (in 2002), the average mobile price basket was at USD PPP 344. After the first revision and before the second revision (in 2006) it was at 571. Finally, after the second revision it was at USD PPP 364.

Table 10. Summary statistics for the average OECD mobile basket (in USD PPP)

Year	Mean	Standard deviation	Min	Max	Number
2000	365	151	148	810	28
2001	324	115	130	588	30
2000-2001	**344**	**134**	**130**	**810**	**58**
2002	618	199	379	1 216	30
2003	577	200	315	1 125	30
2004	575	199	261	1 027	30
2005	514	185	185	965	30
2002-2005	**571**	**197**	**185**	**1 216**	**120**
2006	419	143	114	694	30
2007	393	137	158	660	30
2008	337	140	125	662	30
2009	309	122	106	543	30
2006-2009	**364**	**141**	**106**	**694**	**120**
Total	**444**	**195**	**106**	**1 216**	**298**

Source: OECD data analysed by Microeconomix

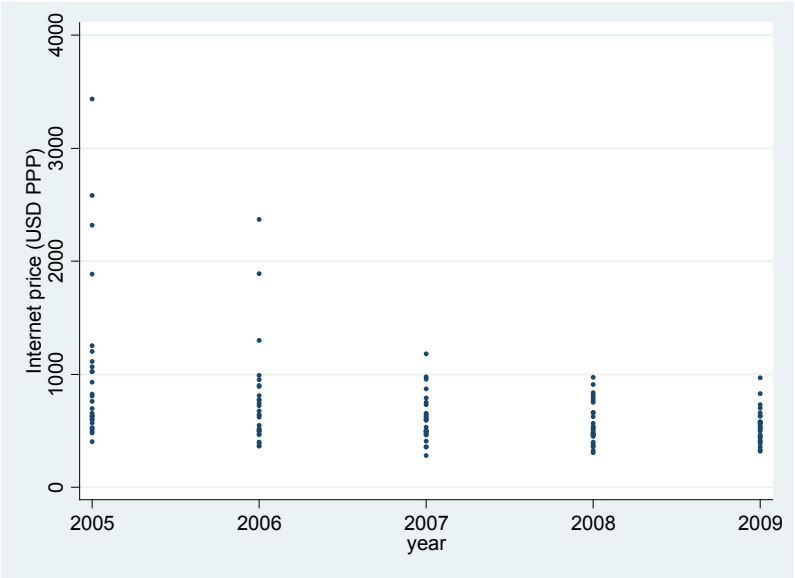
Broadband

The study uses the OECD data for the evolution of a representative broadband subscription over time (2005-2009) that has been collected using the methodology explained at www.oecd.org/document/1/0,3343,en_2649_34225_39575489_1_1_1_1,00.html. This data collection identified one DSL and one cable offer from each country (if available) in 2005. This offer was followed over time in terms of price, speed and bit cap. If the speeds on offer were no longer available the next highest available speed was used. The price data is expressed in local currency.

On the basis of the OECD price data a yearly price indicator was constructed using the following method. First each data point concerning the price was multiplied by 12 in order to estimate annual costs. Second, it was converted to USD PPP. Third, a weighted average of annual prices was calculated.

The created price indicators are presented in the following figure.

Figure 10. Evolution of annual Internet prices (in USD PPP)



Source: OECD data analysed by Microeconomix

The summary statistics for the created Internet price indicator are presented in the table below.

Table 11. Summary statistics for Internet prices (in USD PPP)

Year	Mean	Standard deviation	Min	Max	Number
2005	1 024	725	405	3 436	27
2006	767	456	365	2 369	27
2007	608	209	278	1 179	27
2008	569	187	304	973	27
2009	542	150	320	968	27
Total	702	441	278	3 436	135

Source: OECD data analysed by Microeconomix

Volume data

Fixed telecommunication

The estimation of the loss in consumer surplus uses OECD data for the number of fixed telephone access paths as a measure of the number of subscriptions in 2000-2009. This data combines analogue and ISDN lines. The summary statistics are presented in the table below.

Table 12. Summary statistics for the number of fixed telephone access paths (in millions)

Year	Mean	Standard deviation	Min	Max	Number
1990	16.5	29.0	0.1	134.7	23
1991	17.2	30.0	0.1	139.6	23
1992	17.7	30.6	0.1	142.2	23
1993	18.4	31.5	0.1	146.5	23
1994	19.0	32.4	0.1	150.7	23
1995	19.0	33.0	0.1	157.0	24
1996	18.0	27.9	0.2	127.9	24
1998	16.6	26.6	0.2	133.5	29
1999	18.4	34.3	0.2	180.7	29
2000	18.2	34.9	0.1	183.7	29
2001	17.7	34.6	0.2	184.7	30
2002	17.6	34.1	0.2	182.3	30
2003	17.4	33.1	0.2	175.8	30
2004	17.1	32.1	0.2	170.5	30
2005	17.3	31.5	0.2	167.9	30
2006	16.7	30.1	0.1	160.3	30
2007	16.0	28.4	0.1	151.2	30
2008	15.5	27.9	0.2	149.1	30
2009	14.8	27.3	0.1	146.9	30
Total	17.3	30.6	0.1	184.7	520

Source: OECD data analysed by Microeconomix

Mobile telecommunication

The mobile telecommunication volume data includes mobile subscriptions. The summary statistics are presented in the table below.

Table 13. Summary statistics for mobile subscriptions (in millions)

Year	Mean	Standard deviation	Min	Max	Number
2000	17.5	24.2	0.2	109.5	29
2001	20.3	27.7	0.2	128.5	30
2002	22.4	30.2	0.3	141.8	30
2003	24.8	33.5	0.3	160.6	30
2004	27.9	38.0	0.3	184.7	30
2005	30.9	41.7	0.3	203.7	30
2006	34.0	46.5	0.3	229.6	30
2007	37.4	50.7	0.3	249.3	30
2008	39.6	53.2	0.3	261.3	30
2009	40.9	55.2	0.3	274.3	30
Total	29.6	41.6	0.2	274.3	299

Source: OECD data analysed by Microeconomix

Broadband

The study uses the OECD data on broadband subscriptions (DSL and cable). The number of broadband subscriptions was calculated as a sum of DSL subscriptions and cable subscriptions. The summary statistics for the constructed variable are presented in the following table.

Table 14. Summary statistics for broadband subscriptions (DSL and cable) in millions

Year	Mean	Standard deviation	Min	Max	Number
1999	0.342	0.636	0.005	1.970	9
2000	0.668	1.540	0.002	6.009	20
2001	1.220	2.783	0.000	12.076	26
2002	2.013	4.123	0.006	18.801	26
2003	2.786	5.705	0.008	27.261	28
2004	3.879	7.317	0.044	36.643	29
2005	5.010	9.202	0.067	46.379	28
2006	6.456	11.418	0.099	57.859	27
2007	7.448	13.005	0.128	66.243	27
2008	8.178	14.106	0.143	71.907	27
2009	8.609	14.689	0.158	74.582	27
Total	4.598	9.768	0.000	74.582	274

Source: OECD data analysed by Microeconomix

Variables affecting volume of subscriptions to telecommunication services

Population

All things equal, the number of subscriptions to telecommunication services appears proportional to the population size, which is why it is used as a control variable in the demand equation.

The summary statistics for the size of the population (variable "population") are presented in the following table.

Table 15. Summary statistics for population size (in millions)

Year	Mean	Standard deviation	Min	Max	Number of observations
1990	41.58	58.57	0.25	249.46	20
1991	38.86	57.13	0.26	252.15	22
1992	39.15	57.69	0.26	255.03	22
1993	39.45	58.23	0.26	257.78	22
1994	39.71	58.72	0.27	260.33	22
1995	42.22	58.84	0.27	262.80	23
1996	40.91	58.58	0.27	265.23	24
1998	37.97	55.09	0.27	270.25	29
1999	38.26	55.56	0.28	272.69	29
2000	38.74	57.07	0.28	282.19	29
2001	37.92	56.94	0.28	285.11	30
2002	38.16	57.45	0.29	287.98	30
2003	38.43	57.95	0.29	290.85	30
2004	38.70	58.44	0.29	293.66	30
2005	38.96	58.91	0.29	296.41	30
2006	39.17	59.39	0.30	299.40	30
2007	39.52	60.48	0.31	306.47	30
2008	39.76	60.93	0.32	309.28	30
2009	23.01	25.55	0.32	82.00	22
Total	38.50	56.18	0.25	309.28	504

Source: OECD data analysed by Microeconomix

Next to the variable "population" the variable "population²" was used as a potential variable affecting the number of subscriptions to telecommunication services. This variable denotes the square of the "population". Its summary statistics are presented in the table below. It has been introduced in order to capture potential non-linear relationships between the number of subscription and the size of the population.

Table 16. Summary statistics for the size of "population²" (in millions)

Years	Mean	Standard deviation	Min	Max	Number of observations
1990-2009	4 632	14 588	0.1	95 654	504

Source: OECD data analysed by Microeconomix

GDP per capita

Gross domestic product per capita (in USD PPP)[5] was used in the demand equation as a potential control variable. Presumably, consumers may have a higher propensity to subscribe to telecommunication services in richer countries. This effect may be particularly apparent for broadband subscriptions, as broadband may not constitute a must-have service for a significant part of society in poorer OECD countries. The positive impact of GDP on penetration of mobile phones and fixed phones is less apparent as those markets are in general far better penetrated than the broadband market. Furthermore, it would seem that even in poorer countries people would be less inclined to forego a fixed phone or a mobile phone. The summary statistics for GDP per capita (in USD PPP) are presented in the table below.

Table 17. Summary statistics for GDP per capita (in USD PPP)

Variable	Years	Observations	Mean	Stdandard deviation	Min	Max
GDP	1990-2009	520	25 656	11 110	5 841	89 732

Source: OECD data analysed by Microeconomix

Age distribution

The statistics describing the age distribution of a given country have also been used as control variables in the demand equation. In particular, two variables "ages_0_14_rate" and "ages_over_64_rate" have been tested. The first variable indicates the share of the population aged below 14. The second variable indicates the share of the population aged above 64. The underlying motivation of the use of these two variables as control variables is that consumers' propensities to use telecommunication services may differ with age. While these variables may have a clear effect on the number of subscriptions to telecommunication services, they do not appear to have any obvious effect on prices for telecommunication services. Their summary statistics are presented in the tables below.

Table 18. Summary statistics for "ages_0_14_rate"

Years	Mean	Standard deviation	Min	Max	Number of observations
1990-2009	19%	4%	13%	36%	494

Source: OECD data analysed by Microeconomix

Table 19. Summary statistics for "ages_over_64_rate"

Years	Mean	Standard deviation	Min	Max	Number of observations
1990-2009	14%	3%	4%	22%	500

Source: OECD data analysed by Microeconomix

Education

The statistics describing the level of education in a given country have been used as control variables in the demand equation. In particular, two variables have been tested: "education" and "education_new". The first variable indicates the percentage of the labour force which has completed tertiary education and the second variable indicates the percentage of the population that has entered tertiary education. These two variables are used as control variables, as it appears likely that consumers' propensities to use telecommunication services may differ with education. Both statistics have been collected from the OECD. Their summary statistics are presented in the tables below.

Table 20. Summary statistics for "education"

Year	Mean	Standard deviation	Min	Max	Number
2000	25%	7%	11%	36%	23
2001	24%	8%	11%	37%	26
2002	25%	8%	11%	37%	26
2003	26%	8%	13%	38%	26
2004	27%	8%	14%	39%	26
2005	28%	8%	15%	39%	26
2006	29%	8%	15%	39%	25
2007	28%	8%	15%	40%	21
2008	28%	8%	16%	40%	20
2009	na	na	na	na	0
Total	27%	8%	11%	40%	219

Source: OECD data analysed by Microeconomix

Table 21. Summary statistics for "education_new"

Year	Mean	Standard deviation	Min	Max	Number
1998	0.6%	0.2%	0.3%	1.0%	21
1999	0.6%	0.2%	0.3%	1.0%	21
2000	0.6%	0.2%	0.3%	1.1%	24
2001	0.7%	0.2%	0.4%	1.1%	26
2002	0.7%	0.2%	0.4%	1.2%	25
2003	0.7%	0.3%	0.4%	1.3%	26
2004	0.7%	0.3%	0.4%	1.3%	26
2005	0.7%	0.3%	0.4%	1.3%	26
2006	0.7%	0.2%	0.4%	1.3%	27
2007	0.7%	0.2%	0.4%	1.2%	27
2008	0.7%	0.3%	0.3%	1.3%	28
2009	na	na	na	na	0
Total	0.7%	0.2%	0.3%	1.3%	277

Source: OECD data analysed by Microeconomix

Female rate

"Female_rate" is another variable used as a control variable in the demand estimation. This variable has been constructed by dividing the number of females by the size of population. It may be a potential factor affecting the number of subscriptions to telecommunication services as a decision whether to subscribe to telecommunication services may depend on sex. While this variable may have a clear effect on the number of subscriptions to telecommunication services, it does not appear to have any effect on prices for telecommunication services. The summary statistics for this variable are presented in the table below.

Table 22. Summary statistics for "female_rate"

Year	Mean	Standard deviation	Min	Max	Number
1990	50%	2%	41%	53%	20
1991	51%	1%	49%	53%	22
1992	51%	1%	49%	52%	22
1993	51%	1%	49%	52%	22
1994	51%	1%	49%	52%	22
1995	51%	1%	48%	52%	23
1996	51%	1%	48%	52%	24
1998	51%	1%	48%	52%	29
1999	51%	1%	48%	52%	29
2000	51%	1%	48%	52%	29
2001	51%	1%	48%	52%	30
2002	51%	1%	48%	52%	30
2003	51%	1%	48%	52%	30
2004	51%	1%	47%	52%	30
2005	51%	1%	47%	52%	30
2006	51%	1%	49%	52%	30
2007	51%	1%	50%	52%	30
2008	51%	1%	50%	52%	30
2009	51%	1%	49%	52%	22
Total	51%	1%	41%	53%	504

Source: OECD data analysed by Microeconomix

Variables affecting expenditures related to the subscriptions to telecommunication services

Geographical variables

The "urban_rate", indicating the percentage of people living in urban areas as defined by national statistical offices, and "density", the number of people per sq. km of land area, are used as price determinants. The first variable has been collected from the World Bank and the second from the OECD. They may affect pricing decisions as the density of the population or the number of people leaving in cities may affect the cost of the supply of the telecommunication services and cost factors are standard instruments for prices. The summary statistics for these two variables are presented in tables below.

Table 23. Summary statistics for "urban_rate"

Year	Mean	Standard deviation	Min	Max	Number
1990	73%	12%	48%	96%	23
1991	73%	12%	49%	96%	23
1992	74%	12%	49%	97%	23
1993	74%	12%	50%	97%	23
1994	74%	12%	50%	97%	23
1995	74%	12%	51%	97%	24
1996	74%	12%	52%	97%	24
1998	74%	11%	53%	97%	29
1999	75%	11%	54%	97%	29
2000	75%	11%	54%	97%	29
2001	74%	11%	55%	97%	30
2002	74%	11%	56%	97%	30
2003	75%	11%	56%	97%	30
2004	75%	11%	56%	97%	30
2005	75%	11%	56%	97%	30
2006	75%	11%	56%	97%	30
2007	75%	11%	56%	97%	30
2008	75%	11%	57%	97%	30
2009	76%	11%	57%	97%	30
Total	75%	11%	48%	97%	520

Source: World Bank data analysed by Microeconomix

Table 24. Summary statistics for "density"

Year	Mean	Standard deviation	Min	Max	Number
1990	130	118	2	360	18
1991	123	118	2	363	20
1992	124	119	2	366	20
1993	125	119	2	368	20
1994	125	120	2	370	20
1995	122	118	2	372	21
1996	114	116	2	374	23
1998	130	125	2	465	28
1999	131	125	2	469	28
2000	131	126	2	473	28
2001	131	125	3	476	29
2002	132	125	3	479	29
2003	132	126	3	481	29
2004	133	126	3	483	29
2005	134	126	3	484	29
2006	134	124	3	486	30
2007	134	125	3	487	30
2008	133	130	3	489	27
Total	129	121	2	489	458

Source: OECD data analysed by Microeconomix

Other tested geographical variables include country's area ("area") and the percentage of landmass used by cumulative 50% of the population ("land_use"). Both variables are presented in the table below.

They may affect the price as it may be cheaper to provide telecommunication services in smaller countries or countries in which the population tends to occupy a smaller part of a country's area.

Table 25. Geographical variables related to the landmass

Country	Country's total area (km²)	Percentage of landmass used by cumulative 50% of the population
Australia	7 686 800	10.36
Austria	83 900	28.42
Belgium	30 500	27.63
Canada	9 976 100	15.91
Chile	756 950	
Czech Republic	78 864	29.76
Denmark	43 100	20.99
Estonia	43 698	
Finland	338 000	12.77
France	549 000	23.08
Germany	356 900	26.29
Greece	132 000	20.49
Hungary	93 000	30.05
Iceland	103 000	1.40
Ireland	70 300	26.19
Israel	20 770	
Italy	301 200	29.99
Japan	377 800	12.31
Korea	99 600	6.68
Luxembourg	2 600	24.08
Mexico	1 996 000	12.70
Netherlands	40 800	25.52
New Zealand	268 700	8.31
Norway	324 200	10.97
Poland	312 700	33.69
Portugal	92 400	18.04
Slovak Republic	49 035	38.63
Slovenia	20 273	
Spain	504 800	15.54
Sweden	450 000	10.08
Switzerland	41 300	18.69
Turkey	780 600	18.25
United Kingdom	244 800	7.72
United States	9 376 000	13.91
OECD	35 645 690	

Source: OECD

Level of potential competition

The statistics describing the level of barriers preventing effective competition were used as control variables in the price equation. In particular, the variable "regulatory_barriers", which is the OECD

Indicator of Regulation Impact for post and telecommunications, was used. The methodology for this indicator is described in the following paper: Conway, P. and G. Nicoletti (2006), "Product Market Regulation in the Non-Manufacturing Sectors of OECD Countries: Measurement and Highlights", OECD Economics Department Working Paper, No 530. The underlying motivation of the use of this variable is that barriers to competition may give market power to telephone operators which may result in higher prices. These barriers do not appear to have any obvious effect on the number of subscriptions other than through the price. The summary statistics for this variable are presented in the table below.

Table 26. Summary statistics for "regulatory_barriers"

Year	Mean	Standard deviation	Min	Max	Number
1990	48%	10%	25%	62%	21
1991	46%	11%	25%	62%	21
1992	46%	11%	24%	62%	21
1993	45%	11%	24%	62%	21
1994	43%	12%	24%	62%	21
1995	40%	12%	23%	59%	21
1996	39%	12%	22%	58%	21
1998	37%	11%	20%	55%	27
1999	34%	9%	20%	52%	27
2000	32%	8%	20%	47%	27
2001	30%	7%	19%	45%	28
2002	27%	6%	19%	44%	28
2003	26%	6%	16%	44%	28
2004	26%	6%	16%	44%	28
2005	24%	6%	13%	38%	28
2006	24%	5%	14%	38%	28
2007	23%	5%	12%	35%	28
2008	na	na	na	na	0
2009	na	na	na	na	0
Total	34%	12%	12%	62%	424

Source: OECD data analysed by Microeconomix

The following variables were also used to check for the level of potential competition in mobile telephony:

- "nb_competitors" – number of mobile operators
- "hhi" - Herfindahl–Hirschman Index (the sum of the squares of the market shares)

Both variables have been created on the basis of the OECD data on market shares of mobile operators (available for the years 2000, 2001, 2003, 2005, 2007 and 2009). The summary statistics for these variables are presented in the table below.

Table 27. Summary statistics for various variables used to control for the level of competition in the mobile telecommunication market

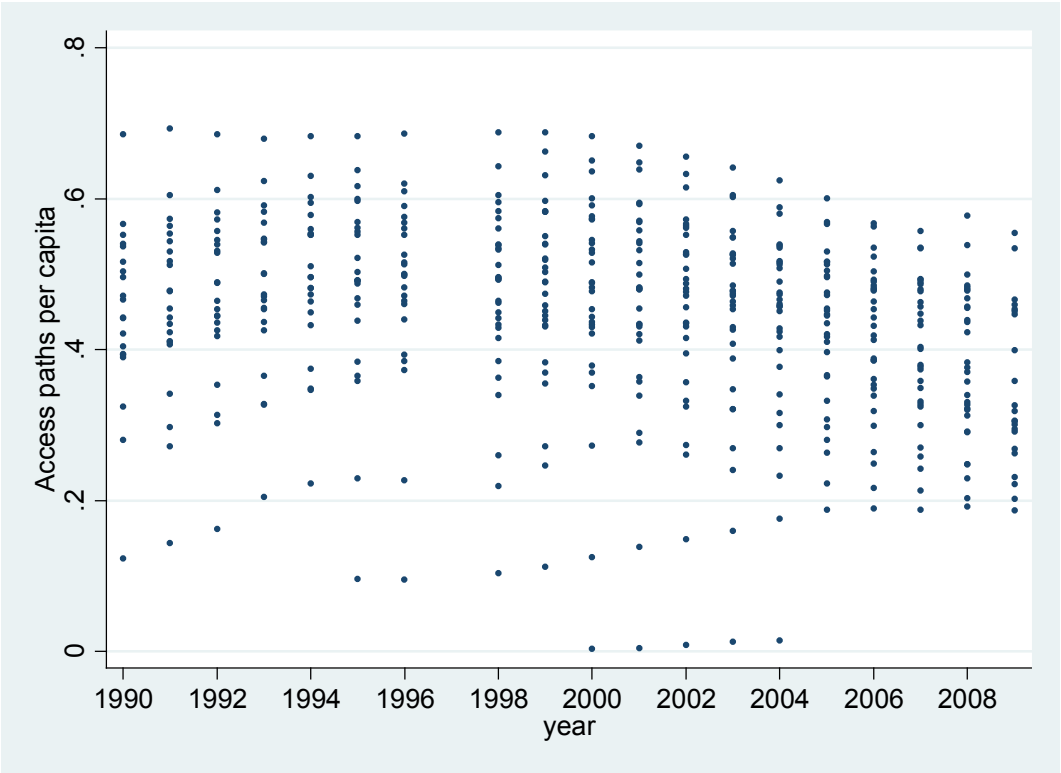
Variable	Obs	Mean	Std. Dev.	Min	Max
nb_competitors	176	3,7	1.0	2	6
hhi	174	0,4	0,1	0,2	0,7

Source: OECD data analysed by Microeconomix

Other control variables

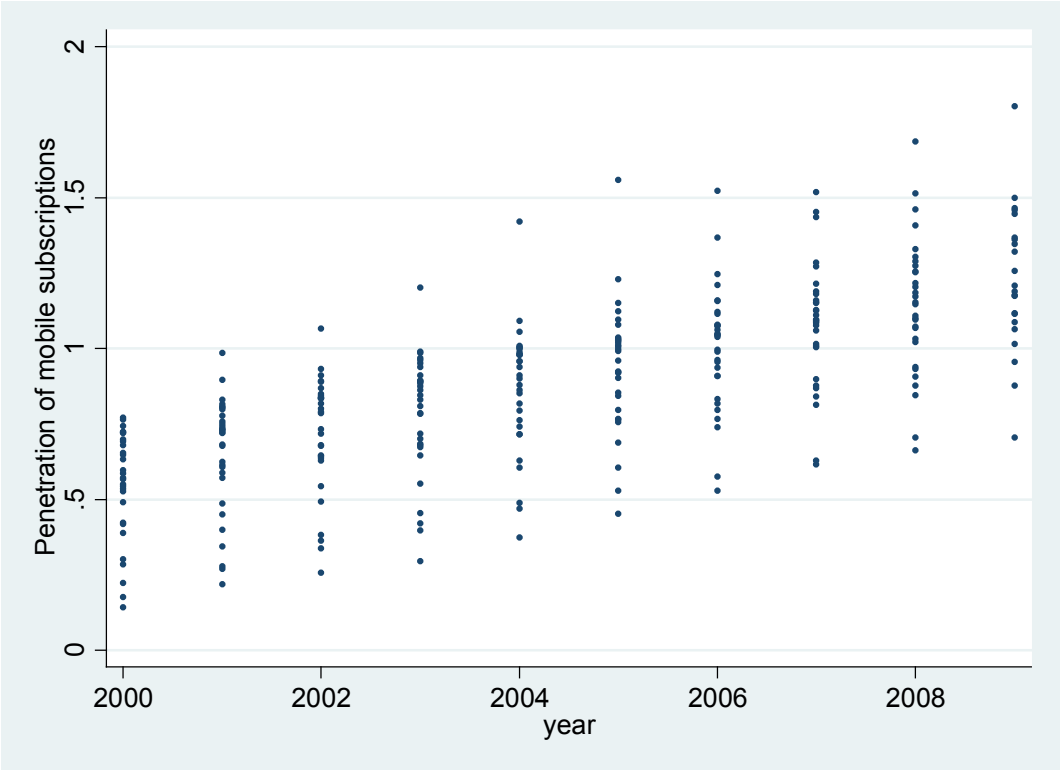
The presence of time fixed effects has been tested. A variable indicating the year ("year") has been also used to check for potential trends. Additionally, a variable "year^2" indicating the square of year has been used in order to capture potential non-linear evolution of the telecommunication penetration illustrated in figures below.

