CORRECTING THE OECD'S ERRONEOUS ASSESSMENT OF TELECOMUNICATIONS COMPETITION IN MEXICO

Jerry A. Hausman[*] *& Agustin J. Ros*[†]

We refute the OECD's conclusion that Mexico's telecommunications sector has experienced a lack of competition. The OECD's conclusion is based on its calculation that high pricing of Mexico's telecommunications services have caused consumers to lose $129.2 billion (USD) in consumer surplus. The OECD is incorrect. There has been no loss in consumer surplus. In fact, consumers in Mexico have obtained billions of dollars of benefits from lower prices and increased purchases of telecommunications services. The OECD's contrary conclusions were achieved because of mistakes, the incorrect use of facts and data and the application of incorrect economic analysis. Correct econometric analysis finds no evidence of market failure in Mexico. Mobile prices in Mexico are far below the average prices in other comparable countries (including nine OECD countries). The fixed-line sector performs better than a comparable sample of its peers. Mexican consumers are receiving billions of dollars of benefits from these lower prices.

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* John and Jennie S. MacDonald Professor of Economics, Economics Department, Massachusetts Institute of Technology; Director, MIT Telecommunications Economics Research Program. Email: jhausman@mit.edu.

† Vice President, NERA Economic Consulting. Email: Agustin.Ros@NERA.com. This report was commissioned by América Móvil. However, the views expressed here are solely the authors'.

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INTRODUCTION

América Móvil has asked us to review and comment on the study that the Organization for Economic Cooperation and Development (OECD) published in January 2012 entitled, "Estimation of Loss in Consumer Surplus Resulting from Excessive Pricing of Telecommunication Services in Mexico" ("OECD Study").[1] The OECD Study concludes that high pricing of Mexico's telecommunications services caused a loss in consumer surplus estimated at $129.2 billion (USD) from 2005 to 2009, or 1.8 percent of Mexico's annual GDP.[2] The OECD attributes this loss to lack of competition in Mexico's telecommunications sector.[3] The OECD then used this calculated consumer-surplus loss to justify the release of another consulting report (written at Cofetel's request) recommending extensive changes to telecommunications regulations in Mexico.[4]

There has been *no* loss of consumer surplus in Mexico. Rather, Mexican consumers have benefitted from consumer welfare gains. The OECD's conclusions to the contrary are incorrect and implausible. When we correct the OECD's errors and unreasonable assumptions, we find that Mexico's mobile and fixed-line prices are low and consumers are receiving billions of dollars of benefits. The mobile and fixed-line sectors perform much better than a comparable sample of its peers. The OECD's conclusion that Mexican consumers have suffered welfare losses from a lack of telecommunications competition has no basis in reality.

In Part I of this report, we explain how the OECD's refusal to provide its data to us violates the accepted practice in academic research and regulatory proceedings around the world. Such conduct would preclude publication of the OECD's results in reputable academic journals. That the OECD made its results public without even the possibility of an independent professional review borders on the unethical.

In Part II, we explain how the OECD's calculation of $129.2 billion (USD) in lost consumer surplus results from mistakes, the improper use of data and seriously flawed economic analysis. The OECD's calculation relies on incorrect assumptions and commits elementary mistakes in econometric methodology. In particular, the OECD used an unrepresentative sample of rich countries to claim—falsely—that Mexican consumers are overpaying for telecommunications services. Additionally, the OECD misused price data and ignored actual market prices to create the illusion of an increase in prices and harm to consumers in Mexico that did not in fact occur. Mobile prices used in the study were not the lowest prices available to consumers in Mexico and the price changes referenced in the OECD study were not real price changes; but rather a product of the OECD's flawed pricing methodology. The OECD's flawed approach to calculating prices leads to results

1. Marta Stryszowska, *Estimation of Loss in Consumer Surplus Resulting from Excessive Pricing of Telecommunications Services in Mexico* (OECD Digital Economy Papers No. 191, 2012) [*OECD 2012 Mexico Consumer Surplus Study*].

2. *Id.* p. 3.