Figure 11. Evolution of the number of fixed access paths per



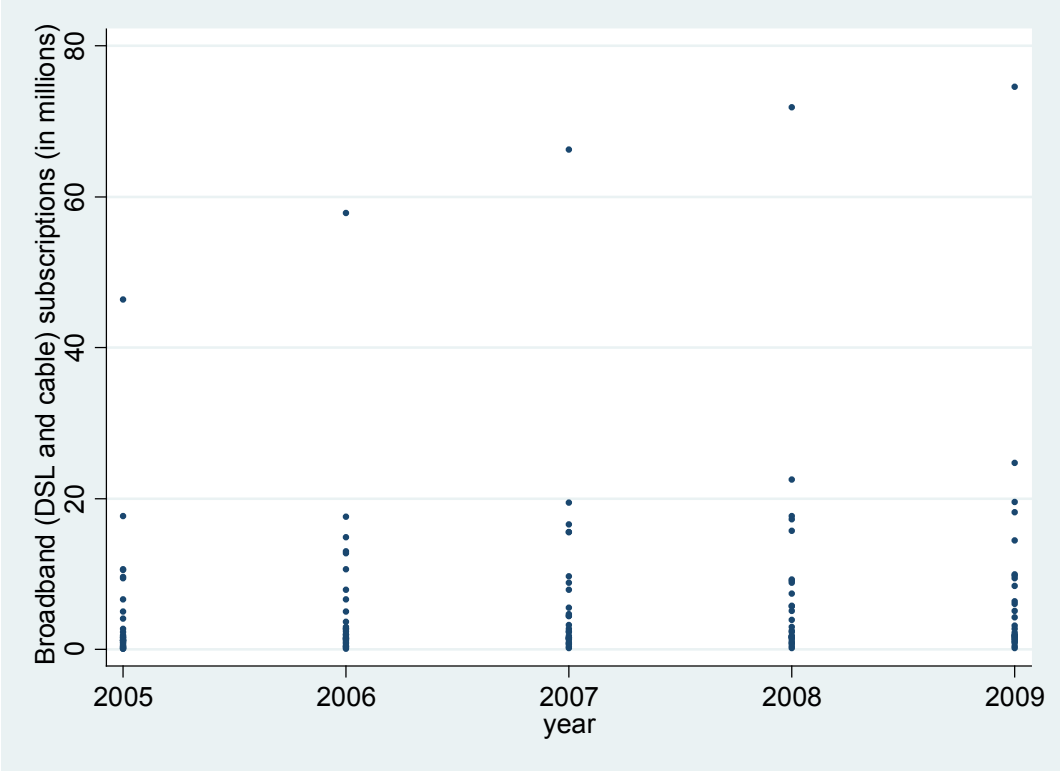
Source: OECD data analysed by Microeconomix

Figure 12. Evolution of the number of mobile subscriptions per capita



Source: OECD data analysed by Microeconomix

Figure 13. Evolution of the number of broadband (DSL and cable) subscriptions per capita



Source: OECD data analysed by Microeconomix

Control variables ("first_methodology_change" and "second_methodology_change") indicating the change in the methodology used for the OECD residential PSTN basket were also used in the estimation of loss in consumer surplus for fixed telecommunication services in Mexico. The first variable ("first_methodology_change") takes the value of 1 for years 2000-2005 and 0 otherwise. The second variable ("second_methodology_change") takes the value of 0 from 1990 to 2005 and 1 as of 2006. Summary statistics for these two variables are presented in the following table.

Table 28. Summary statistics for "first_methodology_change" and "second_methodology_change"

Variable	Number of observations	Mean	Standard deviation	Min	Max
First_methodology_change	520	0,34	0,4755743	0	1
Second_methodology_change	520	0,23	0,4217307	0	1

Source: OECD data analysed by Microeconomix

Control variables ("first_methodology_revision" and "second_methodology_revision") indicating the change in the methodology used for the OECD mobile basket were also used in the estimation of loss in consumer surplus for mobile telecommunication services in Mexico. The first variable ("first_ methodology_revision") takes the value of 1 for years 2002-2005 and 0 otherwise. The second variable ("second_ methodology_revision") takes the value of 0 from 1990 to 2005 and 1 as of 2006. Summary statistics for these two variables are presented in the table below.

Table 29. Summary statistics for "first_methodology_revision" and "second_methodology_revision"

Variable	Number of observations	Mean	Standard deviation	Min	Max
First_methodology_revision	520	0,23	0,42	0	1
Second_methodology_revision	520	0,23	0,42	0	1

Source: OECD data analysed by Microeconomix

The variable "pre-paid" was used in the price equation to check if the concerned mobile price basket for low consumption was based on the prepaid. The summary statistics for this variable are presented in the table below.

Table 30. Summary statistics for "prepaid"

Variable	Number of observations	Mean	Standard deviation	Min	Max
prepaid	298	0,42	0,49	0	1

Source: OECD data analysed by Microeconomix

The following variables were also used for estimations concerning broadband:

- "Cable_share" – Percentage of cable broadband subscriptions in the total number of broadband subscriptions (including DSL and cable). This variable has been included because there may be different availability of access to broadband through cable television infrastructure in different countries. Presumably, countries with more developed cable broadband could observe more broadband subscriptions as consumers may be more inclined to subscribe to broadband services if it is offered together with cable television.
- "Speed_distance" – Difference between the broadband speed offered in a given country and the average broadband speed in all OECD countries in a given year. This variable has been included as the possibility of having faster Internet connection may stimulate the demand for broadband subscriptions.

The summary statistics for the two variables presented above ("cable_share" and "speed_distance") are presented in the following table.

Table 31. Summary statistics for "cable_share" and "speed_distance"

Variable	Number of observations	Mean	Standard deviation	Min	Max
cable_share	274	0.36	0.25	0.00	1.00
speed_distance	135	0.00	20 468	-17 008	85 973

Source: OECD data analysed by Microeconomix

Overview of all variables

The following table presents an overview of tested variables.

Table 32. Overview of summary statistics

Variable	Observations	Mean	Standard deviation	Min	Max
price_fixed_telephony	520	533	220	118	1 273
price_mobile_telephony	298	444	195	106	1 216
price_broadband	135	702	441	278	3 436
volume_fixed_telephony	520	17.26	30.63	0.13	184.71
volume_mobile_telephony	299	29.61	41.63	0.22	274.28
volume_broadband	274	4.60	9.77	0.00	74.58
population	504	38.50	56.18	0.25	309.28
population²	504	4 632	14 588	0	95 654
gdp	520	25 656	11 110	5 841	89 732
age_0_14_rate	494	0.19	0.04	0.13	0.36
age_over_64_rate	500	0.14	0.03	0.04	0.22
education	219	0.27	0.08	0.11	0.40
education_new	277	0.007	0.002	0.003	0.013
female_rate	504	0.51	0.01	0.41	0.53
urban_rate	520	0.75	0.11	0.48	0.97
density	458	129	121	2	489
area	520	1 243 651	2 768 327	2 600	9 976 100
land_use	520	18.60	8.48	1.40	38.63
regulatory_barriers	424	0.34	0.12	0.12	0.62
nb_competitors	176	3.72	1.03	2.00	6.00
hhi	174	0.39	0.10	0.17	0.66
cable_share	274	0.36	0.25	0.00	1.00
speed_distance	135	0	20 468	-17 008	85 973
year	520	2 000	6	1 990	2 009
year²	520	4 001 010	23 048	3 960 100	4 036 081
first_methodology_change	520	0.34	0.48	0.00	1.00
second_methodology_change	520	0.23	0.42	0.00	1.00
first_methodology_revision	520	0.23	0.42	0.00	1.00
second_methodology_revision	520	0.23	0.42	0.00	1.00
prepaid	298	0.42	0.49	0.00	1.00

Source: OECD and World Bank analysed by Microeconomix

ESTIMATION OF LOSS IN CONSUMER SURPLUS

Estimation of lost consumer surplus in the Mexican fixed telephony sector

The methodology to estimate prices of fixed telecommunication services in Mexico

As the following two tables indicate, the average prices (in USD PPP) for fixed telecommunication services in Mexico widely exceeded average prices in the OECD in years 2000-2008. In this period, the average price for fixed telecommunication services was at the level of USD PPP 967, exceeding the OECD average (USD PPP 628) by over USD PPP 300. Given these high prices, Mexico ranked among the five most expensive OECD countries in the domain of fixed telecommunication services in every year between 2000 and 2008. In 2009, the observed average residential PSTN basket (in USD PPP) was exceptionally low compared to other years.

Table 33. Average residential PSTN basket (in USD PPP) in Mexico vs. prices in all OECD countries

Year	Price level in Mexico	Observed prices in OECD countries		
		Mean	Min	Max
2000	1 075	609	213	1 187
2001	995	609	263	1 219
2002	1 025	645	337	1 213
2003	923	622	352	1 273
2004	932	629	378	1 227
2005	932	601	373	1 190
2006	1 024	679	335	1 214
2007	825	663	405	1 116
2008	970	619	333	1 128
2009	510	603	305	1 149

Source: OECD data analysed by Microeconomix

Table 34. Rank of residential PSTN basket (in USD PPP) in Mexico[1]

Year	Rank of Mexico	Number of countries compared
2000	27	29
2001	26	30
2002	27	30
2003	26	30
2004	27	30
2005	29	30
2006	28	30
2007	27	30
2008	28	30
2009	9	30

[1]Price baskets were ranked from the lowest to the highest.

Source: OECD data analysed by Microeconomix

In theory there may exist various explanations why prices of fixed telecommunication services in Mexico ranked among the five most expensive prices in OECD countries in 2000-2008. This high price level may be explained by the insufficient competition in the telecommunication market, but may also be potentially explained by local market conditions in Mexico.

This study estimates the price level for fixed telecommunication services that could have been observed in Mexico, had there been more competition. In particular, it estimates the price level that the other OECD countries would have observed, if they had had the similar market conditions to the ones observed in Mexico. The controlled market conditions include: the level of urbanisation, the population density, the percentage of landmass used by cumulative 50% of the population and the level of local barriers preventing the development of the competition.

As explained in section 1, the study estimates the price level that could have been observed in Mexico following a two-step approach.[6] The implemented approach appears rather conservative, as it takes as a benchmark all OECD countries except Mexico, including those that might have had been characterised by a relatively low level of competition in the fixed telecommunication market (for example Poland). It may hence happen that the estimated price level for telecommunication services in Mexico lies below the actual price level. Such a finding may be interpreted as an absence of consumer overcharge as compared to the OECD average. It would not however necessarily imply that there is no further space for improvement in terms of the level of competition in the market for fixed telecommunication services in Mexico. It may as well indicate that the observed price level for fixed telecommunication services in Mexico appears competitive as compared to the OECD average, but does not achieve the most competitive level.

The methodology used to estimate the fixed telecommunication penetration in Mexico

The market penetration of fixed telephony in Mexico appears to be very low. As indicated in the following three tables, in 2000-2004 the fixed telephone penetration in Mexico was the second lowest in OECD countries and as of 2005 Mexico ranked as the country with the lowest penetration of fixed

telephony. While the penetration of fixed telephony amounted to a maximum of 19% in Mexico in 2000-2009, the average penetration rate in all OECD countries was at least 35% in 2000-2009.

Table 35. Evolution of fixed telephony penetration rate in Mexico

Year	Fixed access paths (in millions)	Population (in millions)	Penetration rate
2000	12.33	98.44	13%
2001	13.77	99.72	14%
2002	14.98	100.91	15%
2003	16.33	102.00	16%
2004	18.07	103.00	18%
2005	19.51	103.95	19%
2006	19.86	104.87	19%
2007	19.87	105.79	19%
2008	20.49	106.68	19%
2009	19.33	107.43	18%

Source: OECD data analysed by Microeconomix

Table 36. Penetration of fixed telephony in Mexico vs. the penetration rate in OECD countries

Year	Mexico	OECD average	OECD minimum	OECD maximum
2000	13%	47%	0.3%	68%
2001	14%	46%	0.5%	67%
2002	15%	45%	1%	66%
2003	16%	44%	1%	64%
2004	18%	43%	1%	62%
2005	19%	43%	19%	60%
2006	19%	41%	19%	57%
2007	19%	40%	19%	56%
2008	19%	38%	19%	58%
2009	18%	35%	19%	55%

Source: OECD data analysed by Microeconomix

Table 37. Rank of fixed telephony penetration in Mexico (when fixed telephony penetrations ranked from the highest to the lowest)

Year	Rank of Mexico	Number of countries included in the ranking
2000	28	29
2001	29	30
2002	29	30
2003	29	30
2004	29	30
2005	30	30
2006	30	30
2007	30	30
2008	30	30
2009	23	23

Source: OECD data analysed by Microeconomix

There may be several explanations for the very low penetration of fixed telephony in Mexico. One possible explication lies in the potentially low degree of competition in the fixed telecommunication sector in Mexico resulting in the relatively high prices of fixed telecommunication services. The other explication may be related to local market conditions.

The goal of this study is to estimate the level of fixed telecommunication penetration that could have been observed in Mexico if prices of telecommunication services had been lower. It hence aims at identifying the potential price impact on the level of fixed telecommunication penetration as well as the influence of local market conditions (such as for example the size of the population, the age distribution, the percentage of females in the total population and the education level) on fixed telecommunication penetration.

As explained in section 1, the present study uses a three-step approach in order to estimate the fixed telecommunication penetration that could have been observed in Mexico if prices of telecommunication services had been lower.[7] The estimation of the fixed telecommunication penetration in Mexico is based on all the other OECD countries but Mexico, including those that may have relatively high prices of fixed telecommunication services and relatively low fixed telecommunication penetration (for example Slovak Republic). This is a conservative approach estimating the level of penetration of fixed telecommunication that could have been achieved in Mexico given local market conditions, if the competition in the Mexican market for fixed telecommunication serviced was comparable to the OECD average but not necessarily to the highest attainable level.

Estimation of price and demand equations

The table below reports estimation results for the system of simultaneous equations including the price equation and the demand equation. This system of equations has been estimated using the 3SLS technique and has been selected as the best fitted specification, using R^2 and statistical significance of

variable as the selection criteria. It includes time fixed effects, which are presented in Table 4 in Appendix 1. The estimation results for other tested specifications are presented in Tables 1-3 in Annex A.

Table 38. Estimation results for demand equation and price equation for fixed telecommunication

Dependent variable	Volume	Price
Price	-0.0145***	
	(0.00171)	
Population	0.383***	
	(0.0106)	
Population²	0.000669***	
	(4.06e-05)	
Female_rate	77.60***	
	(29.05)	
Age_0_14_rate	-24.74***	
	(8.945)	
Area		5.62e-06**
		(2.86e-06)
Land_use		7.135***
		(1.024)
Urban_rate		-487.3***
		(73.15)
Regulatory_barriers		238.2**
		(97.20)
Constant[1]	-28.15*	469.6***
	(15.75)	(80.22)
Observations	398	398
R-squared	0.984	0.524

[1]There are also fixed time effects that are presented in Table 4 in Annex A.

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: OECD and World Bank data analysed by Microeconomix

Price equation

The estimated price equation indicates that the price level for fixed telecommunication services negatively depends on the level of urbanisation ("urban_rate") and is positively affected by the level of barriers preventing effective competition in the telecommunication and post sector ("regulatory_barriers"), country's total area (km²) ("area") and the percentage of landmass used by cumulative 50% of the population ("land_use"). The negative impact of the level of urbanisation on the price of fixed telecommunication services may be explained by the fact that all other things being equal it may be less expensive to offer fixed telecommunication services in a more urbanised country. The positive impact of the area of a given country on the price of fixed telecommunication services in this country may be related to the fact that it may be more expensive to offer fixed telecommunication services in a country of a greater size. Similarly, the positive impact of the percentage of landmass used by cumulative 50% of the population on the price for fixed telecommunication services may be linked to the fact that it may be less expensive to offer fixed telecommunication services to the population occupying smaller area.

The identified effects on prices of fixed telecommunication services appear robust. As presented in Tables 1-4 in Annex A, in all tested specifications the effect of the urbanisation rate on the price level was negative and statistically significant. The impact of the area of the country on the price level was always positive and most of the time statistically significant. The impact of the percentage of landmass used by

cumulative 50% of the population on the price for fixed telecommunication services was always positive and statistically significant. The impact of the level of regulatory barriers on the price level was always positive and statistically significant.

The impact of the population density on the price for fixed telecommunication services have been tested but turned out to be statistically insignificant, as shown in Table 1 in Annex A. However this effect may be captured by the identified effects of other geographical variables (the level of urbanisation, the area of the country and the percentage of landmass used by cumulative 50% of the population) on the price of fixed telecommunication services.

The price equation includes time fixed effects presented in Table 4 of Annex A. Dummies for different years were tested, as shown in Tables 1-3 in Annex A. The retained price equation includes only the dummies for which statistically significant effects were identified.

The price equation has been estimated assuming standard errors. They have hence not been corrected for heteroscedasticity. The STATA command used for the estimation (reg3) does not allow using robust standard errors, but it is possible to estimate the price equation using OLS with robust standard errors. Table 5 in Annex A compares the price equation estimated using 3SLS technique with standard errors to the same price equation using OLS with robust standard errors. The estimated coefficients remain at similar levels, have the same signs and are statistically significant. Hence the use of non-robust standard errors in the price equation does not seem to bias the results.

Demand equation

The estimated demand equation indicates that the demand for the fixed access paths negatively depends on the price for fixed telecommunication services ("price") and the percentage of the population aged below 15 years ("age_0_14_rate") and is positively affected by the size of the population ("population" and "population^2") and the percentage of females in the total population ("female_rate"). These results tend to suggest that all other things being equal countries characterised by a higher population, higher percentage of females in the society or lower percentage of the population aged below 15 years have higher demand for fixed telecommunication services.

As shown in Tables 1-3 in Annex A, the identified results for the demand equation appear robust in different specifications. The identified effect of the price of fixed telecommunication serviced on the number of fixed access paths is always negative and statistically significant. The identified impact of the size of the population on the number of fixed access is always positive and statistically significant. The impact of the percentage of females is always positive and most of the time statistically significant. The impact of the percentage of the population aged below 15 was always negative and most of the time statistically significant.

The variables that have not been retained in the demand equation used for the estimation of loss in consumer surplus in the fixed telecommunication sector in Mexico include: "GDP", "education_new_entrants_rate" and "education". As indicated in Table 1 in Annex A, the impact of GDP per capita on the price of fixed telecommunication services was never statistically significant, which is why the variable "GDP" has not been retained. As shown in Tables 1-2 in Annex A, the impact of education was also statistically insignificant and therefore variables "education_new_entrants_rate" and "education" were dropped.

The demand equation includes time fixed effects presented in Table 4 of Annex A. Dummies for different years have been tested and only those with significant effects have been retained.

The demand equation has been estimated assuming standard errors, as the STATA command used to estimate the demand equation (reg3) does not allow the use of robust errors. Hence they have not been corrected for heteroscedasticity. The estimated results using 3SLS with standard errors are compared to the results estimated using 2SLS with robust errors in Table 6 in Annex A. The estimated coefficients are statistically significant and have the same signs and similar levels for the variables "price", "population", "population²" and "female_rate". The use of standard errors does hence not seem to lead to biased conclusions concerning these variables. The effect of the variable "age_0_14_rate" on the demand for fixed telecommunication services is found to be negative in both specifications, but is not statistically significant in the 2SLS specification with robust errors. As the sign of the coefficient for this variable is negative, its inclusion in the retained model appears to be a conservative approach.

Estimated but-for prices

The price equation has been used to estimate the prices of fixed telecommunication services that would have been observed in the Mexican fixed telecommunication sector in 2000-2007 if there had been more competition. The estimated price equation includes the following explanatory variables: country's total area, the percentage of landmass used by cumulative 50% of the population, the urbanisation rate, the OECD Indicator of Regulation Impact for Post and telecommunications and several fixed time effects. Most of these explanatory variables are available for the period 2000-2009. However, the time series for the OECD Indicator of Regulation Impact for Post and telecommunications ends in 2007. That's why the estimated price equation does not include fixed time variables for 2008-2009 and is not extrapolated after 2007.

By extrapolating the estimated price equation to the data concerning Mexico, this study addresses a question whether the observed prices of fixed telecommunication services in Mexico are higher than the prices that would have been set on average in other OECD countries, if they had had the same local market conditions. The Mexican fixed telecommunication sector is hence compared to the average fixed telecommunication sector in other OECD countries while controlling for local market conditions. This approach indicates the scope for potential improvement for Mexico that would be achievable by the average other OECD country if it had the same market conditions. It does not however suggest the best attainable outcome that could be achieved by the best performing fixed telecommunication sector among all OECD countries except Mexico.

The price equation estimated on the basis of the available data for all OECD countries but Mexico has been extrapolated to the data concerning Mexico. The estimation results return prices that could have been observed in Mexico given local conditions and internationally observed trends. The underlying assumption is that any difference between the observed prices of telecommunication services in Mexico and the observed prices in other OECD countries other than the one explained by the controlled local market conditions constitutes excessive pricing diminishing consumer surplus. The controlled factors include local geographical conditions likely affecting the costs of provision of fixed telecommunication services (such as country's total area, the percentage of landmass used by cumulative 50% of the population and the urbanisation rate) and the level of restrictions to competition in local postal services and telecommunications. They do not include a variable directly controlling the actual level of competitiveness of the sector.[8] The extrapolation of the estimated price equation to the Mexican case aims at identifying the impact of the low level of competitiveness in the Mexican fixed telecommunication sector. The estimated lost consumer surplus is hence a conservative measure in the sense that it is estimated for the actual level of barriers to competition. The alternative, less conservative, approach would be to extrapolate the estimated price equation to the Mexican data concerning geographical market conditions and the OECD average level of barriers to competition in postal services and telecommunications.

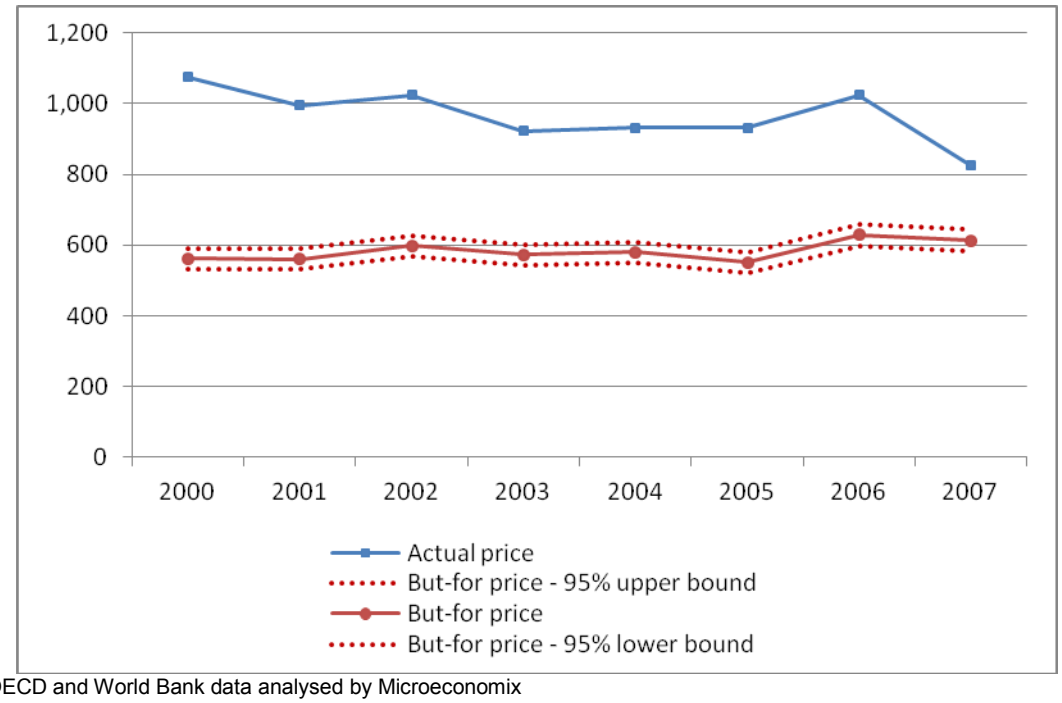
The table and figure below compare the predicted values of prices of telecommunication services with the observed values for Mexico and illustrate the corresponding average overcharge. The estimated prices are significantly lower in years 2000-2007 than the actual prices. While the average price for fixed telecommunication services was at USD PPP 966 in Mexico in 2000-2007, the estimated but-for price was on average USD PPP 583. The estimated overcharge is on average USD PPP 383 in 2000-2007. The upper bound of the 95% confidence interval[9] is well below the actual price.

Table 39. Actual prices vs. but-for prices (in USD PPP)

Year	Observed price	But-for price	Predicted individual overcharge
2000	1 075	562	513
2001	995	560	436
2002	1 025	598	427
2003	923	573	350
2004	932	580	353
2005	932	551	381
2006	1 024	628	396
2007	825	613	212

Source: OECD and World Bank data analysed by Microeconomix

Figure 14. Actual prices vs. but-for prices (in USD PPP)



Source: OECD and World Bank data analysed by Microeconomix

As shown in the table below, the predicted but-for prices of fixed telecommunication services in Mexico are slightly below the OECD average. This may be explained by the fact that the urbanisation rate, which is identified to negatively affect the price of fixed telecommunication services, is slightly higher in Mexico than the average level in OECD countries and by the fact that the percentage of landmass used by cumulative 50% of the population in Mexico, which is found to positively affect the price of fixed telecommunication services, is significantly below the average level observed in OECD countries.

Table 40. But-for prices of Mexico vs. average observed prices in OECD countries (in USD PPP)

Year	Average price	But-for price
2000	609	562
2001	609	560
2002	645	598
2003	622	573
2004	629	580
2005	601	551
2006	679	628
2007	663	613

Source: OECD and World Bank data analysed by Microeconomix

The technique used to estimate the average overcharge in Mexico could be used to predict prices in other OECD countries. The predicted prices would indicate the prices that would have been observed on the average among all the OECD country except Mexico given local market conditions. It would hence indicate whether the observed prices appear excessive or competitive as compared to the other OECD countries. Figure 1 and Table 8 in Annex A compare actual prices with the predicted prices. There is no apparent sign that the model would tend to underestimate prices.

Using the predicted average overcharge and the actual volumes, it is possible to estimate the first component of the lost consumer surplus in the Mexican fixed telecommunication sector. As the tables below indicate, in 2000-2007 the overcharge of existing customers varied between USD PPP 4 214 million and USD PPP 7 858 million.

Table 41. Estimated overcharge of existing consumers of fixed telecommunication services in Mexico

Year	Access paths (in millions)	Individual overcharge (in USD PPP)	Total overcharge (in million USD PPP)
2000	12,33	513	6 331
2001	13,77	436	5 999
2002	14,98	427	6 391
2003	16,33	350	5 717
2004	18,07	353	6 373
2005	19,51	381	7 432
2006	19,86	396	7 858
2007	19,87	212	4 214

Source: OECD and World Bank data analysed by Microeconomix

The estimated price equation may be used to predict the overcharge of existing customers for 2000-2007, but may not be easily extrapolated to estimate the overcharge of existing customers for 2008-2009. This is because the variable controlling the level of local barriers to competition ("regulatory_barriers") has missing observations for 2008-2009. That is why the estimated model does not include any fixed time effects for the years 2008 and 2009.

The present study has used another specification in order to estimate the consumer overcharge in the Mexican fixed telecommunication sector in 2008-2009. This specification has been selected from various specifications without fixed time effects reported in Table 9 in Annex A and is presented in the last column. Using this specification, the present study predicted but-for prices in Mexican fixed telecommunication sector.

The estimation of but-for prices in 2008-2009 requires completing missing observations for two variables (population density in Mexico in 2009 and the OECD regulation impact indicator for post and telecommunications in Mexico in 2008 and 2009). The population density in Mexico in 2009 has been completed by the World Bank data (55.26). The OECD regulation impact indicator for post and telecommunications ("regulatory_barriers") has been assumed to be at the same level in Mexico in 2008-2009 as in 2007 (0.27), which is a conservative assumption given the observed tendency of the "regulatory_barriers" to decrease (see Figure 2 in Annex A for illustration) and the estimated positive relationship between this variable and the price for fixed telecommunication services.[10]

Table 10 in Annex A compares the estimated but-for prices using the specification without the fixed time effects (presented in last column of Table 9 in Annex A) to the estimated but-for prices using the specification with fixed time effects (presented in Table 4 in Annex A as well as in the second column of Table 9 in Annex A). As these prices appear very close, the specification without time fixed effects has been evaluated to possess good predictive power. It has been therefore used to estimate the overcharge of existing consumers in 2008 and 2009.

The estimated but-for price amounts to USD PPP 651[11] in 2008, which is well below the actual price of USD PPP 970, and USD PPP 667[12] in 2009, which exceeds the actual price of 510 USD PPP. The user of fixed telephony in Mexico was hence on average overcharged USD PPP 319 in 2008 and faced a rather competitive price in 2009. The estimated prices are likely upwardly biased, as they rely on a conservative assumption that the level of regulatory barriers in Mexico has not changed since 2007, which is contrary to the observed international trends of decreasing levels of regulatory barriers.

Given the estimated but-for price in 2008 (USD PPP 651), the actual price (USD PPP 970) and the actual level of access paths (20,49 million), the estimated consumer overcharge in 2008 is at USD PPP 6 536 million[13].

The fact that the estimated but-for price in 2009 is below the actual level does not imply a consumer gain and suggests that this study takes a too conservative approach in estimating the price equation. As there were presumably no recent developments drastically decreasing the costs of provision of fixed telephony in Mexico, the occurrence of a sudden price decrease in 2009 indicates that this price cut might have been feasible before 2009. The identified but-for prices for 2000-2007 may hence be overestimated and in reality lower prices might probably have been observed. Nevertheless, given that this low price was observed only once and may possibly reflect a measurement error, the present study retains the estimated but-for prices for 2000-2008 and does not seek for a less conservative approach that could be closer to the reality.

The estimated but-for price for 2009 is not retained as the actual price in 2009 appears exceptionally low as compared to other years. In 2009 Mexico experienced an exceptionally low average price of fixed telecommunication services (USD PPP 510), which was 47% lower than the observed price a year before (USD PPP 970). As in other years the price declined by at most 19%, the exceptionally low level of prices of fixed telecommunication may suggest a measurement error. Furthermore, as demand did not seem to have responded to this price cut,[14] the observed actual price in Mexico in 2009 does not appear to reflect consumers' expenditures on fixed telecommunication services accurately.

Estimated but-for volumes

The demand equation presented in Section 3.1.3 combined with the estimated but-for prices presented in section 3.1.4 were used to estimate the but-for number of access paths. The tables and figures below compare the predicted volume of fixed access paths[15] (in absolute numbers and in terms of penetration rates) with the observed values for Mexico and the corresponding volume of lost subscriptions. The

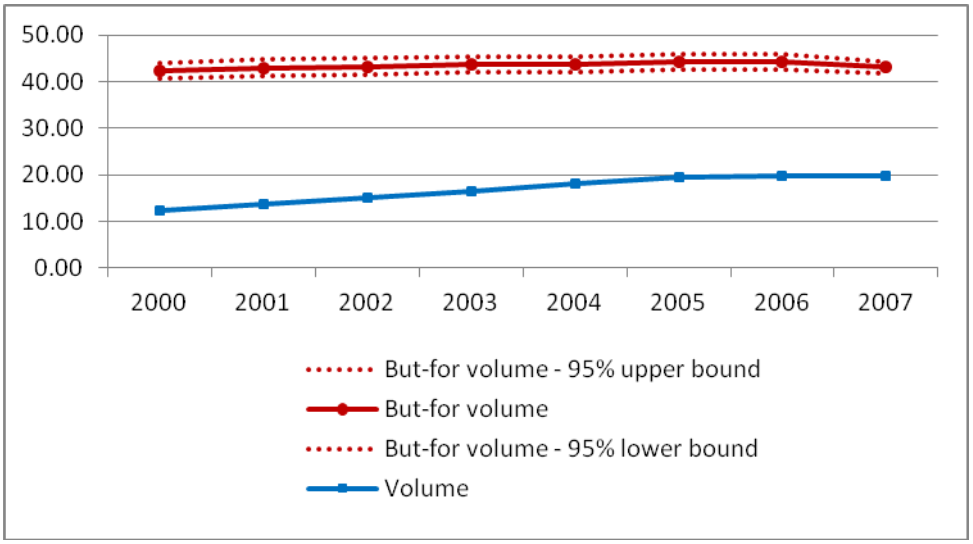
estimated but-for numbers of fixed telephone access paths for 2000-2007 are well above the actual numbers of fixed telephone access paths. The predicted but-for number of access paths was on average 43.44 million in 2000-2007, while the actual number of access paths was on average 16.84 million. The actual volume was hence on average 26.60 millions lower than the predicted but-for volume.

Table 42. Actual volumes vs. but-for volumes (in millions)

Year	Observed number of fixed access paths	But-for number of access paths	Lost volume
2000	12.33	42.35	30.02
2001	13.77	42.97	29.20
2002	14.98	43.29	28.31
2003	16.33	43.59	27.26
2004	18.07	43.76	25.69
2005	19.51	44.34	24.83
2006	19.86	44.20	24.34
2007	19.87	43.03	23.16

Source: OECD and World Bank data analysed by Microeconomix

Figure 15. Actual volumes vs. but-for volumes (in millions)



Source: OECD and World Bank data analysed by Microeconomix

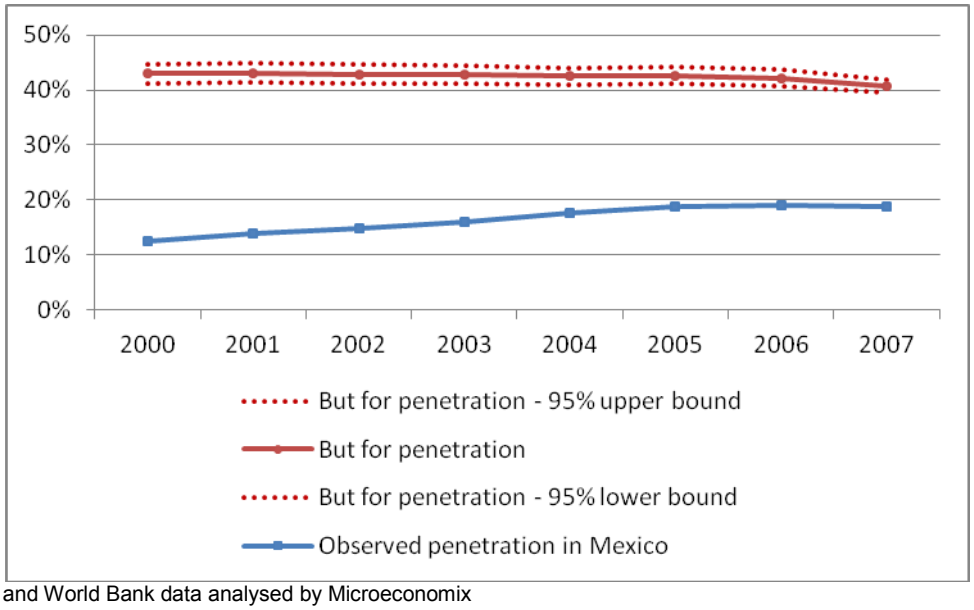
Table 43. Observed penetration rates in Mexico and the estimated volume of lost penetration

Year	Observed fixed telephone penetration	OECD average penetration	But-for fixed telephone penetration	Lost penetration
2000	13%	47%	43%	30%
2001	14%	46%	43%	29%
2002	15%	45%	43%	28%
2003	16%	44%	43%	27%
2004	18%	43%	42%	25%
2005	19%	43%	43%	24%

2006	19%	41%	42%	23%
2007	19%	40%	41%	22%

Source: OECD and World Bank data analysed by Microeconomix

Figure 16. Observed penetration rates in Mexico and estimated lost penetration



Source: OECD and World Bank data analysed by Microeconomix

The technique used to estimate but-for penetration of the fixed telephony for Mexico could be used to predict the penetration of the fixed telephony in other countries. Figure 3 in Annex B compares the predicted fixed telephony penetrations with the actual penetrations. There is no apparent indication that the estimated model would tend to overestimate fixed telephony penetration.

Estimated loss in consumer surplus based on the estimated but-for prices and but-for volumes is presented in the table below. This estimation of loss in consumer surplus consists of two elements: the damage caused by the overcharge and the damage due to the lost subscriptions. On average, in the years 2000-2007, the average annual loss in consumer surplus accounted for USD PPP 14 029 million, including USD PPP 6 289 million of the loss in consumer surplus related to the overcharge of the existing consumers and USD PPP 7 740 million of the loss in consumer surplus related to the unrealised fixed telephone subscriptions.

Table 44. Estimated loss in consumer surplus (in million USD PPP) in fixed telephony in Mexico

Year	Overcharge of existing consumers	Unrealised subscriptions	Total
2000	6 331	8 432	14 763
2001	5 999	8 174	14 173
2002	6 391	8 463	14 855
2003	5 717	7 813	13 530
2004	6 373	7 445	13 818
2005	7 432	6 844	14 276
2006	7 858	7 649	15 507
2007	4 214	7 099	11 313

Source: OECD and World Bank data analysed by Microeconomix

Table 45. Estimated loss in consumer surplus (% of Mexican GDP) in fixed telephony in Mexico

Year	Overcharge of existing consumers	Unrealised subscriptions	Total
2000	0.6%	0.9%	1.5%
2001	0.6%	0.8%	1.4%
2002	0.6%	0.8%	1.4%
2003	0.5%	0.7%	1.2%
2004	0.5%	0.6%	1.2%
2005	0.6%	0.5%	1.1%
2006	0.5%	0.5%	1.1%
2007	0.3%	0.5%	0.7%

Source: OECD and World Bank data analysed by Microeconomix

The estimation of loss in consumer surplus has not been made for years 2008-2009, because the estimated demand equation and price equation do not include time fixed effects that could be easily extrapolated to 2008-2009. As discussed in the previous section, this study has used a different specification (which is presented in the last two columns of Table 9 in Annex A) in order to estimate but-for price and volume in 2008 and 2009. As shown in Table 12 in Annex A, this specification without time fixed effects yields estimates that are similar to the retained specification with time fixed effects. However, as indicated in Table 13 in Annex A, as of 2006 it does not seem to follow the decreasing tendency of fixed telephony penetration. It thus seems more conservative to retain the OECD average penetration of fixed telephony as a proxy of the penetration of fixed telephony in Mexico in 2008. Given this penetration (38%) and the size of the Mexican population in 2008 (107 million), the estimated number of fixed access paths is 40.66 million[16] in 2008. This study does not estimate but-for volume in 2009, as the identified but-for price was below the actual price.

Given the estimated but-for volume for 2008 (40.66 million), the actual level of access paths (20.49 million), the estimated but-for price in 2008 (USD PPP 651), and the actual price (USD PPP 970), the loss in consumer surplus in Mexico in 2008 is USD PPP 13 102 million[17]. The estimated loss in consumer surplus includes USD PPP 6 536 million[18] of consumer overcharge and USD PPP 6 565 million[19] of the loss in consumer surplus due to unrealised transactions. No loss in consumer surplus is estimated for 2009 given that the estimated but-for price is below the actual price.

Estimation of lost consumer surplus in Mexican mobile telephony sector

Estimation strategy for price for mobile telecommunication services

As indicated in the following two tables, the mobile price basket (in USD PPP) in Mexico was relatively high. It significantly exceeded the average, putting Mexico among the ten OECD countries with the most expensive mobile telecommunication services. In 2000-2009, the average price basket amounted on average to USD PPP 568 in Mexico, while the average level among all OECD countries was at USD PPP 443.

Table 46. Average mobile price basket (in USD PPP) in Mexico as compared to price levels in all OECD countries

Year	Price level in Mexico	Observed prices in OECD countries		
		Mean	Min	Max
2000	578	365	148	810
2001	471	324	130	588
2002	851	618	379	1 216
2003	720	577	315	1 125
2004	615	575	261	1 027
2005	610	514	185	965
2006	490	419	114	694
2007	475	393	158	660
2008	464	337	125	662
2009	402	309	106	543

Source: OECD data analysed by Microeconomix

This study estimates the price level that could have been observed in Mexico if there had been more competition in the Mexican market for mobile telecommunication services. It uses other OECD countries as a benchmark, including those with relatively high prices of mobile telecommunication services (for example Czech Republic), and controls for local market conditions (such as for example level of urbanisation, density, level of competition). It hence estimates the prices of mobile telecommunication services that other OECD countries would have observed if they had the same local market conditions as Mexico.

Table 47. Rank of mobile average price basket in Mexico[1]

Year	Rank of Mexico	Number of countries compared
2000	26	28
2001	28	30
2002	27	30
2003	24	30
2004	23	30
2005	23	30
2006	22	30
2007	24	30
2008	25	30
2009	23	30

[1]Price baskets were ranked from the lowest to the highest.

Source: OECD data analysed by Microeconomix

The estimation technique is the same as for fixed telephony. In particular, a system of joint equations including the price equation and the demand equation is first estimated for all countries except Mexico. Next, the estimated price equation is extrapolated to local market conditions in Mexico in order to obtain estimates of competitive prices.

Estimation strategy for number for mobile telecommunication services

The market for mobile telecommunication services does not appear to be well penetrated in Mexico. As indicated in tables below, the penetration of mobile phones in Mexico was close to the observed minimum among OECD countries.

Table 48. Mobile penetration in Mexico vs. mobile penetration in all OECD countries

Year	Mexico	OECD average	OECD minimum	OECD maximum
2000	14%	54%	14%	77%
2001	22%	65%	22%	98%
2002	26%	72%	26%	107%
2003	30%	78%	30%	120%
2004	37%	86%	37%	142%
2005	45%	94%	45%	156%
2006	53%	100%	53%	152%
2007	63%	108%	62%	152%
2008	71%	114%	66%	169%
2009	78%	121%	71%	180%

Source: OECD data analysed by Microeconomix

Table 49. Position of the penetration of mobile telephony in Mexico in the ranking of OECD countries (listing mobile market penetration from the highest to the lowest)

Year	Rank of Mexico	Number of countries compared
2000	29	29
2001	30	30
2002	30	30
2003	30	30
2004	30	30
2005	30	30
2006	30	30
2007	29	30
2008	29	30
2009	22	23

Source: OECD data analysed by Microeconomix

As explained in Section 1, the present study uses a three-step approach in order to estimate mobile phone subscriptions that could have been observed in Mexico given local market conditions if there had been more competition in the market for mobile telecommunication services.[20] The study uses all the other OECD countries except Mexico as a benchmark for competitive prices of mobile telecommunication services in Mexico, while controlling for local market conditions (such as for example size of population, age distribution, level of education or percentage of females in total population). This appears to be a conservative approach as it compares Mexico to countries potentially characterised by relatively low mobile phone penetration and relative high prices of mobile telecommunication services (for example Canada).

Estimated price and demand equations

The following table presents the estimation results for the simultaneous system of demand equation and price equation for the mobile telecommunication services. This specification has been chosen as the best fitted among other tested specifications[21], using R^2 and the significance of variable as the selection criteria.

Price equation

The price for mobile ("price") telecommunication services is found to be decreasing in the number of competitors ("nb_competitors") and urbanisation rate ("urban_rate"). It is increasing in the size of the country ("area") and the percentage of landmass used by cumulative 50% of the population ("land_use"). Hence, it appears that provisioning mobile telephony services is cheaper in more urbanised countries, countries occupying smaller areas or countries in which the population uses a smaller part of the country's area. Furthermore, the level of competition, measured by the number of mobile operators ("nb_competitors"), tends to have a negative impact on the price of mobile telephony services.

Table 50. Estimation results for demand system for mobile telecommunication services

	3SLS	
VARIABLES	volume	price
Price	-0.0280**	
	(0.0118)	
Population	0.862***	
	(0.0488)	
Population²	-0.000941***	
	(0.000173)	
Education	-30.73**	
	(15.02)	
Age_over_64_rate	124.1***	
	(32.81)	
Year	-2.118***	30.50**
	(0.364)	(15.13)
Year²	0.00106***	-0.0151**
	(0.000183)	(0.00756)
First_methodology_revision	5.322*	318.2***
	(2.752)	(58.00)
Second_methodology_revision		254.6**
		(103.3)
Area		1.60e-05**
		(6.52e-06)
Land_use		5.752***
		(1.413)
Urban_rate		-247.4**
		(113.2)
Nb_competitors		-56.18***
		(11.86)
Observations	113	113
R-squared	0.957	0.926

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: OECD and World Bank data analysed by Microeconomix

The identified effects appear robust, as shown in Tables 1-4 in Annex B. The impact of the number of competitors on the price of mobile telephony is always negative and statistically significant. The impact of the urbanisation rate on the price of mobile telephony is always negative and most of the time statistically significant. The area of the country is found to have, most of the time, a positive statistically significant effect on price. The percentage of landmass used by cumulative 50% of the population always has a positive and statistically significant impact on the price of mobile telephony.