3. *Id*. p. 9.

4. ORGANIZATION FOR ECONOMIC COOPERATION & DEVELOPMENT, OECD REVIEW OF TELECOMMUNICATIONS POLICY AND REGULATION IN MEXICO (Jan. 2012) [OECD 2012 CONSULTING REPORT]. The OECD undertook this report "at the behest of the Comisión Federal de Telecomunicaciones." *Id.* Foreword p. 3.

that are contrary to reality. The fact is that Mexican consumers are benefiting from low prices – among the lowest in Latin America – and have experienced significant *gains* in consumer surplus.

In Part III, we select a sample of "peer" countries that are similar to Mexico in terms of GDP per capita. We review the mobile and fixed-line sectors in Mexico and find that, by proper international comparisons, Mexico's prices are low. We show that prices have declined considerably causing significant increases in purchases and benefits to consumers. The empirical evidence further refutes the OECD's conclusion that Mexico has suffered from a lack of competition in its telecommunications sectors.

In Part IV, we demonstrate that not only has there been no consumer loss in Mexico but there have, in fact, been significant gains in consumer surplus, much more than expected when compared to peer countries. We use publicly available data to estimate econometric demand and price models for Mexico's mobile and fixed-line sectors (based on a sample of peer countries). We then use these models to assess the actual performance of the Mexican telecommunications markets. Based on this analysis we find that telecommunications prices in Mexico are low. Specifically, we find that Mexico's actual mobile and fixed-line prices are *below* the predicted prices. In other words, Mexican consumers are paying lower prices than what one would expect based on comparisons of comparable countries. Also, and contrary to the OECD's calculation of consumer loss, we calculate that in 2011 Mexican consumers have received at least $4 to $5 billion (USD) in consumer *surplus* from these lower mobile prices and in 2010 they received over $1 billion (USD) in consumer *surplus* from these lower fixed-line prices.

I. THE OECD'S REFUSAL TO PROVIDE ITS DATA VIOLATES ACCEPTED PRACTICE[5]

The OECD has refused to provide the data that it used in the OECD Study.[6] In my experience as an academic and participant in policy debates, I have found that, in almost all situations, authors have made data and computer programs available for any econometric analysis relied upon in their studies. For example, the American Economic Association, the largest worldwide association of economists, posts the following policy on its website and includes it in all of its journals:

> It is the policy of the *American Economic Review* to publish papers only if the data used in the analysis are clearly and precisely documented and are readily available to any researcher for purposes of replication. Authors of accepted papers that contain empirical work, simulations, or experimental work must provide to the *Review*, prior to publication, the data, programs, and other details of the computations sufficient to permit replication. These will be posted on the *AER* Web site. . . . For econometric and simulation papers, the minimum requirement should include the data set(s) and programs used to run the final models, plus a description of how previous intermediate data sets and programs were employed to create the final data set(s).[7]

Similarly, the Econometric Society, the largest worldwide association of econometricians, states its policy for its journal Econometrica:

5. This section of the report was authored by Jerry A. Hausman.

6. Through its outside counsel, América Móvil has requested the data from the OECD and has stated that it would pay all licensing fees necessary to use the data.

7. American Economic Association Website, The American Economic Review: Data Availability Policy, http://www.aeaweb.org/aer/data.php.

> Econometrica has the policy that all empirical, experimental and simulation results must be replicable. Therefore, authors of accepted papers must submit data sets, programs, and information on empirical analysis, experiments and simulations that are needed for replication and some limited sensitivity analysis.[8]

All academic economic journals have similar policies.