The impact of several other variables on the price of mobile telephony has also been tested, as presented in Tables 1-4 in Annex B. Population density has never been found to significantly influence the price. However, its impact may be partially captured by other variables (for example the urbanisation rate). No statistically significant effect has also been identified for the variable indicating that a given price basket includes a prepaid plan. Finally, other variables measuring the level of competition (such as the OECD indicator of the level of barriers to competition and the HHI index) have been tested, but the number of competitors was found to yield the estimation generating the highest R^2.

The price equation includes time effects measured by four different variables ("year", "year²", "first_methodology_revision" and "second_methodology_revision"). Time fixed effects were also tested, but replacing time fixed effects by the indicated four time variables led to a higher R^2. As discussed in Section 1, no country fixed effects were estimated because the data used for the estimation of the price equation did not include the data for Mexico.[22]

The price equation has been estimated assuming standard errors. Table 5 in Annex B compares the estimated price equation with the price equation using OLS with robust standard errors. None of the identified effects becomes statistically insignificant. The signs of the coefficients remain the same. The values of the coefficients are similar. The identified results appear hence robust and do not seem to be biased by the potential presence of heteroscedasticity.

Demand equation

The demand equation indicates that the number of mobile subscriptions negatively depends on the price. This is a typical characteristic of a demand for a standard good. As the price increases, fewer consumers want to buy it.

The number of mobile subscriptions ("mobile_subscriptions") appears to depend positively on the size of the population ("population") and negatively on the square of the population ("population²"). This suggests diminishing scale effects.

The percentage of people aged over 64 ("age_over_64_rate") is found to positively affect the number of mobile subscriptions. Hence, countries with older people tend to have more mobile subscriptions. This may be explained by the fact that older people may have a preference to spend more time over the phone and are thus more inclined to subscribe to mobile services. It may also be justified by the fact that families of older people may be more inclined to subscribe to mobile telecommunication services in order to be able to more easily reach the older family members.

The number of mobile subscriptions is negatively correlated with the percentage of the labour force which has completed tertiary education ("education"). This may be because the more skilled labour force has less time to spend on private mobile phones and is hence less inclined to subscribe to mobile services. More educated employees may also have easier access to other forms of telecommunication (for example work mobile phones) and prefer not to have a private mobile subscription.

The identified effects appear robust, given the estimation results presented in Tables 1-4 in Annex B. The impact of the price on the number of mobile subscription is most of the time negative and statistically significant. Diminishing scale effects have been identified in all the tested specifications. The impact of the percentage of people aged over 64 has been always found positive and most of the time statistically significant. The impact of the percentage of the labour force which has completed the tertiary education level has always been found negative and most of the time statistically significant.

The impact of other variables ("education_new", "GDP", "age_0_14_rate" and "female_rate") has been also tested. The impacts of "education_new" , "female_rate" and "GDP" on the number of mobile subscriptions always turned out to be insignificant. Thus, it appears that the level of mobile subscriptions in a given country does not depend on the level of its GDP, the percentage of females in the society or the percentage of the population that has entered tertiary education. The impact of "age_0_14_rate" was insignificant most of the time, so it seems that the number of mobile subscriptions is also not related to the percentage of the population aged below 15 years.

The demand equation includes time effects measured by three different variables ("year", "year²" and "first_methodology_revision"). Time fixed effects were also tested, but replacing time fixed effects by the indicated four time variables led to a higher R^2.

As already discussed, no fixed country effects were estimated, because data for Mexico has not been used to estimate the demand equation. This is because this data may likely be biased by the low level of competition in the Mexican mobile telephony sector and eliminating this bias may be impossible given the available data.

Table 6 in Annex B compares the estimated demand equation with the demand equation using identical specification and 2SLS with robust errors. None of the identified effects becomes statistically insignificant. The identified results hence appear robust and do not seem to be biased by the potential presence of heteroscedasticity.

Estimated but-for prices

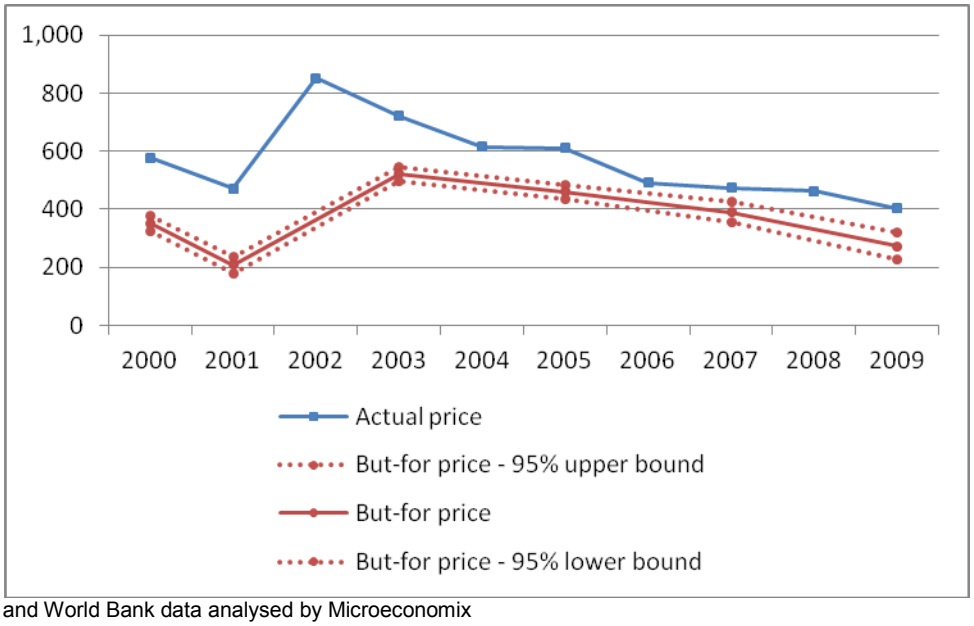
The estimated price equation has been used to estimate the price level that would have been observed in Mexico if there had been more competition. The estimation results are presented in the following table and figure. The estimated but-for price[23] was significantly lower than the actual prices in the years 2000-2009.

Table 51. Estimated but-for prices of mobile telecommunication services vs. actual prices in Mexico (in USD PPP)[1]

Year	Observed price	But-for price	Overcharge
2000	578	352	226
2001	471	209	262
2002	851	na	na
2003	720	522	199
2004	615	na	na
2005	610	460	150
2006	490	na	na
2007	475	391	84
2008	464	na	na
2009	402	273	129

Source: OECD and World Bank data analysed by Microeconomix

Figure 17. But-for prices of mobile telecommunication services vs. actual prices (in USD PPP)[1]



Source: OECD and World Bank data analysed by Microeconomix

The estimated price equation could be used to predict prices in other OECD countries. The estimated overcharges for all OECD countries are presented in Figure 1 in Annex B. There is no apparent indication of any downward bias.

The estimated but-for prices concern the years for which data on the number of operators is available (2000, 2001, 2003, 2005, 2007 and 2009). For the remaining years (2002, 2004, 2006 and 2008), it is assumed that the but-for price followed the same evolution as the actual price. In other words, it is assumed

[1] But-for prices have been estimated using the price equation.

that the shocks affecting but-for price would be the same as the shocks affecting the actual price. The estimated but-for prices for all years are indicated in the table and figure below.

Table 52. Estimated but-for prices of mobile telephony services vs. the actual prices in Mexico (in USD PPP) [2]

Year	Observed price	But-for price	Individual overcharge
2000	578	352	226
2001	471	209	262
2002	851	377	473
2003	720	522	199
2004	615	446	170
2005	610	460	150
2006	490	370	121
2007	475	391	84
2008	464	382	82
2009	402	273	129

Source: OECD and World Bank data analysed by Microeconomix

Figure 18. But-for prices of mobile telecommunication services vs. actual prices in Mexico (in USD PPP)[2]

Source: OECD and World Bank data analysed by Microeconomix

[2] But-for prices have been estimated using the price equation and the actual price evolution.

The overcharge of existing consumers is estimated by multiplying the estimated overcharge by the number of mobile subscriptions. The estimation results are presented in the table below.

Table 53. Overcharge of existing consumers (in million USD PPP)

Year	Overcharge per subscription	Number of mobile subscriptions	Overcharge of existing customers
2000	226	14.08	3 184
2001	262	21.76	5 697
2002	473	25.93	12 274
2003	199	30.10	5 980
2004	170	38.45	6 528
2005	150	47.13	7 077
2006	121	55.40	6 685
2007	84	66.56	5 585
2008	82	75.30	6 171
2009	129	83.53	10 783

Source: OECD and World Bank data analysed by Microeconomix

Estimated but-for volumes

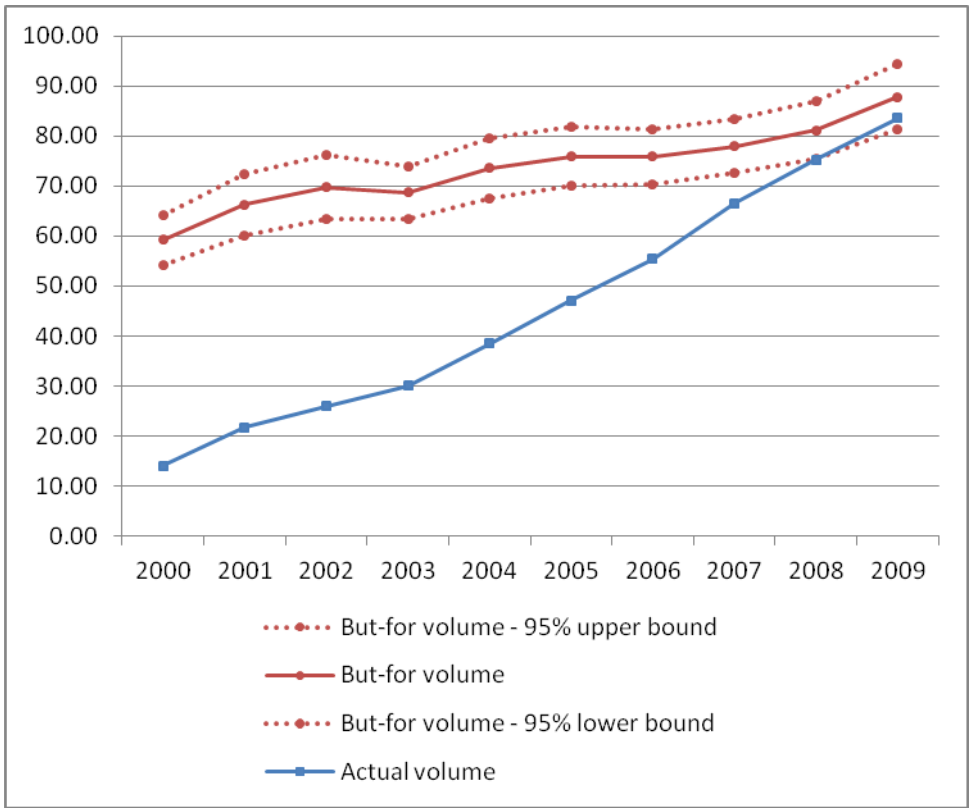
The estimated but-for prices of mobile telecommunication services have been used together with the estimated demand equation to evaluate the level of mobile subscriptions that would have been observed in Mexico if there had been more competition in the market for mobile telecommunication services.[24] The following assumptions have been made concerning the missing data. First, the percentage of the population that entered the tertiary education in Mexico was assumed to be the same in 2009 and in 2008 (0.5%).[25] Second, the missing values of the variables "age_over_64_rate", "population" and "female_rate" were replaced by the World Bank data.[26] Third, the World Bank data was used to calculate the value of "population²" in Mexico in 2009.[27] The estimation results are presented in the following table and the following figure.

Table 54. But-for level of the mobile subscriptions vs. the actual level of mobile subscriptions (in millions)

Year	Actual number of mobile subscriptions	But-for number of mobile subscriptions	Lost subscriptitions
2000	14.08	59.18	45.10
2001	21.76	66.24	44.48
2002	25.93	69.79	43.86
2003	30.10	68.68	38.59
2004	38.45	73.53	35.08
2005	47.13	75.83	28.71
2006	55.40	75.87	20.48
2007	66.56	77.97	11.41
2008	75.30	81.16	5.86
2009	83.53	87.80	4.27

Source: OECD and World Bank data analysed by Microeconomix

Figure 19. But-for level of the mobile subscriptions vs. the actual level of mobile subscriptions (in millions)



Source: OECD and World Bank data analysed by Microeconomix

The actual volume of mobile subscriptions in 2009 exceeds the lower bound of the confidence interval.[28] It hence appears conservative to suppose that in 2009 there were no lost mobile subscriptions resulting from excessive pricing of mobile telephony services in Mexico.

The demand equation may be used to predict volumes of mobile subscriptions for all OECD countries. Figure 3 in Annex B depicts the difference between the predicted volume and the actual volume. It does not indicate any apparent estimation bias.

The estimated but-for volumes of mobile subscriptions imply the following lost consumer surplus due to unrealised transactions.

Table 55. Lost consumer surplus due to unrealised mobile subscriptions (in million USD PPP)

Year	Lost mobile subscription	But-for price	Lost consumer surplus
2000	45.10	352	7 932
2001	44.48	209	4 641
2002	43.86	377	8 274
2003	38.59	522	10 063
2004	35.08	446	7 817
2005	28.71	460	6 602
2006	20.48	370	3 785
2007	11.41	391	2 230
2008	5.86	382	1 117

Source: OECD and World Bank data analysed by Microeconomix

The overall lost consumer surplus, combining overcharge of existing customers and consumer loss due to unrealised transactions, is presented in the following tables.

Table 56. Estimated loss in consumer surplus resulting from excessive pricing of mobile telecommunication services in Mexico (in million USD PPP)

Year	Overcharge of existing consumers	Unrealised subscriptions	Total loss in consumer surplus
2000	3 184	7 932	11 116
2001	5 697	4 641	10 339
2002	12 274	8 274	20 548
2003	5 980	10 063	16 043
2004	6 528	7 817	14 344
2005	7 077	6 602	13 678
2006	6 685	3 785	10 470
2007	5 585	2 230	7 815
2008	6 171	1 117	7 288
2009	10 783	0	10 783

Source: OECD and World Bank data analysed by Microeconomix

Table 57. Estimated loss in consumer surplus resulting from excessive pricing of mobile telecommunication services in Mexico (% of Mexican GDP)

Year	Overcharge of existing consumers	Unrealised subscriptions	Total loss in consumer surplus
2000	0.3%	0.8%	1.1%
2001	0.6%	0.5%	1.0%
2002	1.2%	0.8%	2.0%
2003	0.5%	0.9%	1.4%
2004	0.5%	0.7%	1.2%
2005	0.5%	0.5%	1.1%
2006	0.5%	0.3%	0.7%
2007	0.4%	0.1%	0.5%
2008	0.4%	0.1%	0.4%
2009	0.7%	0%	0.7%

Source: OECD and World Bank data analysed by Microeconomix

Estimation of lost consumer surplus in the Mexican broadband sector

Estimation strategy for prices of broadband subscriptions

As the table below indicates, the relative price of a broadband subscription (in USD PPP per kbit/s) in Mexico exceeded the average price of a broadband subscription in OECD countries. In particular, it amounted to USD PPP 0.73 per kbit/s in 2005-2009, while the OECD average was at USD PPP 0.21 per kbit/s.

Table 58. Average annual costs for broadband subscriptions (DSL and cable) per kbit/s (in USD PPP)

Year	Mexico	OECD average	OECD minimum	OECD maximum
2005	1.222	0.411	0.006	2.145
2006	0.622	0.239	0.006	1.157
2007	0.526	0.150	0.007	0.526
2008	0.753	0.129	0.004	0.753
2009	0.512	0.113	0.004	0.512

Source: OECD data analysed by Microeconomix

As the table below presents, in 2005, Mexico had the third (relative) highest price (in USD per kbit/s) for a broadband subscriptions among all OECD countries. In 2006, the price of a broadband subscription in Mexico was the second highest. As of 2007, it was the highest.

Table 59. Rank[3] of Mexico with respect to the average annual cost for broadband subscription (DSL and cable) in USD PPP per kbit/s

Year	Rank of Mexico	Number of countries compared
2005	25	27
2006	26	27
2007	27	27
2008	27	27
2009	27	27

Source: OECD data analysed by Microeconomix

Prices of broadband subscriptions in Mexico appear more competitive when broadband speed is not taken into account. As indicated in table below, in 2005-2009, the average price of a broadband subscription amounted to USD PPP 782 in Mexico. At the same time, the price of a broadband subscription was on average USD PPP 702 in all OECD countries. It thus seems that a low degree of competition in the Mexican broadband sector mainly had an impact on broadband speed and had a lower impact on the price of a broadband subscription.

Table 60. Average annual costs for broadband subscriptions (DSL and cable) (in USD PPP)

Year	Mexico	OECD average	OECD minimum	OECD maximum
2005	1 251	1 024	405	3 436
2006	637	767	365	2 369
2007	608	608	278	1 179
2008	836	569	304	973
2009	576	542	320	968

Source: OECD data analysed by Microeconomix

The present study investigates whether, given local market conditions in Mexico, the observed prices of the broadband subscriptions could have been lower. The estimation strategy is the same as for the fixed telephony and the mobile telephony. First, the relationship between local market conditions and prices of broadband subscriptions is estimated for all OECD countries except Mexico. Second, the estimated price function is extrapolated to local market conditions in Mexico in order to estimate but-for prices, which is the price that would have been observed in Mexico, if broadband had been more competitive there.

Estimation strategy for broadband penetration

The broadband penetration in Mexico tends to be one of the lowest among OECD countries, as indicated in the tables below.

[3] Prices were ranked from the lowest to the highest.

Table 61. Percentage of population with a broadband subscription (DSL or cable)

Year	Mexico	OECD average	OECD minimum	OECD maximum
2000		1.29%	0.01%	8.32%
2001	0.07%	2.53%	0.01%	17.13%
2002	0.20%	4.42%	0.04%	19.36%
2003	0.39%	6.80%	0.14%	21.98%
2004	0.97%	9.98%	0.69%	22.60%
2005	2.18%	13.92%	2.12%	26.00%
2006	2.81%	17.05%	2.81%	30.61%
2007	4.14%	19.97%	4.14%	33.68%
2008	6.95%	21.62%	6.95%	35.08%
2009	8.76%	22.62%	8.28%	36.37%

Source: OECD data analysed by Microeconomix

Table 62. Rank of Mexico with respect to the percentage of population with a broadband subscription (DSL or cable)[4]

Year	Rank of Mexico	Number of countries compared
2001	23	26
2002	23	26
2003	26	28
2004	27	29
2005	27	28
2006	27	27
2007	27	27
2008	27	27
2009	19	20

Source: OECD data analysed by Microeconomix

The present study estimates the broadband penetration that could have been obtained in Mexico given local market condition and tendencies observed in other OECD countries. It uses a two-step approach. The first step estimates the price for broadband subscriptions that would have been observed in Mexico if there had been more competition in the market for broadband services and the second step uses this estimated price to estimate the corresponding broadband penetration.

[4] Volumes were ranked from the highest to the lowest.

Estimated price and demand equations

Price equation

Among several tested specifications, presented in Tables 1-4 in Annex C, the specification presented in the following table was chosen as the most fitting specification for broadband demand system. The choice of the specification was made on the basis of R^2 and the statistical significance of the explanatory variables.

Table 63. Estimated demand system for broadband services (DSL and cable)

VARIABLES	volume	price
price	-0.00486***	
	(0.000741)	
GDP	6.36e-05***	
	(1.46e-05)	
population	0.186***	
	(0.00475)	
cable_share	4.588***	
	(1.647)	
2006.year		-239.6**
		(108.2)
2007.year		-401.9***
		(108.7)
2008.year		-459.2***
		(109.0)
2009.year		-501.5***
		(119.1)
land_use		10.32**
		(4.180)
Constant		811.4***
		(112.7)
Observations	123	123
R-squared	0.944	0.201

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: OECD data analysed by Microeconomix

The identified price equation indicates that the price of a broadband subscription has a tendency to decrease over time at an increasing speed. Furthermore, the price of a broadband subscription positively depends on the percentage of landmass used by cumulative 50% of the population ("land_use"). This may be explained by the fact that it may be more expensive to provide broadband to a population occupying a greater part of a country's area.

The identified results appear robust in specifications presented in Tables 1-4 in Annex C. The impact of the percentage of landmass used by cumulative 50% of the population ("land_use") on the price of a broadband subscription is always found positive and most of the time statistically significant. The tendency of a price of a broadband subscription to decrease at an increasing speed is confirmed by every specification presented in Tables 1-4 in Annex C.

The impact of other variables on the price of a broadband subscription has been tested in specifications 1-4 in Annex C. The impact of a country's size ("area") on the price of a broadband subscription was not statistically significant in most of the specifications. Population density had a negative and statistically significant impact on the price when the variable describing the level of education ("education") was used in the demand equation, but once this variable was dropped from the demand equation[29] the impact of the population density on the price became statistically insignificant. Density may hence have a certain impact on the price, but even if this effect exists it is likely captured by the variable "land_use". Similarly, the impact of the share of cable broadband subscriptions ("cable_share") on the price was only significant in specifications with the variable "education" occurring in the demand equation. This casts a doubt about the robustness of the identified effect of the "cable_share" on the price. The level of urbanisation ("urban_rate") never had a statistically significant effect on the price. The level of regulatory barriers in post and telecommunications ("regulatory barriers") had a statistically insignificant effect most of the time. Broadband speed ("speed_distance"), measured as a distance between the actual speed and the OECD average in a given year, never had a significant effect on the price.

The techniques used to estimate the price equation (3SLS) assumes standard errors. The estimated price equation is compared to the price equation estimated using OLS with standard errors and to the price equation estimated using OLS with robust standard errors in Table 5 in Annex C. The estimated coefficients have the same signs and similar levels in both specifications. All but one coefficient are statistically significant. The only coefficient that is not statistically significant at 10% is statistically significant at 11%. It hence appears that potential presence of heroscedasticity does bias results identified by the price equation.

Demand equation

The demand for broadband subscriptions is found to negatively depend on the price and be positively affected by GDP ("GDP"), size of population ("Population") and the share of cable broadband subscriptions ("cable_share"). It thus appears that consumers are more inclined to opt for a broadband subscription if it is cheaper or if they have higher disposable income.[30] Furthermore, countries with a higher population tend to have more broadband subscriptions. Last but not least, countries in which cable subscriptions play a more important role tend to have more internet subscriptions. This may be because consumer may be more inclined to subscribe to broadband services if they are offered a package with cable television.[31]

The estimated results appear robust, as indicated in Tables 1-4 in Annex C. The impact of the price on the volume of broadband subscriptions is always negative and most of the time statistically significant. The impact of GDP was most of the time positive and statistically significant. The impact of population was always positive and statistically significant. The impact of the share of cable broadband subscriptions was always positive. Furthermore, it was statistically significant in all the specifications without the variable "education".

The demand equation has been estimated using 3SLS with standard errors. Table 6 in Annex C compares the estimated equation with the demand equation estimated using 2SLS with robust standard errors. The estimated coefficients are at similar levels, have the same signs and are all statistically significant. Potential presence of heteroscedasticity hence does not appear to affect the effects identified by the demand equation.

Effects of other variables on the volume of broadband subscriptions have been tested in specifications presented by Tables 1-4 in Annex C. The impact of square population ("population²") was statistically insignificant most of the time, so it has been dropped. Similarly, the impact of the percentage of females in the society ("female_rate") has been statistically insignificant most of the time. The percentage of the

labour force which has completed tertiary education ("education") has mostly not had a statistically significant effect on the volume of broadband subscriptions. The percentage of the population that has entered tertiary education ("education_new") has had a statistically insignificant effect on the volume of broadband subscriptions. The age distribution ("age_0_14_rate" and "age_over_64_rate") was also found not to affect the volume of broadband subscriptions. Finally, no significant time fixed effects were identified.

Estimated but-for prices

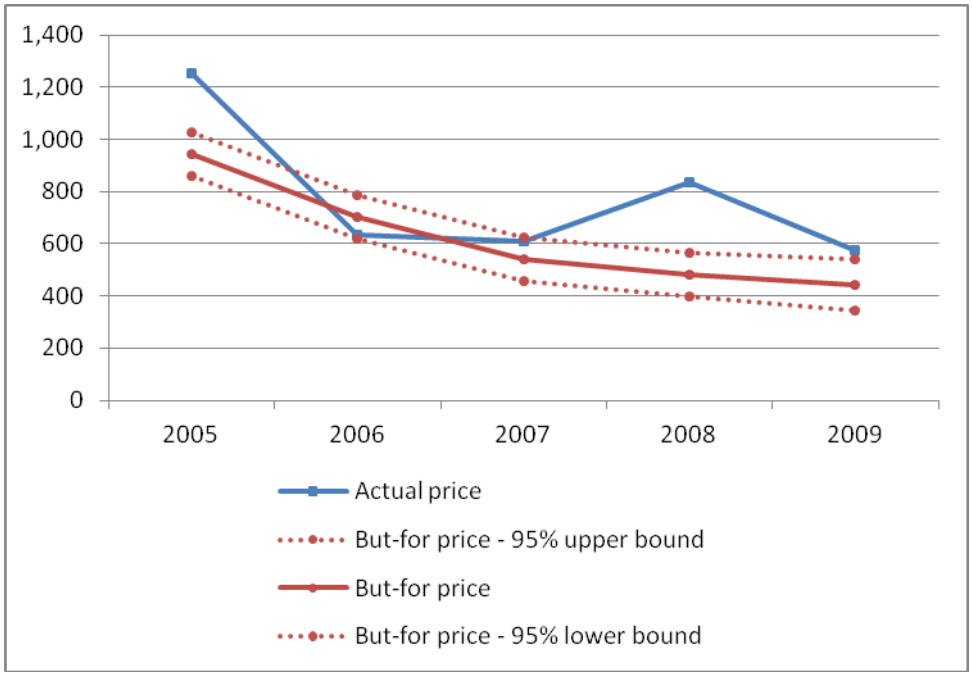
The estimated but-for prices are presented in the table below.[32] Actual prices are rather close to the estimated but-for prices in 2006 and 2007 and significantly exceed the estimated prices in 2005, 2008 and 2009. The estimated but-for prices do not take into account the fact that broadband speed in Mexico is often significantly slower than in other OECD countries. In other words, but-for prices are estimated under the implicit assumption that broadband speed in Mexico is comparable to broadband speed observed in other OECD countries.[33] This implicit assumption may be justified by the fact that increased competitiveness of the Mexican broadband sector would likely result in increased broadband speed.[34]

Table 64. Actual prices of broadband services (DSL and cable) vs. estimated but-for prices in USD PPP

Year	Actual price	But-for price	Difference
2005	1 251	942	309
2006	637	703	-66
2007	608	541	67
2008	836	483	353
2009	576	441	135

Source: OECD data analysed by Microeconomix

Figure 20. Actual prices of broadband services (DSL and cable) vs. estimated but-for prices in USD PPP



Source: OECD data analysed by Microeconomix

It appears conservative to retain but-for prices only for the years in which the actual price exceeds the estimated upper bound of the 95% confidence interval. The actual price is above the upper bound of the 95% confidence of the estimated but-for price in years 2005, 2008, 2009. But-for prices are therefore retained for those years. In years 2006 and 2007, the actual price falls into the estimated 95% confidence interval. Estimated but-for prices are hence dropped for those years and replaced by the actual prices.

The following table overviews the estimated individual overcharges and calculates total overcharges of existing consumers. As presented in the table below, the estimated total consumer overcharge amounts to USD PPP 700 million in 2005, USD PPP 2 615 million in 2008 and USD PPP 1 274 million in 2009. No overcharge is estimated for 2006 and 2007, because actual prices fall into estimated 95% confidence intervals for those years, suggesting that consumers might not have been overcharged in those years. The actual loss in consumer surplus could be significantly higher than the estimates presented in the table below, as the present study does not quantify the loss suffered by existing consumers because of the poor broadband speed in Mexico.

Table 65. Estimated overcharge of existing consumers (in million USD PPP)

Year	Broadband subscriptions (in millions)	Individual overcharge (in USD PPP)	Total overcharge (in M USD PPP)
2005	2,27	309	700
2006	2,95	0	0
2007	4,38	0	0
2008	7,42	353	2 615
2009	9,41	135	1 274

Source: OECD data analysed by Microeconomix

Estimated but-for volumes

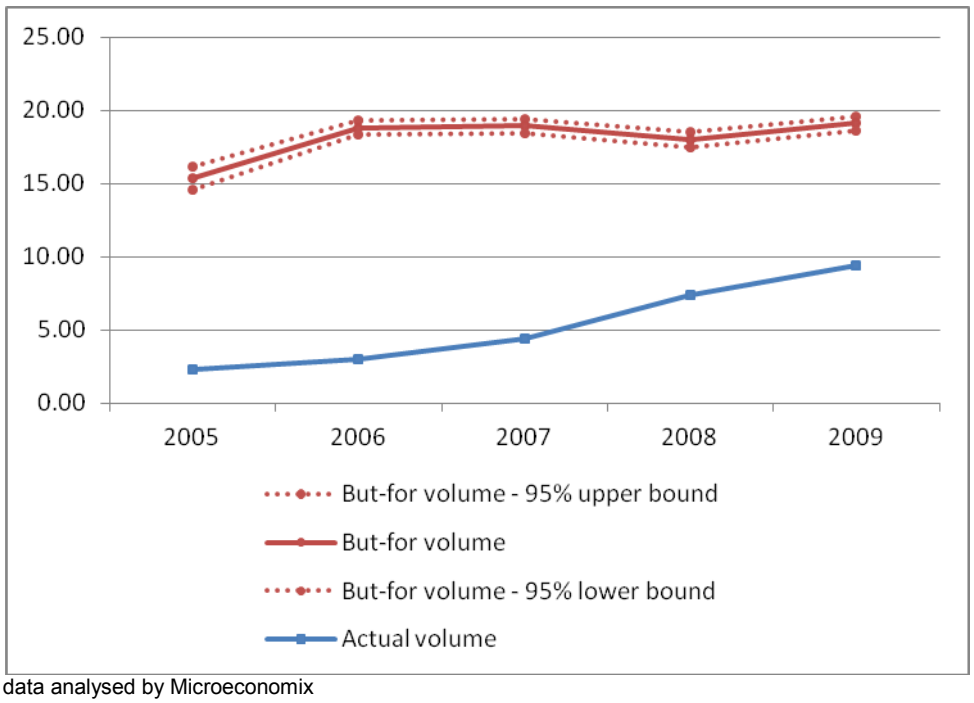
Estimated but-for numbers of broadband (DSL and cable) subscriptions are presented in the table below.[35] The estimated but-for volumes are significantly higher than actual volumes. This happens for two reasons. First, more competition in Mexican broadband might have led to lower prices that would have translated into higher volumes. Second, increased competitiveness of Mexican broadband might have resulted in higher broadband speed that could further boost the number of broadband subscriptions.

Table 66. Actual number of broadband (DSL and cable) subscriptions vs. estimated but-for number (in millions)

Year	Actual volume	But-for volume	Unrealised subscriptions
2005	2,27	15,39	13,12
2006	2,95	18,82	15,87
2007	4,38	18,95	14,56
2008	7,42	17,98	10,56
2009	9,41	19,12	9,71

Source: OECD data analysed by Microeconomix

Figure 21. Actual number of broadband (DSL and cable) subscriptions vs. estimated but-for number (in millions)



Source: OECD data analysed by Microeconomix

The tables below summarise total loss in consumer surplus in Mexican broadband sector estimated by comparing actual volumes and prices to the estimated but-for volumes and prices.

Table 67. Estimated loss in consumer surplus in the market for broadband services (in million USD PPP)

Year	Overcharge of existed consumers	Unrealised subscriptions	Total
2005	700	6 180	6 880
2006	0	5 055	5 055
2007	0	4 426	4 426
2008	2 615	2 550	5 165
2009	1 274	2 141	3 415

Source: OECD data analysed by Microeconomix

Table 68. Estimated loss in consumer surplus in the market for broadband services (% of Mexican GDP)

Year	Overcharge of existed consumers	Unrealised subscriptions	Total
2005	0.1%	0.5%	0.5%
2006	0.0%	0.4%	0.4%
2007	0.0%	0.3%	0.3%
2008	0.2%	0.2%	0.3%
2009	0.1%	0.1%	0.2%

Source: OECD data analysed by Microeconomix

1 3SLS allows resolving potential reverse causality and simultaneity issues.

2 The choice of the control variables is discussed in the following section.

3 Since the variable controlling for factors potentially facilitating market power abuses (such as for example the level of regulatory barriers) occurs in the estimated price equation, but-for prices are interpreted as prices that would have been observed in Mexico if there have been more effective (and not potential) competition in the Mexican telecommunication sector. This is justified by the fact that there is a clear distinction between factors potentially allowing for market power abuses and the actual presence of market power abuses. Indeed, factors facilitating market power abuses (for example barriers to entry) do not necessarily imply that the market power is actually abused.

4 An alternative approach would be to take the OECD data for fixed line subscriber market share of new entrants (% of total fixed analogue subscriber lines) as a proxy of the competition in the fixed telecommunication sector. This proxy has not been used, as this statistic is not available for Mexico.

5 This statistics has been derived using the expenditure approach.

6 The first step estimates a joint system of equations including the price equation and the demand equation using 3SLS technique and the data concerning all countries but Mexico. The second step extrapolates the estimated price equation to the local market conditions in order to infer the prices of fixed telecommunication services that could have been observed in Mexico if there had been more competition.

7 The first step of this three-step approach uses 3SLS in order to estimate a joint system of price equation and demand equation for all OECD countries but Mexico. The second step uses the estimated price equation in order to infer prices of fixed telecommunication services that would have been observed in Mexico if there had been more competition in the Mexican market for fixed telecommunication services. The third step combines these estimated prices with the estimated demand equation in order to estimate the fixed telecommunication penetration level that would have been observed in Mexico if there had been more competition in the Mexican telecommunication sector.

8 The indicator measuring the level of restrictions to competition in local postal services and telecommunications does not necessarily measure the level of competitiveness of the sector. For example, a given sector may have high entry barriers and is heavily regulated. Under those circumstances, the indicator measuring the level of restrictions to competition may indicate a high level of barriers to competition, while the sector may appear very competitive as compared to other countries.

9 The lower and upper bounds of confidence intervals are presented in Table 7 in Annex A.

10 An alternative approach would be to extend the observed trend to years 2008-2009. This study prefers however to avoid the risk of underestimating but-for prices by taking too high values of the OECD regulation impact indicator.

11 The 95% confidence interval is [627, 675].

12 The 95% confidence interval is [642, 692].

13 (970-651)*20.49

14 Even though the price of fixed telecommunication services was cut almost in half in 2009, the number of fixed access paths decreased from 20.49 million in 2008 to 19.33 million in 2009.

15 Standard errors for the point predictions are presented in Table 11 in Annex A.

16 0.38*107 millions = 40.66 millions.

17 (970-651)*20.49+0.5*651*40.66=13 102

18 (970-651)*20.49=6 536

19 0.5*651*40.66=6 565

20 In the first step of this three-step approach a joint system of demand equation and price equation is estimated. The second step estimates the prices of mobile telecommunication services that could have been observed in Mexico if there had been more competition in the market for mobile telecommunication services. The third step uses these estimated prices and estimated demand equation in order to predict the number of mobile phone subscriptions that could have been observed in Mexico if the prices of telecommunication services had been more competitive.

21 Other tested specifications are presented in tables 1-4 in Annex B.

22 The price equation does not include any country fixed effects as the data used for the estimation did not include Mexico. It was thus not possible to estimate a fixed country effect for Mexico. The inclusion of Mexico in the data used for the estimation of the price equation did not appear a valid option, because this data could reflect low level of competition in the Mexican mobile telephony. The retained proxy of the level of competition (number of competitors) is imperfect and would likely be unable to separate perfectly the low level of competition in Mexican mobile telephony. Therefore, the estimated fixed effect for Mexico would likely include this lack of competition. This would yield a risk of reaching a likely false conclusion that prices of mobile telephony are not excessive in Mexico, simply because it is Mexico.

23 The confidence intervals for these point estimates are presented in table 7 in Annex B.

24 The predicted number of mobile subscriptions for all OECD countries are compared with the actual numbers in Figure 3 in Annex B. The interval predictions are presented in table 8 in Annex B.

25 This is a conservative assumption given the observed tendency of the percentage of the population that has entered the tertiary education in OECD countries to increase (see Figure 2 in Annex B for illustration).

26 According to the World Bank, the percentage of the population aged over 64 years was 6.39% in 2009 in Mexico. The size of the Mexican population in 2009 was 107,4 millions. The female rate was 50,76% in Mexico in 2009.

27 According to the World Bank, the size of the Mexican population in 2009 was 107,4 millions. The value of "population²" for Mexico 2009 is hence 107,4^2=11541,47.

28 The confidence intervals are presented in table 8 in Annex B.

29 The variable "education" was dropped from the demand equation because most of the time it had a statistically insignificant effect on the number of broadband subscriptions.

30 The estimated positive correlation between GDP and price of broadband subscription may in theory be composed of two elements *i)* wealth effect (higher propensity of consumers from richer countries to subscribe to broadband services) and *ii)* positive impact of the volume of broadband subscriptions on GDP. The existence of the second component may in theory upwardly bias but-for volumes. However, this potential bias is rather small, as completely ignoring the impact of GDP on the volume (that is assuming that the impact of GDP on the volume is null while remaining identified coefficients for all the other variables) would decrease the estimated but-for volume for Mexico by at most 0.01%.

[31] One could argue that in theory the increased demand for broadband subscriptions in countries with higher percentage of cable broadband subscriptions may be explained by the fact that cable broadband subscriptions may be cheaper than DSL broadband subscriptions. However, as presented in Figure 1 in Annex C, there are many cases when a DSL broadband subscription is cheaper than a cable broadband subscription.

[32] Figure 2 in Annex C compares fitted values with actual values for all OECD countries. Interval predictions are presented in table 7 in Annex C.

[33] The effect of the speed in the price equation has been tested but turned out to be statistically insignificant. The impact of broadband speed on the price of a broadband subscription may be difficult to identify as it may combine two opposite effects. On the onehand, broadband speed may positively influence the price of a broadband subscription, because operators may be able to increase the price if they offer higher broadband speed. On the other hand, more competitive broadband sectors may simultaneously observe lower prices and faster broadband connections.

[34] Countries with more competitive broadband sectors tend to have lower prices of broadband subscriptions and higher broadband speed. In Mexico, prices of broadband subscriptions per kbit/s appear particularly high, while total prices appear more competitive. It hence seems that increased competitiveness of Mexican broadband would have a significant effect on the broadband speed and somewhat less significant effect on the price of broadband subscriptions.

[35] Figure 3 in Annex C compares fitted values with actual values for all OECD countries. Interval predictions are presented in table 8 in Annex C.

ANNEX A

Table A1. Estimation results for fixed telephony – specification (1) – (3)

VARIABLES	volume	price	volume	price	volume	price
price	-0.0178***		-0.0169***		-0.0219***	
	(0.00475)		(0.00476)		(0.00310)	
population	0.389***		0.392***		0.384***	
	(0.0204)		(0.0181)		(0.0206)	
population²	0.000653***		0.000725***		0.000674***	
	(7.74e-05)		(6.74e-05)		(7.56e-05)	
GDP	5.94e-05		-0.000109			
	(0.000109)		(0.000104)			
female_rate	215.1***		42.22		237.2***	
	(83.01)		(79.13)		(84.86)	
education_new	-182.2				-218.7	
	(162.2)				(163.9)	
education			-0.750			
			(5.964)			
age_0_14_rate	-42.62*		-26.50		-42.64*	
	(23.81)		(26.72)		(23.66)	
age_over_64_rate	-56.50**		-18.65		-59.28**	
	(21.96)		(21.20)		(24.33)	
area		1.08e-05**		1.24e-05*		9.73e-06*
		(5.47e-06)		(6.79e-06)		(5.39e-06)
land_use		9.836***		11.37***		9.550***
		(1.505)		(1.754)		(1.492)
density		-0.126		-0.0867		-0.116
		(0.0959)		(0.124)		(0.0953)
urban_rate		-325.9**		-530.1***		-334.2**
		(137.6)		(151.5)		(134.9)
regulatory_barriers		535.0***		395.1*		532.3***
		(168.6)		(234.6)		(165.6)
1999.year	3.195**	38.11			3.342**	38.06
	(1.626)	(56.79)			(1.649)	(56.78)
2000.year	4.407**	172.0***	0	0	5.243***	172.0***
	(1.869)	(54.90)	(0)	(0)	(1.673)	(54.88)
2001.year	4.163**	179.2***	-0.210	-5.587	5.049***	179.4***
	(1.896)	(54.54)	(1.144)	(53.53)	(1.662)	(54.49)
2002.year	4.396**	229.1***	0.227	45.21	5.473***	229.3***
	(2.051)	(56.16)	(1.205)	(54.61)	(1.719)	(56.08)
2003.year	3.548*	213.8***	-0.615	27.12	4.619***	213.9***
	(2.067)	(55.92)	(1.214)	(55.31)	(1.705)	(55.83)
2004.year	3.006	222.2***	-0.992	30.67	4.190**	222.2***
	(2.205)	(56.05)	(1.307)	(55.44)	(1.749)	(55.96)
2005.year	2.478	197.3***	-1.222	11.21	3.621**	197.3***
	(2.219)	(56.94)	(1.349)	(56.54)	(1.746)	(56.82)
2006.year	3.096	285.9***	-0.572	86.43	4.705**	285.8***
	(2.677)	(56.65)	(1.751)	(57.65)	(1.856)	(56.50)
2007.year	1.699	277.7***	-0.0666	67.57	3.360*	277.6***
	(2.788)	(57.42)	(1.970)	(61.02)	(1.855)	(57.25)
Constant	-85.92**	333.9**	0.592	675.1***	-93.32**	345.9**
	(43.09)	(139.0)	(39.03)	(149.2)	(44.08)	(136.2)
Observations	221	221	170	170	221	221
R-squared	0.981	0.408	0.989	0.423	0.980	0.407

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

Source: OECD and World Bank data analysed by Microeconomix

Table A2. Estimation results for fixed telephony – specification (4) – (6)

VARIABLES	volume	price	volume	price	volume	price
price	-0.0230***		-0.0190***		-0.0169***	
	(0.00325)		(0.00282)		(0.00227)	
population	0.393***		0.384***		0.384***	
	(0.0201)		(0.0108)		(0.0107)	
population²	0.000646***		0.000664***		0.000663***	
	(7.47e-05)		(4.19e-05)		(4.14e-05)	
female_rate	254.9***		93.81***		85.51***	
	(85.26)		(35.23)		(31.95)	
education_new	-223.2					
	(163.3)					
age_0_14_rate	-46.13**		-37.52***		-22.47**	
	(23.15)		(12.96)		(9.736)	
age_over_64_rate	-67.69***		-20.79			
	(24.37)		(16.49)			
area		1.28e-05***		4.44e-06		4.96e-06*
		(4.90e-06)		(2.77e-06)		(2.81e-06)
land_use		8.937***		6.794***		6.899***
		(1.450)		(0.994)		(1.008)
urban_rate		-425.3***		-471.6***		-475.2***
		(123.2)		(70.48)		(71.78)
regulatory_barriers		575.0***		258.5***		262.3***
		(160.0)		(94.55)		(96.41)
1991.year			0.432	31.11	0.357	31.17
			(1.489)	(50.04)	(1.448)	(50.04)
1992.year			1.181	58.27	1.039	58.51
			(1.472)	(49.44)	(1.429)	(49.44)
1993.year			1.793	66.59	1.625	66.87
			(1.472)	(49.46)	(1.427)	(49.46)
1994.year			2.295	76.67	2.112	77.05
			(1.473)	(49.61)	(1.427)	(49.62)
1995.year			3.089**	103.4**	2.857**	103.9**
			(1.479)	(49.87)	(1.429)	(49.89)
1996.year			2.353	140.3***	2.077	140.8***
			(1.455)	(49.12)	(1.402)	(49.15)
1998.year	0	0	2.855**	196.4***	2.525*	196.9***
	(0)	(0)	(1.422)	(47.62)	(1.364)	(47.68)
1999.year	3.189**	38.56	4.511***	199.1***	4.196***	199.7***
	(1.614)	(55.04)	(1.419)	(48.46)	(1.362)	(48.55)
2000.year	5.244***	169.7***	6.599***	346.2***	5.993***	347.0***
	(1.645)	(53.28)	(1.577)	(49.03)	(1.467)	(49.13)
2001.year	5.118***	178.8***	6.382***	347.7***	5.798***	348.5***
	(1.635)	(52.85)	(1.571)	(49.59)	(1.465)	(49.73)
2002.year	5.606***	230.1***	6.621***	387.6***	5.970***	388.5***
	(1.696)	(54.33)	(1.624)	(50.46)	(1.502)	(50.63)
2003.year	4.752***	215.3***	5.730***	369.8***	5.128***	370.7***
	(1.679)	(54.12)	(1.598)	(50.91)	(1.484)	(51.09)
2004.year	4.383**	223.5***	5.326***	377.6***	4.713***	378.5***
	(1.723)	(54.25)	(1.614)	(50.98)	(1.496)	(51.17)
2005.year	3.814**	201.3***	4.684***	351.2***	4.127***	352.2***
	(1.718)	(55.12)	(1.580)	(51.65)	(1.471)	(51.87)
2006.year	5.102***	294.3***	5.336***	429.7***	4.623***	430.8***
	(1.856)	(54.96)	(1.707)	(51.86)	(1.560)	(52.08)
2007.year	3.748**	286.8***	4.044**	422.9***	3.347**	424.0***
	(1.853)	(55.65)	(1.697)	(52.37)	(1.553)	(52.61)
Constant	-100.3**	387.2***	-31.22*	396.1***	-33.45*	394.0***
	(43.98)	(132.7)	(17.42)	(85.84)	(17.19)	(87.40)
Observations	229	229	398	398	398	398
R-squared	0.979	0.414	0.983	0.529	0.984	0.530

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

Source: OECD and World Bank data analysed by Microeconomix

Table A3. Estimation results for fixed telephony – specification (7) – (9)