I have been involved in regulatory proceedings and policy debates in a number of countries, including the United States, Canada, the United Kingdom, Australia, New Zealand, and the European Commission. With only one exception in the past ten years, the data on which regulatory determinations or policy recommendations are based have been made available to all parties to the proceedings. I find it remarkable that the OECD, an inter-governmental agency, has engaged in consulting activity for the Mexican telecommunications regulatory authority, yet the OECD has refused to follow the long-accepted policy of making its data and computer programs available so its results can be replicated and analyzed.[9]

II. THE OECD'S ESTIMATION OF CONSUMER SURPLUS LOSS IS INCORRECT AND HAS NO BASIS IN REALITY

The OECD's calculation of $129.2 billion in lost consumer surplus rests on unsupportable assumptions and elementary econometric errors. Consequently, the OECD Study is incorrect. The OECD has failed to demonstrate either that mobile prices are "too high" in Mexico or that mobile penetration is "too low." Consequently, one cannot conclude that Mexico has experienced *any* loss in consumer surplus for mobile and fixed-line telecommunications.

A. The OECD Used a Sample of Rich Countries to Make Incorrect Conclusion about Mexico

The OECD used a sample of rich countries to claim that Mexican consumers are overpaying for telecommunications services. As a result, the OECD's econometric estimations of high telecommunications prices in Mexico are incorrect.

1. The OECD's Selection of Rich Countries Is Unscientific

The econometric models in the OECD study have a fundamental methodological flaw. The OECD assumes that "the level of actual competition in the Mexican telecommunication sector would be similar to the average level of competition in the telecommunication sector in *any other OECD country*."[10] By comparing Mexico to all

8. The Econometric Society Website, Instructions for Submitting Articles to Econometrica, Revised 2011, http://www.econometricsociety.org/submissioninstructions.asp.

9 The OECD refusal to provide the data used in the OECD Study (*OECD 2012 Mexico Consumer Surplus Study*) is quite important because the OECD price basket variable was changed twice during the period 2000-2009. (p. 18) Without access to the OECD Study data I cannot analyze the effects of this changed methodology to the mobile price variable and the effects on the econometric models. Indeed, the OECD Study concludes "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." (p. 19) The "significant impact" of the two revisions in the OECD data are likely to significantly affect the econometric results in the OECD Study. The OECD procedure of using "dummy variables" for changes in the OECD methodology are unlikely to solve the problem since they do not vary across countries.

10. *OECD 2012 Mexico Consumer Surplus Study*, op. cit. p. 10 (emphasis added).

OECD countries, irrespective of income level and not controlling for income level in its economic analysis, the OECD has made the "exchangeability assumption" that all OECD countries are similar."[11] The OECD assumes that competition in Mexico would be the same as the average level of competition in the United States, the United Kingdom, and the other countries of the OECD, even though Mexico is the poorest country in the OECD. This assumption fails the "common sense test." No economist would assume that countries such as Mexico and the United States or Switzerland and Italy behave in a similar economic manner. Yet this is precisely the assumption on which the OECD based its analysis.

Mexico differs from the average OECD country in three important respects that influence the demand for telecommunications services: GDP per capita, income inequality, and computer penetration.[12] The consensus in the academic literature is that income is an important determinant of demand for mobile and fixed-line telecommunications.[13] With respect to GDP per capita, Mexico is an extreme data point among OECD countries. Mexico's GDP per capita of $7,852 is the *lowest of the OECD countries*.[14] Average GDP per capita of the OECD countries is approximately $35,000,[15] and the highest GDP per capita is approximately $104,000 (Luxembourg).[16] Even if one compares GDP per capita using purchasing power parity (PPP) exchange rates to convert local currencies, Mexico's GDP per capital is still the lowest of OECD countries.[17] The difference between Mexico and the average OECD country (and the importance of income on telecommunications demand) means that it is incorrect to ignore income in demand analysis. It also means that comparing rich countries with significantly lower-income countries without proper econometric modelling leads to incorrect conclusions. When comparing telecommunications demand and prices between Mexico and other countries, one should compare countries of similar socio-economic levels.

Another significant difference between Mexico and the average OECD country is that the income distribution is much more unequal in Mexico. This fact can dampen the demand for telecommunications services. It can cause differences among countries in penetration rates for fixed and mobile services even though countries may have similar income levels. A common measure of income distribution is the Gini coefficient. A higher value of a country's Gini coefficient indicates a more unequal distribution of

11. Jerry A. Hausman, *Specification Tests in Econometrics*, 46 ECONOMETRICA 1251, 1262-63, 1273 (1978), discusses the exchangeability assumption in panel data econometrics and how the Hausman specification test can be used to test the assumption.

12. In our econometric model, we control for GDP per capita and show that it is a significant determinant of telecommunications demand and price. Robust cross-country and time-series data are not available for income inequality. We assume that income inequality is approximately constant during our estimation period and thus accounted for through our fixed-effects econometric estimation. Computer penetration is an important determinant of broadband demand, which we do not estimate in this report due to lack of data.

13. *See, e.g.*, Christopher Garbacz & Herbert G. Thompson, Jr., *Demand for Telecommunications Services in Developing Countries*, 31 TELECOMM. POL'Y 276 (2007) who find the income elasticity for residential fixed-line telecommunications services to range between 0.291 and 0.476 and the income elasticity for mobile telecommunications services to range between 0.93 and 1.21. *See also*, Jerry A. Hausman, *Valuing the Effect of Regulation on New Services in Telecommunications*, 1997 BROOKINGS PAPERS ON ECON. ACTIVITY: MICROECON. 1 (1997); Gary Madden, Grant Coble-Neal & Brian Dalzell, *A Dynamic Model of Mobile Telephony Subscription Incorporating a Network Effect*, 28 TELECOMM. POL'Y 133 (2004).

14. World Bank Website, Data, GDP per Capita (Current U.S.$), http://data.worldbank.org/indicator/NY.GDP.PCAP.CD.

15. *Id.*

16. *Id.*

17. *Id.*

income. Mexico has the second-highest Gini coefficient of OECD countries after taxes and transfers have occurred.[18] Because income is an important determinant of telecommunications demand,[19] a more unequal distribution of income should result in lower country-wide demand for telecommunications services (and lower penetration levels). Therefore, comparing Mexico with countries that have greater income equality, as the OECD has done here, leads to incorrect conclusions.

Finally, computer penetration is an important determinant of the demand for broadband services. Access to a computer is still the dominant hardware input needed to consume broadband services, and it is thus a prerequisite for broadband demand, especially during the period of analysis of our paper and the OECD study. One would expect broadband demand to differ among countries to the extent that the countries differ in their level of computer penetration.[20] Mexico's computer penetration is the lowest of the OECD countries, at approximately 30 percent of households,[21] whereas the average computer penetration among OECD countries is approximately 75 percent.[22] The country with the next-lowest computer penetration to Mexico is Turkey, at 44 percent.[23] The country with the highest computer penetration is Iceland, at 93 percent[24]—more than three times the level found in Mexico. The OECD's failure to control for differences in computer penetration in its broadband demand analysis leads to biased results.

2. The OECD's Incorrect Assumptions Undermines Its Econometric Estimations

The OECD does not use fixed-effects econometric model specifications, which are necessary to avoid biased and inconsistent results resulting from differences in GDP per capita, income inequality, computer penetration, and other factors that differ across countries in the sample.[25] The OECD's demand model does not have a GDP per capita variable or any other measure of income.[26] Consequently, the OECD has failed to hold constant the effects of income on demand for telecommunications services. The OECD's model specification contrasts with most mobile demand models in the academic literature, which find an important role for GDP or income.[27] The OECD's demand estimation also finds a small price effect. For example, the OECD estimated price elasticity for mobile services for 2009 (which is the final year of the OECD sample) is only –0.135, whereas most of the literature finds price elasticities considerably larger (in

18. OECD StatExtracts Website, Income Distribution – Inequality – Country Tables, http://stats.oecd.org/Index.aspx?DatasetCode=INEQUALITY. "Latest year" value used; "Current definition" for the Gini coefficient used.

19. *See, e.g.*, Christopher Brown, *Does Income Distribution Matter for Effective Demand? Evidence from the United States*, 16 REV. POL. ECON. 291 (2004).