VARIABLES	volume	price	volume	price	volume	price
price	-0.0170***		-0.0168***		-0.0161***	
	(0.00228)		(0.00227)		(0.00218)	
population	0.384***		0.384***		0.385***	
	(0.0107)		(0.0107)		(0.0107)	
population²	0.000662***		0.000663***		0.000663***	
	(4.14e-05)		(4.15e-05)		(4.15e-05)	
female_rate	87.60***		87.63***		86.38***	
	(31.66)		(31.69)		(31.46)	
age_0_14_rate	-22.33**		-22.58**		-22.40**	
	(9.728)		(9.732)		(9.688)	
area		4.80e-06*		4.82e-06*		4.97e-06*
		(2.81e-06)		(2.82e-06)		(2.84e-06)
land_use		6.883***		6.917***		7.019***
		(1.010)		(1.012)		(1.018)
urban_rate		-475.5***		-477.0***		-481.8***
		(71.88)		(72.03)		(72.57)
regulatory_barriers		256.3***		251.0***		234.5**
		(96.43)		(96.25)		(96.19)
1994.year	1.319	35.94				
	(1.080)	(37.81)				
1995.year	2.067*	62.65	1.595	52.93	0.986	
	(1.083)	(38.10)	(1.040)	(37.17)	(0.983)	
1996.year	1.291	99.40***		81.10**		72.97**
	(1.048)	(37.06)		(34.58)		(34.23)
1998.year	1.746*	155.4***	1.258	145.4***		124.5***
	(0.998)	(34.98)	(0.944)	(33.86)		(32.16)
1999.year	3.418***	158.0***	2.930***	147.9***	2.591***	135.2***
	(0.998)	(36.06)	(0.944)	(34.91)	(0.910)	(34.10)
2000.year	5.232***	305.1***	4.713***	294.9***	4.274***	281.9***
	(1.138)	(36.79)	(1.080)	(35.62)	(1.026)	(34.78)
2001.year	5.038***	306.5***	4.518***	296.1***	4.077***	282.7***
	(1.137)	(37.51)	(1.078)	(36.31)	(1.023)	(35.43)
2002.year	5.214***	346.4***	4.686***	335.9***	4.222***	322.1***
	(1.184)	(38.64)	(1.124)	(37.43)	(1.065)	(36.52)
2003.year	4.370***	328.5***	3.846***	318.0***	3.398***	304.0***
	(1.164)	(39.21)	(1.105)	(38.00)	(1.048)	(37.08)
2004.year	3.956***	336.4***	3.431***	325.8***	2.978***	311.8***
	(1.181)	(39.30)	(1.122)	(38.09)	(1.063)	(37.17)
2005.year	3.368***	309.9***	2.849***	299.2***	2.418**	285.0***
	(1.151)	(40.16)	(1.092)	(38.95)	(1.038)	(38.01)
2006.year	3.872***	388.5***	3.336***	377.8***	2.852**	363.4***
	(1.264)	(40.43)	(1.204)	(39.22)	(1.140)	(38.28)
2007.year	2.595**	381.6***	2.061*	370.8***	1.585	356.3***
	(1.256)	(41.07)	(1.196)	(39.86)	(1.133)	(38.91)
Constant	-33.71**	438.5***	-33.29*	450.9***	-32.69*	470.5***
	(17.14)	(80.31)	(17.15)	(79.57)	(17.02)	(79.29)
Observations	398	398	398	398	398	398
R-squared	0.984	0.527	0.984	0.526	0.984	0.523

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

Source: OECD and World Bank data analysed by Microeconomix

Table A4. Estimation results for fixed telephony – specification (10)

VARIABLES	Specification 10 volume	price
price	-0.0145***	
	(0.00171)	
population	0.383***	
	(0.0106)	
population²	0.000669***	
	(4.06e-05)	
female_rate	77.60***	
	(29.05)	
age_0_14_rate	-24.74***	
	(8.945)	
area		5.62e-06**
		(2.86e-06)
land_use		7.135***
		(1.024)
urban_rate		-487.3***
		(73.15)
regulatory_barriers		238.2**
		(97.20)
1996.year		76.62**
		(34.60)
1998.year		129.6***
		(32.44)
1999.year	2.189**	135.8***
	(0.866)	(34.15)
2000.year	3.631***	282.6***
	(0.919)	(34.84)
2001.year	3.425***	283.3***
	(0.910)	(35.51)
2002.year	3.512***	322.8***
	(0.933)	(36.63)
2003.year	2.716***	304.8***
	(0.922)	(37.19)
2004.year	2.279**	312.6***
	(0.930)	(37.28)
2005.year	1.763*	285.8***
	(0.916)	(38.14)
2006.year	2.065**	364.4***
	(0.973)	(38.41)
2007.year		350.8***
		(38.79)
Constant	-28.15*	469.6***
	(15.75)	(80.22)
Observations	398	398
R-squared	0.984	0.524

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

Source: OECD and World Bank data analysed by Microeconomix

Table A5. Estimation results for price equation for fixed telephony – 3SLS vs. OLS

	Price equation estimated using 3SLS	Price equation estimated using OLS with standard errors	Price equation estimated using OLS with robust errors
Area	5.62e-06**	4.51e-06	4.51e-06*
	(2.86e-06)	(2.77e-06)	(2.51e-06)
Land_use	7.135***	6.672***	6.672***
	(1.024)	(1.055)	(1.168)
Urban_rate	-487.3***	-451.6***	-451.6***
	(73.15)	(75.54)	(53.57)
Regalatory_barriers	238.2**	165.2*	165.2*
	(97.20)	(97.59)	(96.09)
year1999	135.8***	122.1***	122.1***
	(34.15)	(34.15)	(25.90)
year2000	282.6***	267.4***	267.4***
	(34.84)	(34.79)	(38.53)
year2001	283.3***	266.9***	266.9***
	(35.51)	(35.41)	(40.98)
year2002	322.8***	304.6***	304.6***
	(36.63)	(36.47)	(40.71)
year2003	304.8***	285.7***	285.7***
	(37.19)	(37.00)	(45.80)
year2004	312.6***	293.2***	293.2***
	(37.28)	(37.09)	(43.71)
year2005	285.8***	265.3***	265.3***
	(38.14)	(37.92)	(38.04)
year2006	364.4***	343.3***	343.3***
	(38.41)	(38.17)	(44.61)
year1996	76.62**	68.18*	68.18***
	(34.60)	(35.69)	(26.07)
year1998	129.6***	122.5***	122.5***
	(32.44)	(33.23)	(24.65)
year2007	350.8***	335.4***	335.4***
	(38.79)	(38.79)	(40.82)
Constant	469.6***	492.1***	492.1***
	(80.22)	(82.33)	(57.45)
Observations	398	414	414
R-squared	0.524	0.522	0.522

*** p<0.01, ** p<0.05, * p<0.1,

Source: OECD and World Bank data analysed by Microeconomix

Table A6. Estimation results for demand equation for fixed telephony – 3SLS vs. 2SLS

VARIABLES	3SLS	2SLS with standard errors	2SLS with robust errors
price	-0.0145***	-0.0142***	-0.0142***
	(0.00171)	(0.00171)	(0.00183)
population	0.383***	0.389***	0.389***
	(0.0106)	(0.0108)	(0.0160)
population²	0.000669***	0.000648***	0.000648***
	(4.06e-05)	(4.16e-05)	(9.82e-05)
female_rate	77.60***	104.0***	104.0**
	(29.05)	(29.71)	(48.32)
age_0_14_rate	-24.74***	-14.11	-14.11
	(8.945)	(9.143)	(12.14)
year1999	2.189**	2.174**	2.174*
	(0.866)	(0.866)	(1.156)
year2000	3.631***	3.600***	3.600***
	(0.919)	(0.920)	(1.131)
year2001	3.425***	3.419***	3.419***
	(0.910)	(0.910)	(1.075)
year2002	3.512***	3.514***	3.514***
	(0.933)	(0.933)	(0.991)
year2003	2.716***	2.754***	2.754***
	(0.922)	(0.922)	(0.885)
year2004	2.279**	2.341**	2.341***
	(0.930)	(0.931)	(0.824)
year2005	1.763*	1.868**	1.868**
	(0.916)	(0.916)	(0.789)
year2006	2.065**	2.171**	2.171**
	(0.973)	(0.974)	(1.077)
Constant	-28.15*	-43.82***	-43.82*
	(15.75)	(16.12)	(26.39)
Observations	398	398	398
R-squared	0.984	0.984	0.984

*** p<0.01, ** p<0.05, * p<0.1,

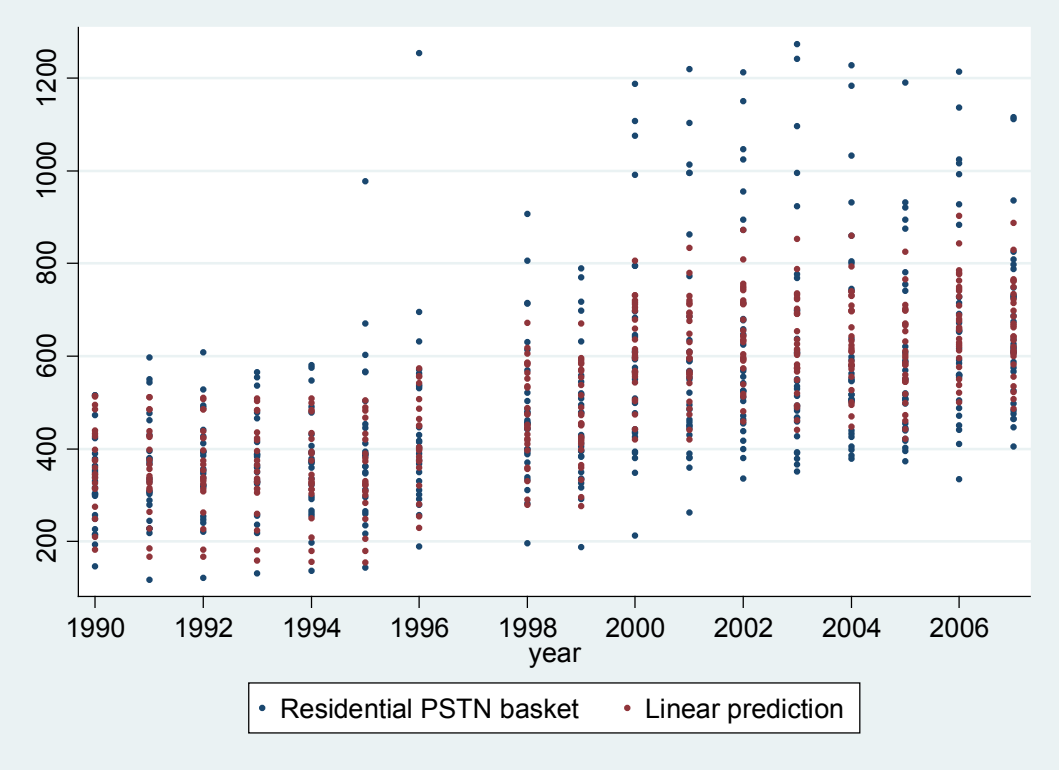
Source: OECD data analysed by Microeconomix

Table A7. Observed prices vs. but-for prices

Year	Observed price	But-for price	Standard error	Interval prediction	
				Lower bound	Upper bound
2000	1 075	562	29	532	591
2001	995	560	29	531	589
2002	1 025	598	29	568	627
2003	923	573	29	544	603
2004	932	580	29	550	609
2005	932	551	30	522	581
2006	1 024	628	30	599	658
2007	825	613	30	584	643

Source: OECD data analysed by Microeconomix

Figure A1 Observed average OECD residential PSTN basket (in USD PPP) vs. predicted price



Source: OECD data analysed by Microeconomix

Table A8. Observed average OECD residential PSTN basket (in USD PPP) vs. predicted price

Year	Predicted price > actual price	Predicted price < actual price
2000	14	13
2001	15	13
2002	16	12
2003	16	12
2004	16	12
2005	14	14
2006	15	13
2007	14	14

Source: OECD and World Bank data analysed by Microeconomix

Table A9. Estimation results for fixed telephony – specifications with various time effects

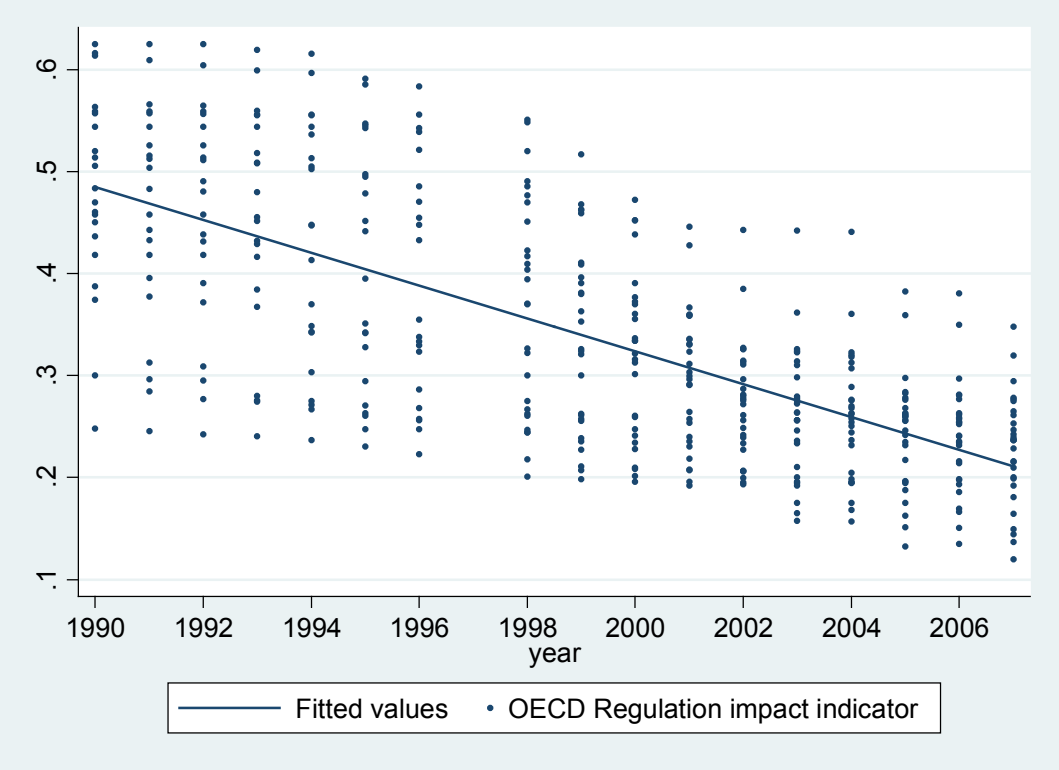
VARIABLES	Volume	Price	Volume	Price	Volume	Price	Volume	Price	Volume	Price
price	-0.0145***		-0.0170***		-0.0166***		-0.0160***		-0.0163***	
	(0.00171)		(0.00234)		(0.00233)		(0.00227)		(0.00220)	
population	0.383***		0.386***		0.386***		0.385***		0.386***	
	(0.0106)		(0.0109)		(0.0109)		(0.0108)		(0.0108)	
population²	0.000669***		0.000657***		0.000657***		0.000659***		0.000658***	
	(4.06e-05)		(4.25e-05)		(4.24e-05)		(4.20e-05)		(4.18e-05)	
female_rate	77.60***		92.81***		91.61***		89.88***		91.55***	
	(29.05)		(32.00)		(31.97)		(31.89)		(31.38)	
age_0_14_rate	-24.74***		-19.72**		-19.79**		-20.49**		-20.04**	
	(8.945)		(9.902)		(9.891)		(9.835)		(9.687)	
area		5.62e-06**		4.55e-06		4.73e-06		5.27e-06*		5.21e-06*
		(2.86e-06)		(2.88e-06)		(2.89e-06)		(2.85e-06)		(2.85e-06)
land_use		7.135***		7.014***		7.061***		6.992***		6.975***
		(1.024)		(1.034)		(1.037)		(1.023)		(1.022)
urban_rate		-487.3***		-481.6***		-484.4***		-481.6***		-480.7***
		(73.15)		(73.61)		(73.86)		(72.95)		(72.85)
regulatory_barriers		238.2**		230.0**		229.9**		253.7***		253.3***
		(97.20)		(97.24)		(97.62)		(97.47)		(97.37)
year1996		76.62**								
		(34.60)								
year1997		0								
		(0)								
year1998		129.6***								
		(32.44)								
year1999	2.189**	135.8***								
	(0.866)	(34.15)								
year2000	3.631***	282.6***								
	(0.919)	(34.84)								
year2001	3.425***	283.3***								
	(0.910)	(35.51)								
year2002	3.512***	322.8***								
	(0.933)	(36.63)								
year2003	2.716***	304.8***								
	(0.922)	(37.19)								
year2004	2.279**	312.6***								
	(0.930)	(37.28)								

VARIABLES	Volume	Price	Volume	Price	Volume	Price	Volume	Price	Volume	Price
year2005	1.763*	285.8***								
	(0.916)	(38.14)								
year2006	2.065**	364.4***								
	(0.973)	(38.41)								
year2007		350.8***								
		(38.79)								
year			0.272***	26.76***	-0.294***	-26.11***	-0.225**	-17.27***	-0.200**	-16.98***
			(0.0737)	(2.253)	(0.0823)	(2.287)	(0.102)	(3.636)	(0.0782)	(3.552)
year2					0.000139***	0.0132***	0.000104**	0.00879***	9.12e-05**	0.00864***
					(3.87e-05)	(0.00114)	(4.97e-05)	(0.00182)	(3.69e-05)	(0.00178)
First_methodology_change							1.588*	115.4***	1.875***	117.9***
							(0.911)	(30.06)	(0.509)	(29.32)
Second_methodology_change							-0.502	106.6**		111.2***
							(1.323)	(44.67)		(42.98)
Constant	-28.15*	469.6***	-577.7***	-52,845***	0	0	0	0	0	0
	(15.75)	(80.22)	(155.6)	(4,532)	(0)	(0)	(0)	(0)	(0)	(0)
Observations	398	398	398	398	398	398	398	398	398	398
R-squared	0.984	0.524	0.983	0.498	0.983	0.498	0.983	0.518	0.983	0.518

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

Source: OECD and World Bank data analysed by Microeconomix

Figure A2. Evolution of the OECD Indicator of regulation impact for post and telecommunications



Source: OECD and World Bank data analysed by Microeconomix

Table A10. But-for prices predicted by the price equation with fixed time effect (second column of Table A9) vs. but-for prices predicted by the price equation without fixed time effects (last column of Table A9) (in USD PPP)

Year	Actual price	Price equation with fixed time effects	Price equation without fixed time effects		
		But-for price	But-for price	But-for price - 95% lower bound	But-for price - 95% upper bound
2000	1075	562	535	519	551
2001	995	560	550	536	564
2002	1025	598	566	552	580
2003	923	573	577	563	591
2004	932	580	593	578	608
2005	932	551	609	592	626
2006	1024	628	619	597	641
2007	825	613	635	612	657
2008	970	na	651	627	675
2009	510	na	667	642	692

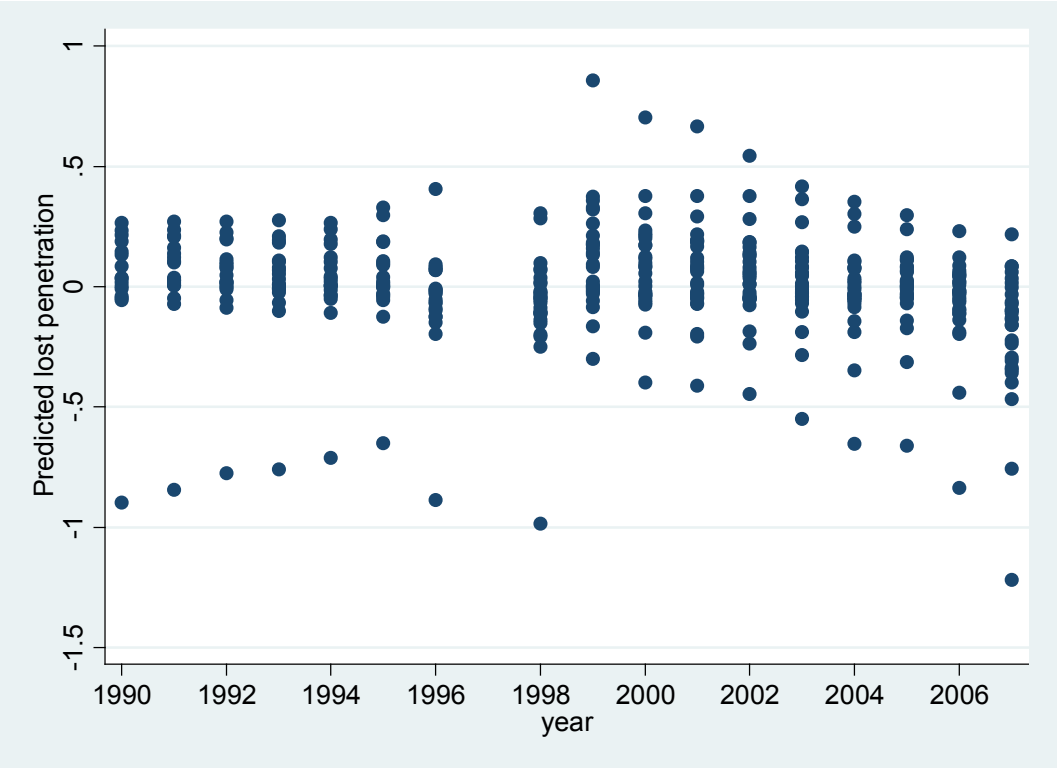
Source: OECD and World Bank data analysed by Microeconomix

Table A11. Observed volume vs. but-for volume (in millions)

Year	Observed volume	But-for volume	Standard error	Interval prediction	
				Lower bound	Upper bound
2000	12.33	42.35	1.71	40.64	44.06
2001	13.77	42.97	1.70	41.27	44.67
2002	14.98	43.29	1.68	41.61	44.97
2003	16.33	43.59	1.66	41.93	45.25
2004	18.07	43.76	1.64	42.12	45.40
2005	19.51	44.34	1.62	42.72	45.96
2006	19.86	44.20	1.60	42.61	45.80
2007	19.87	43.03	1.21	41.82	44.24

Source: OECD and World Bank data analysed by Microeconomix

Figure A3 Observed number of access paths per capita vs. predicted penetration (in millions)



Source: OECD and World Bank data analysed by Microeconomix

Table A12. But-for volume (in millions) predicted by the volume equation with fixed time effect (first column of Table A9) vs. but-for volume (in millions) predicted by the volume equation without fixed time effects (second last column of Table A9)

Year	Observed volume	With fixed time effects	Without fixed time effects		
		But-for volume	But-for volume	But-for volume - 95% lower bound	But-for volume - 95% upper bound
2000	12.33	42.35	42.50	40.81	44.19
2001	13.77	42.97	43.21	41.54	44.89
2002	14.98	43.29	43.88	42.22	45.53
2003	16.33	43.59	44.58	42.95	46.21
2004	18.07	43.76	45.17	43.57	46.77
2005	19.51	44.34	45.73	44.15	47.30
2006	19.86	44.20	44.51	42.97	46.06
2007	19.87	43.03	45.07	43.54	46.60
2008	20.49		45.60	44.09	47,11

Source: OECD and World Bank data analysed by Microeconomix

Table A13. But-for penetrations predicted by the price equation with fixed time effect (first column of Table A9) but-for prices predicted by the price equation without fixed time effects (second last column of Table A9) vs. the average penetration

Year	Actual average penetration	Penetration predicted with fixed time effects	Penetration predicted without fixed time effects
2000	47%	43%	43%
2001	46%	43%	43%
2002	45%	43%	43%
2003	44%	43%	44%
2004	43%	42%	44%
2005	43%	43%	44%
2006	41%	42%	42%
2007	40%	41%	43%
2008	38%	na	43%
2009	34%	na	43%

Source: OECD and World Bank data analysed by Microeconomix

ANNEX B

Table B1 Estimation results for mobile telephony – specifications 1-4

	Specification 1		Specification 2		Specification 3		Specification 4	
VARIABLES	volume	price	volume	price	volume	price	volume	price
price	3.15e-05		0.00480		-0.0156		-0.0133	
	(0.0150)		(0.0248)		(0.0122)		(0.0181)	
GDP	0.000274		0.000221		0.000209		1.54e-05	
	(0.000222)		(0.000343)		(0.000167)		(0.000120)	
Population	0.784***		0.748***		0.897***		0.880***	
	(0.0470)		(0.0635)		(0.0453)		(0.0594)	
population²	-0.000538***		-0.000419*		-0.000970***		-0.00101***	
	(0.000170)		(0.000231)		(0.000159)		(0.000208)	
female_rate	-76.39		-175.2		8.616		-79.42	
	(193.1)		(245.1)		(171.2)		(216.1)	
Education_new	203.9		510.4					
	(397.1)		(604.0)					
Education					-26.08**		-22.32	
					(12.41)		(14.65)	
age_0_14_rate	-107.6*		-100.2		-45.81		9.032	
	(58.05)		(74.14)		(58.11)		(63.16)	
age_over_64_rate	46.41		83.71		81.79*		131.6**	
	(48.70)		(66.38)		(47.63)		(56.06)	
2001.year	0.866	-23.81	0.907	-23.26	-0.135	-41.34	0.434	-52.43
	(2.950)	(46.15)	(3.074)	(43.53)	(2.672)	(45.08)	(2.460)	(41.51)
2002.year	2.401	309.0***			6.330	270.3***		
	(5.396)	(47.44)			(4.353)	(46.03)		
2003.year	4.489	290.6***	2.854	295.7***	7.815*	218.9***	7.710	207.7***
	(5.215)	(49.60)	(7.822)	(49.32)	(4.054)	(50.03)	(4.992)	(49.05)
2004.year	7.164	291.6***			10.87**	226.2***		
	(5.551)	(49.73)			(4.329)	(50.11)		
2005.year	9.419*	229.5***	7.937	222.6***	12.14***	158.6***	12.37***	137.3***
	(4.978)	(50.36)	(7.172)	(49.99)	(3.886)	(50.94)	(4.452)	(47.73)
2006.year	11.30***	124.3**			12.76***	39.23		
	(4.119)	(49.63)			(3.288)	(50.51)		
2007.year	13.63***	101.4**	13.50**	98.91**	11.72***	-3.981	13.42***	-15.07
	(4.125)	(49.98)	(5.466)	(49.98)	(3.382)	(52.95)	(3.415)	(51.44)
area		4.78e-06		1.48e-05*		-7.71e-07		3.24e-06
		(5.60e-06)		(7.63e-06)		(5.85e-06)		(8.41e-06)
land_use		5.303***		6.636***		8.412***		7.109***
		(1.468)		(1.809)		(1.445)		(1.703)
density		-0.0445		0.198		-0.147		-0.0342
		(0.0956)		(0.129)		(0.103)		(0.142)
urban_rate		-19.97		-100.3		69.73		-116.8
		(134.4)		(164.4)		(126.4)		(151.5)
regulatory_barriers		754.4***				217.1		
		(183.7)				(193.4)		
pre_paid		-19.85		-47.01		12.17		6.593
		(28.53)		(36.71)		(27.83)		(36.33)
hhi				410.6**				-49.96
				(196.6)				(187.1)
Constant	37.32	46.49	79.92	91.43	-7.967	105.5	23.51	334.8**
	(101.1)	(133.7)	(128.5)	(180.5)	(86.71)	(124.9)	(107.2)	(140.0)
Observations	184	184	114	114	169	169	108	108
R-squared	0.944	0.461	0.936	0.461	0.945	0.488	0.943	0.468

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: OECD and World Bank data analysed by Microeconomix

Table B2. Estimation results for mobile telephony – specifications 5-8

	Specification 5		Specification 6		Specification 7		Specification 8	
VARIABLES	volume	price	volume	price	volume	price	volume	price
price	-0.0255*		-0.0327**		-0.0375***		-0.0398***	
	(0.0151)		(0.0160)		(0.0134)		(0.0142)	
GDP	3.75e-06							
	(0.000110)							
population	0.881***		0.882***		0.882***		0.874***	
	(0.0565)		(0.0641)		(0.0498)		(0.0528)	
population²	-0.00101***		-0.00100***		-0.000999***		-0.000966***	
	(0.000200)		(0.000224)		(0.000175)		(0.000184)	
female_rate	-23.64		6.878					
	(202.1)		(225.9)					
education	-29.83**		-33.95**		-37.17**		-40.11**	
	(14.00)		(14.78)		(15.04)		(16.31)	
age_0_14_rate	0.617		-5.682		-14.55			
	(63.10)		(64.05)		(65.43)			
age_over_64_rate	117.1**		111.3*		106.1*		119.6***	
	(54.64)		(60.21)		(55.95)		(34.87)	
2001.year	-0.106	-22.62	-0.441	-23.85	-0.682	-24.63	-0.774	-25.45
	(2.475)	(38.33)	(2.569)	(38.31)	(2.595)	(38.29)	(2.701)	(38.25)
2003.year	10.47**	232.4***	12.08***	230.3***	13.07***	229.3***	13.65***	227.2***
	(4.319)	(44.67)	(4.378)	(44.33)	(3.809)	(44.14)	(4.103)	(43.77)
2005.year	14.57***	164.6***	15.83***	162.8***	16.57***	161.9***	17.09***	160.1***
	(3.989)	(43.79)	(3.893)	(43.49)	(3.381)	(43.33)	(3.690)	(42.99)
2007.year	14.13***	44.57	14.42***	41.88	14.52***	40.50	14.76***	38.27
	(3.309)	(46.84)	(3.026)	(46.59)	(2.943)	(46.41)	(3.031)	(46.12)
area		1.69e-05**		1.67e-05**		1.65e-05**		1.62e-05**
		(7.33e-06)		(7.24e-06)		(7.16e-06)		(7.04e-06)
land_use		5.236***		5.246***		5.195***		5.205***
		(1.621)		(1.579)		(1.565)		(1.530)
density		0.136		0.123		0.118		0.0989
		(0.121)		(0.119)		(0.118)		(0.113)
urban_rate		-270.4**		-280.3**		-286.6**		-283.6**
		(136.3)		(133.0)		(131.5)		(125.7)
pre_paid		16.08		17.01		17.08		18.62
		(32.11)		(31.25)		(30.80)		(29.67)
nb_competitors		-58.01***		-55.92***		-54.43***		-52.99***
		(14.05)		(13.91)		(13.70)		(13.42)
Constant	5.108	609.7***	-4.780	612.6***	3.573	614.5***	0.646	610.7***
	(102.4)	(134.1)	(110.9)	(130.4)	(22.21)	(128.8)	(10.75)	(124.5)
Observations	109	109	109	109	109	109	109	109
R-squared	0.939	0.536	0.934	0.535	0.930	0.534	0.928	0.533

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: OECD and World Bank data analysed by Microeconomix

Table B3. Estimation results for mobile telephony – specifications 9-13

	Specification 9		Specification 10		Specification 11		Specification 12		Specification 13	
VARIABLES	volume	price	volume	price	volume	price	volume	price	volume	price
price	-0.0380***		-0.0334**		-0.0340***		-0.0334**		-0.0363***	
	(0.0143)		(0.0135)		(0.0131)		(0.0135)		(0.00706)	
population	0.873***		0.860***		0.865***		0.860***		0.872***	
	(0.0528)		(0.0511)		(0.0505)		(0.0511)		(0.0436)	
population²	-0.000967***		-0.000922***		-0.000943***		-0.000922***		-0.000962***	
	(0.000184)		(0.000178)		(0.000177)		(0.000178)		(0.000159)	
education	-38.37**		-35.99**		-36.71**		-35.99**		-39.58***	
	(16.38)		(16.22)		(15.82)		(16.22)		(9.301)	
age_over_64_rate	117.6***		123.5***		122.8***		123.5***		115.9***	
	(34.60)		(33.45)		(33.33)		(33.45)		(24.87)	
2000.year	0	0	0	0			-2.870	603.6***		-51.37
	(0)	(0)	(0)	(0)			(10.39)	(109.0)		(42.25)
2001.year	-0.686	-25.36	-0.495	-21.40			-3.365	582.2***	-0.721	-73.37*
	(2.684)	(38.29)	(2.562)	(37.76)			(9.783)	(111.2)	(2.359)	(39.75)
2003.year	13.26***	240.6***	11.98***	240.2***	11.95***	234.5***	9.111	843.8***	12.56***	188.2***
	(4.105)	(38.62)	(3.868)	(38.03)	(3.826)	(30.15)	(13.02)	(112.2)	(3.098)	(39.61)
2005.year	16.78***	172.5***	15.44***	167.4***	15.39***	162.0***	12.57	771.0***	15.93***	115.4***
	(3.689)	(38.40)	(3.466)	(37.76)	(3.392)	(30.08)	(12.59)	(111.8)	(2.878)	(39.75)
2007.year	14.71***	48.91	14.39***	52.03	13.03***		11.52	655.6***	14.60***	0
	(3.013)	(43.25)	(2.920)	(42.36)	(2.544)		(11.46)	(115.0)	(2.784)	(0)
area		1.68e-05**		1.59e-05**		1.46e-05**		1.59e-05**		1.58e-05**
		(7.02e-06)		(6.43e-06)		(6.51e-06)		(6.43e-06)		(6.47e-06)
land_use		5.191***		5.627***		5.818***		5.627***		5.583***
		(1.536)		(1.384)		(1.402)		(1.384)		(1.386)
density		0.108								
		(0.113)								
urban_rate		-278.2**		-256.8**		-255.3**		-256.8**		-256.3**
		(126.3)		(110.1)		(112.4)		(110.1)		(111.1)
nb_competitors		-53.66***		-56.01***		-53.03***		-56.01***		-55.63***
		(13.49)		(11.97)		(11.76)		(11.97)		(11.84)
Constant	-0.115	607.4***	-2.870	603.6***	-2.321	594.2***		0		654.8***
	(10.78)	(125.1)	(10.39)	(109.0)	(9.716)	(110.5)		(0)		(116.2)
Observations	109	109	113	113	113	113	113	113	113	113
R-squared	0.929	0.533	0.932	0.532	0.932	0.517	0.955	0.532	0.953	0.532

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

Source: OECD and World Bank data analysed by Microeconomix

Table B4. Estimation results for mobile telephony – specifications 14-17

	Specification 14		Specification 15		Specification 16		Specification 17	
VARIABLES	volume	price	volume	price	volume	price	volume	price
price	-0.0365***		-0.0365***		-0.0319**		-0.0280**	
	(0.00704)		(0.00704)		(0.0133)		(0.0118)	
population	0.872***		0.872***		0.861***		0.862***	
	(0.0436)		(0.0436)		(0.0509)		(0.0488)	
Population²	-0.000965***		-0.000965***		-0.000930***		-0.000941***	
	(0.000159)		(0.000159)		(0.000178)		(0.000173)	
Education	-39.92***		-39.92***		-33.90**		-30.73**	
	(9.242)		(9.242)		(16.03)		(15.02)	
age_over_64_rate	114.2***		114.2***		124.1***		124.1***	
	(24.29)		(24.29)		(33.44)		(32.81)	
2000.year		601.5***		601.5***				
		(109.8)		(109.8)				
2001.year		584.1***		584.1***				
		(112.1)		(112.1)				
2003.year	12.99***	843.5***	12.99***	843.5***				
	(2.770)	(113.3)	(2.770)	(113.3)				
2005.year	16.36***	770.7***	16.36***	770.7***				
	(2.518)	(112.9)	(2.518)	(112.9)				
2007.year	15.02***	655.3***	15.02***	655.3***				
	(2.416)	(116.2)	(2.416)	(116.2)				
Year					-1.355	34.23**	-2.118***	30.50**
					(1.115)	(15.92)	(0.364)	(15.13)
Year²					0.000676	-0.0170**	0.00106***	-0.0151**
					(0.000557)	(0.00796)	(0.000183)	(0.00756)
First_methodology_revision					8.957	331.5***	5.322*	318.2***
					(5.822)	(60.68)	(2.752)	(58.00)
Second_methodology_revision					5.745	280.9**		254.6**
					(8.001)	(109.1)		(103.3)
area		1.58e-05**		1.58e-05**		1.61e-05**		1.60e-05**
		(6.47e-06)		(6.47e-06)		(6.46e-06)		(6.52e-06)
land_use		5.577***		5.577***		5.697***		5.752***
		(1.386)		(1.386)		(1.393)		(1.413)
urban_rate		-256.6**		-256.6**		-253.1**		-247.4**
		(111.0)		(111.0)		(111.1)		(113.2)
nb_competitors		-55.67***		-55.67***		-54.88***		-56.18***
		(11.84)		(11.84)		(11.83)		(11.86)
Constant		0						
		(0)						
Observations	113	113	113	113	113	113	113	113
R-squared	0.953	0.532	0.953	0.926	0.955	0.926	0.957	0.926

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

Source: OECD and World Bank data analysed by Microeconomix

Table B5. Price equation – 3SLS vs. OLS with robust standard errors

	3SLS		OLS with standard errors	OLS with robust errors
VARIABLES	volume	price	price	price
price	-0.0280**			
	(0.0118)			
population	0.862***			
	(0.0488)			
Population²	-0.000941***			
	(0.000173)			
Education	-30.73**			
	(15.02)			
age_over_64_rate	124.1***			
	(32.81)			
year	-2.118***	30.50**	39.68***	39.68***
	(0.364)	(15.13)	(12.06)	(12.65)
Year²	0.00106***	-0.0151**	-0.0197***	-0.0197***
	(0.000183)	(0.00756)	(0.00603)	(0.00632)
First_methodology_revision	5.322*	318.2***	351.6***	351.6***
	(2.752)	(58.00)	(49.35)	(51.96)
Second_methodology_revision		254.6**	323.6***	323.6***
		(103.3)	(94.94)	(98.76)
area		1.60e-05**	1.27e-05***	1.27e-05***
		(6.52e-06)	(4.23e-06)	(3.73e-06)
land_use		5.752***	3.408**	3.408**
		(1.413)	(1.382)	(1.324)
urban_rate		-247.4**	-324.0***	-324.0***
		(113.2)	(110.7)	(103.6)
nb_competitors		-56.18***	-44.61***	-44.61***
		(11.86)	(10.97)	(11.10)
Observations	113	113	169	169
R-squared	0.957	0.926	0.912	0.912

*** p<0.01, ** p<0.05, * p<0.1

Source: OECD and World Bank data analysed by Microeconomix

Table B6. Demand equation – 3SLS vs. 2SLS with robust standard errors

	3SLS	2SLS with standard errors	2SLS with robust errors
VARIABLES	volume	volume	volume
price	-0.0280**	-0.0291**	-0.0291***
	(0.0118)	(0.0121)	(0.0107)
population	0.862***	0.930***	0.930***
	(0.0488)	(0.0513)	(0.0508)
Population²	-0.000941***	-0.00117***	-0.00117***
	(0.000173)	(0.000181)	(0.000258)
Education	-30.73**	-35.18**	-35.18**
	(15.02)	(15.74)	(14.10)
age_over_64_rate	124.1***	100.2***	100.2***
	(32.81)	(34.87)	(26.02)
Year	-2.118***	-2.177***	-2.177***
	(0.364)	(0.366)	(0.411)
Year²	0.00106***	0.00109***	0.00109***
	(0.000183)	(0.000184)	(0.000206)
Second_methodology_revision	5.322*	5.516**	5.516**
	(2.752)	(2.786)	(2.705)
Observations	113	113	113
R-squared	0.957	0.958	0.958

*** p<0.01, ** p<0.05, * p<0.1

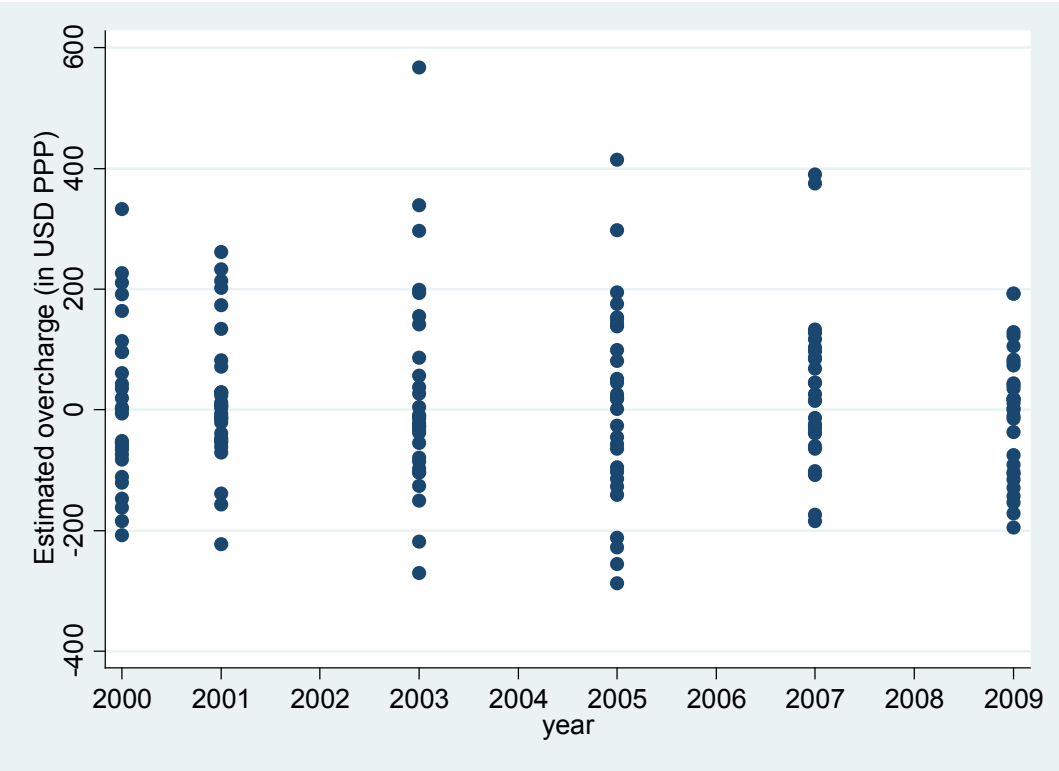
Source: OECD and World Bank data analysed by Microeconomix

Table B7. Estimated but-for price for mobile telecommunication services (in USD PPP)

Year	Actual price	Point prediction	Standard error	Interval prediction – lower bound	Interval prediction – upper bound
2000	578	352	25	327	377
2001	471	209	28	181	236
2002	851				
2003	720	522	26	496	547
2004	615				
2005	610	460	26	434	486
2006	490				
2007	475	391	37	354	428
2008	464				
2009	402	273	46	227	319

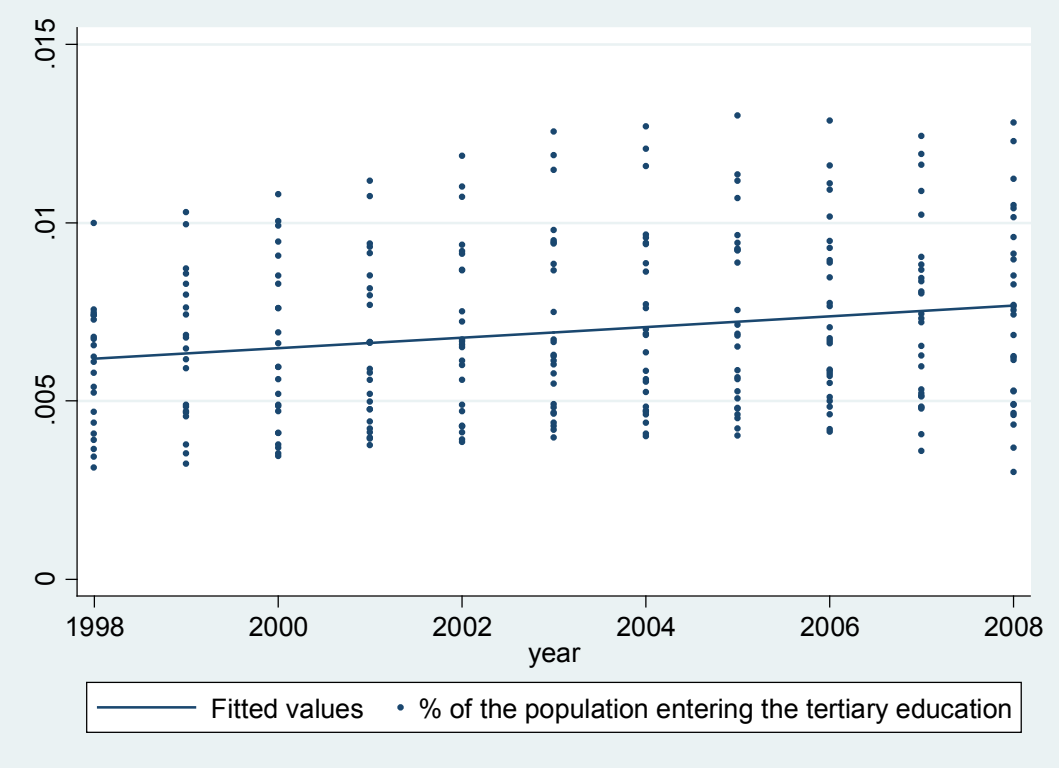
Source: OECD and World Bank data analysed by Microeconomix

Figure B1. Predicted overcharges for mobile telecommunication services (in USD PPP)



Source: OECD and World Bank data analysed by Microeconomix

Figure B2. Evolution of the percentage of the population that has entered the tertiary education



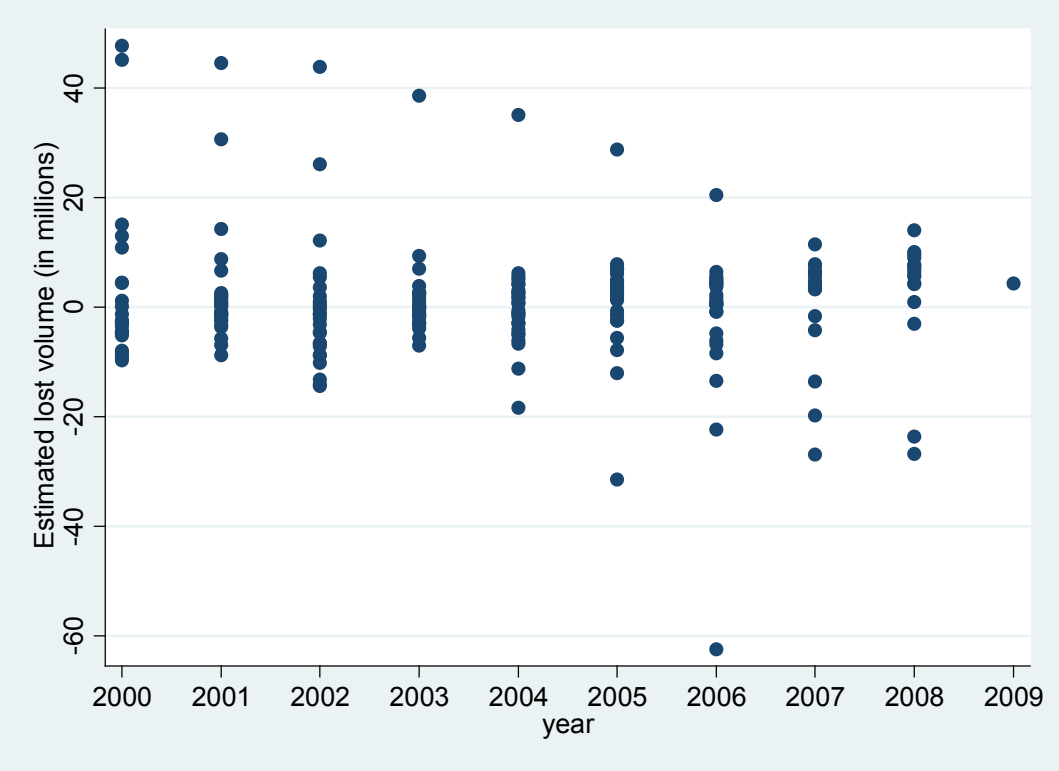
Source: OECD and World Bank data analysed by Microeconomix