20. *See, e.g.*, Nejc M. Jakobin & Andreas Klein, *Determinants of Broadband Internet Access Take-Up: Country Level Driver*, 13 INFO 29 (2011) who conclude that computer penetration and income are the two most important factors for broadband Internet uptake rates.

21. World Telecommunications/ICT, Indicators Database 2011 (15th ed., 2011), *available at* http://www.itu.int/ITU-D/ict/publications/world/world.html. [hereinafter World Telecomm./ICT Database 2011].

22. *Id.*

23. *Id.*

24. *Id.*

25. "Unbiased and consistent" means that the model results are correct on average. "Biased and inconsistent results" means that the model results are unreliable.

26. When GDP is included in the OECD Study's model, the OECD finds a positive effect of price on demand in the original demand specification—that is, an upward-sloping demand curve. *See OECD 2012 Mexico Consumer Surplus Study*, op. cit. p. 85 Annex B, tbl.B1, Specification 1 & Specification 2.

27. *See* note 13 above.

magnitude), near –0.50, especially for non-rich countries such as Mexico.[28] The OECD's anomalous result may arise from the OECD's failure to deflate the price data, which is necessary to have price data in constant U.S. dollars.[29] (The result may also arise because of the OECD's two methodological revisions in the price data calculations, which we explain below.)

For the specification of the OECD's price equations, the OECD again assumes that Mexico is no different from any other OECD country. Furthermore, the price equation contains no cost variable. This omission is an important mistake, as cost is the major economic driver of mobile prices.

The Hausman specification test enables one to test the exact assumption made by the OECD.[30] As the OECD has refused to provide us the data for the OECD Study, we cannot do an econometric analysis of whether its results are unbiased and consistent, although they appear not to be. However, the OECD does provide one additional set of results that allows for limited specification tests to be computed. In Table 6 of Annex B of the OECD Study, the OECD's demand equation is estimated with two-stage least squares (2SLS), and the OECD's price equation is estimated with ordinary least squares (OLS).[31] One can compare these results with the main three-stage least squares (3SLS) results in Table 50.[32] According to the Hausman specification test, the results of both estimation approaches should be similar if the model is correctly specified.

First, we compare the estimated coefficients for the number of competitors in the price equation, which changes from –44.6 to –56.2 when going from OLS to 3SLS. The value of the Hausman test statistic is 7.71, which is distributed as chi-square with one degree of freedom, so the *p*-value is 0.0055. (A low *p*-value means that there is a high probability that the difference between the two results is significant, or not due to random chance.) The Hausman specification test thus finds that the OECD's price equation is incorrectly specified. The coefficient estimates should not differ by a significant amount because the OECD study assumes that number of competitors is an exogenous variable, uncorrelated with the unobserved country effect.[33]

Second, we compare the estimated coefficients for population, which is the most important economic variable in the demand equation. When we compare the 3SLS estimate with the 2SLS estimate and do a Hausman specification test, the test statistic is 23.2, with one degree of freedom, so the *p*-value is 0.0000015. This result leads to a rejection of the OECD's demand model specification. Thus, both the OECD's price equation and its demand equation are incorrectly specified, which results in biased and inconsistent estimates.

B. The OECD Incorrectly Used Price Data to Inflate Mobile Prices in Mexico

The OECD achieved its conclusion that mobile prices are high in Mexico by ignoring actual market prices and incorrectly using price data.[34] The OECD thus has incorrectly claimed an increase in prices and harm to consumer that did not occur. This flaw undermines the OECD's entire study.

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28. *Id*.
29. The OECD Study uses PPP in U.S. dollars, but it needs to deflate to have constant U.S. dollars. The study never mentions this required adjustment. We cannot tell whether the OECD Study performed this adjustment because the OECD has not permitted us access to the data used in its study.
30. Hausman, *Specification Tests in Econometrics*, op. cit. pp 1264-66, 1273-91.
31. *OECD 2012 Mexico Consumer Surplus Study*, op. cit. p. 55, 89 tbl.B6.
32. *Id.* p. 53 tbl.50.
33. Fixed-effects estimation would control for this potential problem.
34. OECD 2012 CONSULTING REPORT, op. cit. p. 4.