Table B8. The actual number of mobile subscriptions in Mexico vs. the predicted number (in millions)

Year	Actual number of mobile subscriptions	Point prediction	Standard deviation	Interval prediction - lower bound	Interval prediction - upper bound
2000	14.08	59.18	5.05	54.13	64.23
2001	21.76	66.24	6.22	60.02	72.46
2002	25.93	69.79	6.43	63.36	76.22
2003	30.10	68.68	5.32	63.36	74.01
2004	38.45	73.53	5.95	67.58	79.48
2005	47.13	75.83	5.89	69.94	81.73
2006	55.40	75.87	5.48	70.40	81.35
2007	66.56	77.97	5.47	72.50	83.44
2008	75.30	81.16	5.73	75.43	86.89
2009	83.53	87.80	6.55	81.24	94.35

Source: OECD and World Bank data analysed by Microeconomix

Figure B3. Predicted numbers of lost transactions mobile telecommunication services (in millions)



Source: OECD and World Bank data analysed by Microeconomix

ANNEX C

Table C1. Estimation results for broadband – specifications 1-3

	Specification 1		Specification 2		Specification 3	
VARIABLES	volume	price	volume	price	volume	price
price	-0.00701***		-0.00738***		-0.00707***	
	(0.00233)		(0.00159)		(0.00220)	
GDP	5.56e-05		-1.69e-05		5.66e-05	
	(5.95e-05)		(7.20e-05)		(5.85e-05)	
population	0.173***		0.125***		0.173***	
	(0.0270)		(0.0275)		(0.0258)	
population²	-1.27e-05		0.000177*		-1.59e-05	
	(0.000105)		(9.98e-05)		(9.95e-05)	
female_rate	94.45		-159.3*		98.02	
	(148.3)		(91.36)		(143.1)	
education	-9.225*				-9.257*	
	(5.295)				(5.282)	
education_new			92.07			
			(148.2)			
age_0_14_rate	28.00		-42.53		28.17	
	(25.52)		(28.35)		(25.47)	
age_over_64_rate	8.969		-7.723		8.537	
	(21.26)		(24.41)		(20.74)	
2006.year	-0.200	-262.0**	-0.857	-254.1*	-0.216	-261.9**
	(0.878)	(108.4)	(0.931)	(140.3)	(0.858)	(108.4)
2007.year	-0.704	-426.8***	-1.480	-414.5***	-0.737	-427.4***
	(1.191)	(115.7)	(1.026)	(141.4)	(1.134)	(115.6)
Speed_distance	2.74e-05	0.000474	-6.05e-05**	-0.00245	2.61e-05	
	(3.24e-05)	(0.00516)	(2.45e-05)	(0.00443)	(2.89e-05)	
cable_share	4.612	1.236***	5.109	96.54	4.702	1.233***
	(3.281)	(391.7)	(3.615)	(474.5)	(3.133)	(390.9)
area		-4.22e-05		3.00e-07		-4.22e-05
		(2.66e-05)		(2.78e-05)		(2.66e-05)
land_use		14.56**		11.34		14.21***
		(6.590)		(8.812)		(5.331)
density		-1.261**		-0.577		-1.231***
		(0.566)		(0.684)		(0.471)
urban_rate		-202.2		-111.1		-221.1
		(540.5)		(693.9)		(499.7)
regulatory_barriers		586.6		2,828***		592.7
		(729.1)		(925.1)		(726.2)
Constant	-48.64	597.4	95.61**	302.9	-50.42	612.9
	(75.40)	(484.6)	(48.69)	(678.6)	(72.88)	(454.0)
Observations	57	57	67	67	57	57
R-squared	0.922	0.405	0.925	0.326	0.921	0.405

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: OECD and World Bank data analysed by Microeconomix

Table C2. Estimation results for broadband – specifications 4-6

	Specification 4		Specification 5		Specification 6	
VARIABLES	volume	price	volume	price	volume	price
price	-0.00374		-0.00309		-0.00482*	
	(0.00339)		(0.00483)		(0.00280)	
GDP	4.33e-05		5.99e-05		6.44e-05	
	(4.41e-05)		(4.65e-05)		(4.99e-05)	
population	0.171***		0.173***		0.172***	
	(0.00548)		(0.00701)		(0.00678)	
female_rate	-15.78		-48.99			
	(130.9)		(163.6)			
education	-5.510		-5.598		-7.288	
	(5.545)		(6.259)		(4.911)	
age_0_14_rate	22.40		22.14		25.05	
	(22.20)		(23.74)		(22.33)	
age_over_64_rate	16.05		17.53		14.95	
	(17.51)		(18.52)		(17.06)	
Speed_distance	2.14e-05		1.59e-05		1.68e-05	
	(2.75e-05)		(2.72e-05)		(2.63e-05)	
cable_share	3.026	1.262***	2.715	1.235***	3.575	1.225***
	(2.710)	(391.6)	(3.641)	(376.7)	(3.648)	(372.6)
2005.year	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)
2006.year	0.550	-265.6**	0.668	-262.3**	0.266	-260.7**
	(0.982)	(108.4)	(1.335)	(108.3)	(1.033)	(108.2)
2007.year	0.523	-437.3***	0.718	-429.9***	0.0665	-425.1***
	(1.417)	(115.8)	(1.964)	(115.1)	(1.340)	(114.8)
area		-4.58e-05*		-3.87e-05		-3.72e-05
		(2.74e-05)		(2.46e-05)		(2.36e-05)
land_use		17.03***		16.84***		15.67***
		(5.818)		(5.011)		(4.679)
density		-1.363***		-1.368***		-1.330***
		(0.456)		(0.340)		(0.339)
urban_rate		-40.18				
		(536.6)				
regulatory_barriers		461.3		496.5		543.9
		(747.4)		(646.4)		(594.0)
Constant	4.023	466.7	19.69	432.4**	-3.569	439.9**
	(63.83)	(498.3)	(79.24)	(200.7)	(6.551)	(195.8)
Observations	57	57	57	57	57	57
R-squared	0.959	0.409	0.962	0.405	0.947	0.402

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: OECD and World Bank data analysed by Microeconomix

Table C3. Estimation results for broadband – specifications 7-11

	Specification 7		Specification 8		Specification 9		Specification 10		Specification 11	
VARIABLES	volume	price	volume	price	volume	price	volume	price	volume	price
price	-0.00556**		-0.00557**		-0.00536**		-0.00571**		-0.000227	
	(0.00253)		(0.00253)		(0.00252)		(0.00252)		(0.00267)	
GDP	5.79e-05		7.35e-05*		7.45e-05*		4.40e-06		7.57e-05***	
	(4.71e-05)		(4.19e-05)		(4.17e-05)		(2.06e-05)		(2.92e-05)	
population	0.171***		0.171***		0.171***		0.175***		0.185***	
	(0.00668)		(0.00669)		(0.00663)		(0.00665)		(0.00496)	
education	-7.470		-7.044		-5.160		-0.582			
	(4.972)		(4.968)		(4.584)		(4.765)			
age_0_14_rate	25.43		13.27							
	(22.63)		(16.42)							
age_over_64_rate	13.08									
	(17.07)									
cable_share	4.243	1.213***	3.808	1.190***	3.744	1.209***	1.584	846.9***	6.852***	-84.42
	(3.567)	(370.9)	(3.506)	(370.0)	(3.466)	(369.9)	(2.897)	(311.9)	(2.100)	(353.6)
2005.year	0	0	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
2006.year	0.106	-259.9**	0.0641	-257.8**	0.0521	-260.6**	0.0551	-256.6**	1.044	-256.8**
	(1.038)	(108.2)	(1.037)	(108.1)	(1.021)	(108.1)	(1.010)	(102.2)	(1.035)	(121.7)
2007.year	-0.211	-423.3***	-0.264	-419.6***	-0.330	-425.5***	-0.147	-413.6***	1.704	-420.4***
	(1.299)	(114.7)	(1.299)	(114.6)	(1.263)	(114.5)	(1.305)	(107.7)	(1.315)	(121.8)
2008.year							-0.479	-492.7***	1.812	-479.9***
							(1.463)	(114.2)	(1.407)	(126.4)
area		-3.47e-05		-3.24e-05		-3.66e-05		-3.24e-05		-4.78e-06
		(2.32e-05)		(2.30e-05)		(2.25e-05)		(2.23e-05)		(1.99e-05)
land_use		15.65***		15.72***		16.23***		15.84***		13.88***
		(4.649)		(4.654)		(4.671)		(4.407)		(5.264)
density		-1.321***		-1.282***		-1.299***		-1.119***		-0.462
		(0.333)		(0.331)		(0.332)		(0.278)		(0.398)
regulatory_barriers		533.0		654.8		577.6				
		(575.6)		(556.0)		(550.4)				
Constant	-2.567	442.3**	1.045	410.1**	2.611	420.1**	4.197	641.4***	-5.641	847.3***
	(6.339)	(192.7)	(4.414)	(188.3)	(3.530)	(187.6)	(3.085)	(129.9)	(3.714)	(156.1)
Observations	57	57	57	57	57	57	75	75	100	100
R-squared	0.938	0.401	0.938	0.400	0.941	0.405	0.926	0.330	0.944	0.215

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: OECD data analysed by Microeconomix

Table C4. Estimation results for broadband – specifications 12-17

	Specification 12		Specification 13		Specification 14		Specification 15		Specification 16		Specification 17	
VARIABLES	volume	price	volume	price	volume	price	volume	price	volume	price	volume	price
price	-0.000227		-0.000286		-0.00289**		-0.00468***		-0.00480***		-0.00486***	
	(0.00267)		(0.00267)		(0.00147)		(0.000725)		(0.000742)		(0.000741)	
GDP	7.58e-05***		7.49e-05**		7.59e-05***		5.41e-05***		6.24e-05***		6.36e-05***	
	(2.92e-05)		(2.91e-05)		(2.56e-05)		(1.51e-05)		(1.46e-05)		(1.46e-05)	
population	0.185***		0.184***		0.183***		0.183***		0.186***		0.186***	
	(0.00495)		(0.00490)		(0.00475)		(0.00479)		(0.00473)		(0.00475)	
cable_share	6.731***		6.600***		6.678***		5.626***		4.548***		4.588***	
	(2.037)		(2.015)		(1.984)		(1.775)		(1.640)		(1.647)	
2006.year	1.044	-257.2**	1.032	-256.9**		-264.3**		-255.2**		-238.9**		-239.6**
	(1.035)	(121.7)	(1.034)	(122.0)		(121.1)		(116.5)		(107.4)		(108.2)
2007.year	1.704	-421.4***	1.685	-421.1***		-433.3***		-418.8***		-400.5***		-401.9***
	(1.315)	(121.7)	(1.314)	(122.0)		(121.4)		(117.2)		(108.0)		(108.7)
2008.year	1.817	-483.4***	1.800	-484.0***		-495.2***		-478.4***		-457.4***		-459.2***
	(1.406)	(125.6)	(1.406)	(125.8)		(125.3)		(121.5)		(108.3)		(109.0)
2009.year										-509.4***		-501.5***
										(118.5)		(119.1)
area		-7.42e-06										
		(1.66e-05)										
land_use		13.69***		14.33***		14.25***		12.78***		7.030		10.32**
		(5.205)		(5.012)		(4.997)		(4.833)		(4.622)		(4.180)
density		-0.506		-0.446		-0.261		-0.164				
		(0.353)		(0.325)		(0.336)		(0.324)				
urban_rate										-594.7		
										(381.1)		
Constant	-5.619	839.6***	-5.486	809.0***	-2.433	791.8***		800.1***		1.323***		811.4***
	(3.712)	(152.8)	(3.701)	(136.4)	(1.987)	(137.0)		(132.4)		(345.7)		(112.7)
Observations	100	100	100	100	100	100	100	100	123	123	123	123
R-squared	0.944	0.215	0.945	0.212	0.947	0.213	0.953	0.210	0.944	0.202	0.944	0.201

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: OECD data analysed by Microeconomix

Table C5. Price equation – 3SLS vs. OLS with robust errors

	3SLS with standard errors		OLS with standard errors	OLS with robust errors
variable	volume	price	price	price
price	-0.00486***			
	(0.000741)			
GDP	6.36e-05***			
	(1.46e-05)			
population	0.186***			
	(0.00475)			
cable_share	4.588***			
	(1.647)			
2006.year		-239.6**	-257.1**	-257.1
		(108.2)	(108.8)	(158.5)
2007.year		-401.9***	-416.6***	-416.6***
		(108.7)	(108.8)	(140.2)
2008.year		-459.2***	-455.1***	-455.1***
		(109.0)	(108.8)	(139.8)
2009.year		-501.5***	-482.1***	-482.1***
		(119.1)	(108.8)	(138.7)
land_use		10.32**	10.48**	10.48***
		(4.180)	(4.024)	(3.637)
Constant		811.4***	819.9***	819.9***
		(112.7)	(109.9)	(134.5)
Observations	123	123	135	135
R-squared	0.944	0.201	0.208	0.208

*** p<0.01, ** p<0.05, * p<0.1

Source: OECD data analysed by Microeconomix

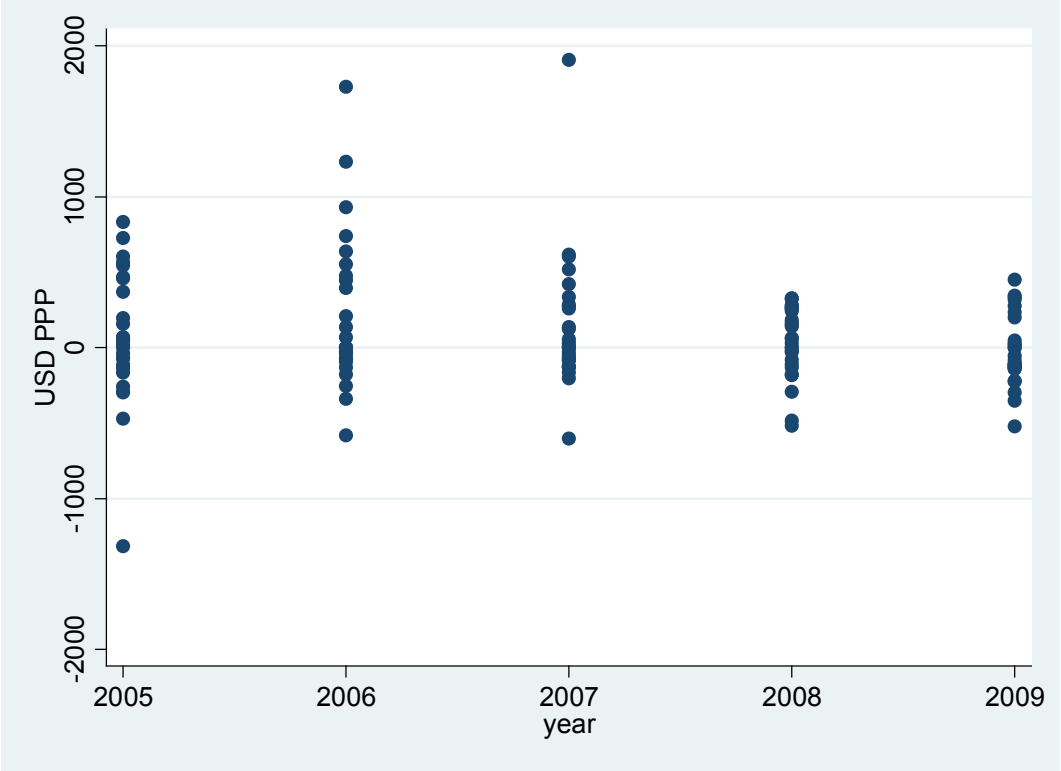
Table C6. Demand equation – 3SLS vs. 2SLS with robust errors

	3SLS with standard errors		2SLS with standard errors	2SLS with robust errors
VARIABLES	volume	price	volume	volume
price	-0.00486***		-0.00400***	-0.00400***
	(0.000741)		(0.000917)	(0.000853)
GDP	6.36e-05***		5.33e-05***	5.33e-05***
	(1.46e-05)		(1.60e-05)	(1.12e-05)
population	0.186***		0.186***	0.186***
	(0.00475)		(0.00486)	(0.0115)
cable_share	4.588***		3.810**	3.810**
	(1.647)		(1.748)	(1.501)
2006.year		-239.6**		
		(108.2)		
2007.year		-401.9***		
		(108.7)		
2008.year		-459.2***		
		(109.0)		
2009.year		-501.5***		
		(119.1)		
land_use		10.32**		
		(4.180)		
Constant		811.4***		
		(112.7)		
Observations	123	123	123	123
R-squared	0.944	0.201	0.947	0.947

*** p<0.01, ** p<0.05, * p<0.1

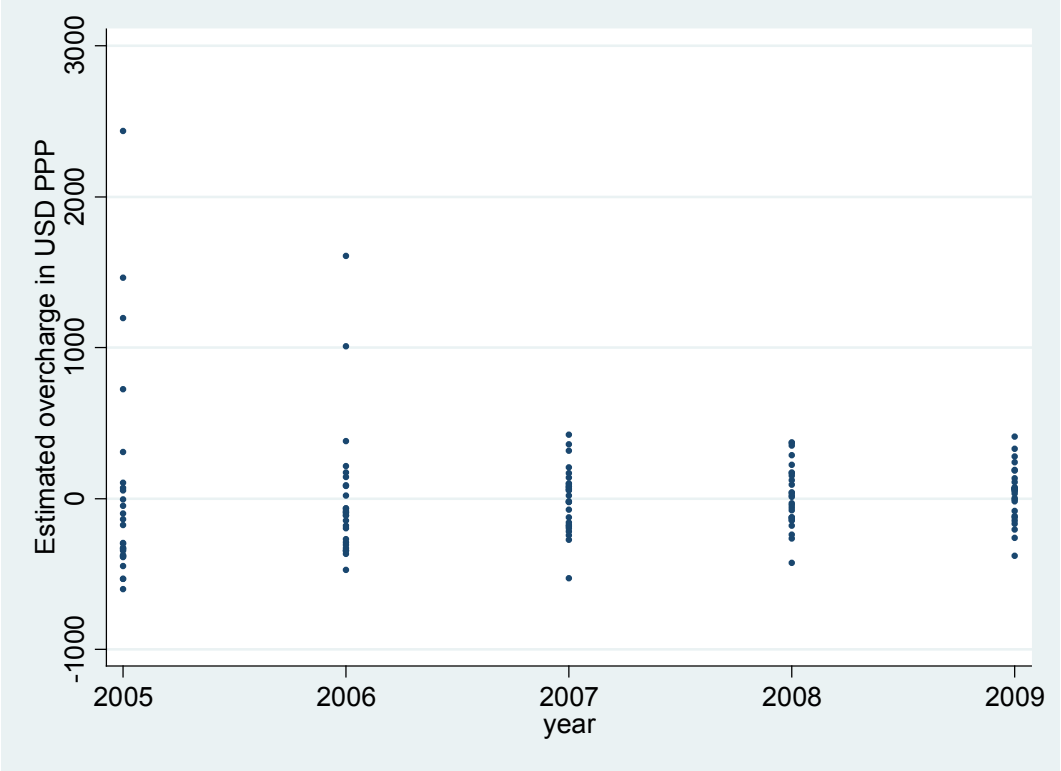
Source: OECD data analysed by Microeconomix

Figure C1. Difference between cable broadband price and DSL broadband price (in USD PPP)



Source: OECD data analysed by Microeconomix

Figure C2. Difference between fitted prices and actual prices (in USD PPP)



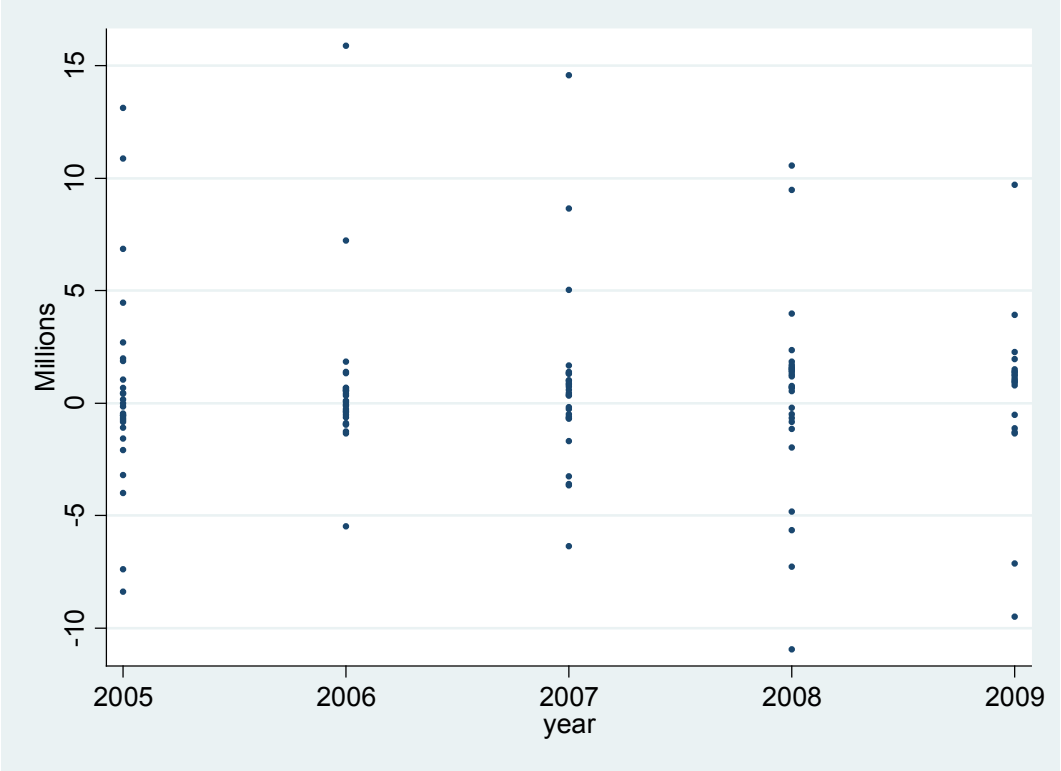
Source: OECD data analysed by Microeconomix

Table C7. But-for prices of broadband services in Mexico – point and interval predictions (in USD PPP)

Year	Actual price	But-for price	Standard error	Interval prediction - lower bound	Interval prediction - upper bound
2005	1 251	942	83	860	1 025
2006	637	703	82	620	785
2007	608	541	83	458	623
2008	836	483	83	401	566
2009	576	441	99	342	540

Source: OECD data analysed by Microeconomix

Figure C3. Difference between fitted subscriptions and actual subscriptions (in millions)



Source: OECD data analysed by Microeconomix

Table C8. But-for volume of broadband subscriptions in Mexico – point and interval predictions (in millions)

Year	Actual volume	But-for volume	Standard error	Interval prediction - lower bound	Interval prediction - upper bound
2005	2.27	15.39	0.79	14.60	16.18
2006	2.95	18.82	0.52	18.30	19.34
2007	4.38	18.95	0.49	18.46	19.43
2008	7.42	17.98	0.56	17.43	18.54
2009	9.41	19.12	0.48	18.64	19.59

Source: OECD data analysed by Microeconomix