First, the OECD's decision not to use actual market price data has no economic or empirical basis and inevitably results in erroneous conclusions. Also, the OECD's basket methodology is supposed to use the cheapest available tariff plan for its hypothetical basket of low, medium and high use customers. The OECD's price methodology for Mexico before 2009, however, failed to adequately account for promotions and discounts and thus did not reflect the cheapest options available to consumers.[35] In addition, the tariff plans in use by the OECD in 2009 were more than two years old and had been updated by new, cheaper plans that at the time accounted for more than 90 percent of post-paid gross additions of subscribers.[36] Because the OECD failed to account for the cheapest options available to consumers during this period, their results are invalid. Remarkably, although the OECD's methodology changed after 2009 to attempt to account for promotions and discounts, its consumer surplus calculations end in 2009. In other words, although the OECD itself sought to account for discounts and promotions in some of its analysis, it did not account for these market realities in arriving at its erroneous conclusion regarding consumer welfare loss.

Second, the OECD does not use market data for what consumers actually pay for mobile services. Instead, it takes averages of *hypothetical* baskets of usage and calculates prices using tariffed rates.[37] The results do not make economic sense. Figure 7.11 of the "2011 OECD Communications Outlook Report" states that Mexico mobile price for a 100-call basket in August 2010 was approximately $37.40 (USD-PPP), which made Mexico the 15th-highest of the 34 countries (near the median amount of $35.70, and 13 percent above the mean of $33.00, although the difference is not statistically significant).[38] However, in the OECD's 2012 Consulting Report, the OECD calculates Mexico's mobile price for February 2011 (six months later) to be approximately $45 (USD-PPP), which makes Mexico the third-highest of the OECD countries.[39] In its 2012 report, the OECD estimates Mexico's prices to be 66 percent higher than the OECD average.[40] Thus, according to the OECD's 2012 Consulting Report, mobile prices in Mexico for a 100-call basket increased by approximately 20.4 percent in 6 months.

However, in the real world, mobile prices do not typically increase over time, especially to such an extent.[41] More significantly, in Mexico mobile prices did not increase by 20.4 percent in 6 months. We have confirmed with America Movil that during the period it did not change its prices for the "Amigos Fidelidad 500" plan, the plan that was used by the OECD for the August 2010 price point. Rather, the OECD reported price difference reflects another change in the OECD basket methodology—specifically a change in the application of discounts to on-net and off-net calls for "top-off" promotions.[42] Further distorting the comparison, the February 2011 price point for

35 Presentation from America Movil to the OECD, June 2009.

36 *Id*.

37. *OECD 2012 Mexico Consumer Surplus Study*, op. cit. p. 17.

38. OECD COMMUNICATIONS OUTLOOK 2011 261, fig.7.11 (2011) [OECD 2011 COMMUNICATIONS OUTLOOK].

39. OECD 2012 CONSULTING REPORT, op. cit. p. 32 fig.1.9. We cannot perform an exact calculation, as the OECD has refused to provide us its data.

40. *Id.* p. 31 tbl.1.7.

41 According to Merrill Lynch data (using actual market data for average voice revenue per minute), mobile prices in Mexico *decreased* by 6.2 percent over this six-month period, from $0.0498 to $0.0467. Indeed, the OECD-computed average price for all 34 OECD countries decreased over the period, as did almost all countries except for Mexico. BANK OF AMERICA - MERRILL LYNCH, GLOBAL WIRELESS MATRIX, 4Q Y2011, 3Q Y2011 & 1Q Y2007 REPORTS.

42 Confirmation with America Movil officials that there was no price change for the tariff plan "Amigo Fidelidad 500 con llamadas gratuitas a 3 numeros" during August 2010 to February 2011.

100 mobile calls prices out a post-paid plan (since it includes a fixed component) while the August 2010 price is for a pre-paid plan (since it does not include a fixed component). Thus, the OECD is comparing apples to oranges. Additionally, the OECD's choice of post-paid plans makes no sense given that more than 90 percent of Mexican customers are pre-paid consumers.

In the OECD 2012 Consulting Report, the OECD never states that it has changed its methodology from its previous 2011 OECD Communications Outlook report, nor does it give an explanation for the change. When one changes the manner in which discounts are handled, the prices of mobile services in Mexico can appear higher than they actually are. For the OECD to claim that consumers have been suffering from excessive prices when they have actually been paying discounted prices is incorrect.

This change in the OECD's pricing methodology invalidates the OECD Study and Consulting Report. It demonstrates the arbitrary manner in which the OECD's econometric estimates of mobile prices may change depending on its pricing methodology, especially when the results are completely contrary to real-world market developments. For example, in the OECD's econometric price equation, the first methodology revision has a coefficient of 318.2,[43] and the second revision has a coefficient of 254.6.[44] Because the computed price level for Mexico in 2009 is $402,[45] the data revision *explains more than 50 percent* of the most recent observed price for Mexico and an even larger percentage for the average OECD country.

The OECD's change in mobile price data illustrates the need for independent review of the data before they can be used to make regulatory or policy decisions. It is unfortunate that the OECD released this report with its attendant publicity without such a review and that the OECD subsequently refused to provide the data used in the report. Without access to the study's data, we cannot analyze the effects of this changed pricing methodology on the mobile price variable and the effects on the econometric models. Indeed, the OECD Study concludes that "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."[46] The "significant impact" of the two revisions in the OECD data is likely to affect significantly the econometric results in the OECD Study. The OECD's solution of using "dummy variables" for changes in the OECD methodology is unlikely to solve the problem, because the dummy variables do not vary across countries.

C. The OECD's Use of Purchasing Power Parity Conflicts with its Own Guidelines.

Using purchasing power parity to compare telecommunications prices across countries creates a further incorrect inference that prices in Mexico are high by international standards. PPP calculations are based on hundreds or even thousands of price comparisons at a minute level of consumer expenditure shares. Consequently, they inherit the problems of price indices in individual countries, especially in their incorrect treatment of new goods or improved goods, both of which are important factors for mobile telecommunications. Using actual observed consumer behavior to calculate real

43. *OECD 2012 Mexico Consumer Surplus Study*, op. cit. p. 53 tbl.50.
44. *Id*.
45. *Id.* p. 50 tbl.46.
46. *Id.* p. 19.

income is superior to "using accounting-based measures such as PPP adjustment which have little or no economic basis."[47]

The OECD itself urges caution when using PPP. The OECD developed its PPP methodology to facilitate the comparison of the economic aggregates of various countries—originally, 18 European countries. The OECD's methodology manual—which was published to promote the use of PPP when comparing GDPs and other macroeconomic indicators—delineates the recommended and not recommended uses of PPPs.[48] The recommended uses include comparison of GDPs and other macroeconomic indicators such as GDP per capita and GDP per hour.[49] The not recommended uses include their use "[a]s measures to undertake price level comparisons at low levels of aggregation" and "[a]s precise measures to establish strict rankings of countries."[50]

It is surprising that the OECD nonetheless used PPP to make "price level comparisons" – one of its "not recommended" uses – and that it did not even duplicate its analysis using market exchange rates. We have recreated in Figures 1 and 2 the OECD's pricing rankings using market exchange rates instead of PPP.[51] Use of prices based on market exchange instead of PPP prices would have changed the OECD's conclusions. For example, the OECD used PPP to rank Mexico as the fourth-most expensive OECD country for residential telephone charges. However, when market exchange rates are used, Mexico ranks 16th out of 34 countries.[52] Similarly, the OECD's use of PPP made Mexico the third-most expensive OECD country for the 100-calls mobile basket; but, when market exchange rates are used, Mexico is the tenth-cheapest country.

47. Jerry A. Hausman, *Mobile Phones in Developing Countries* 23 (Working Paper, 2010). *See also* Angus Deaton & Alan Heston, *Understanding PPPs and PPP-Based National Accounts*, 2 AM. ECON. J.: MACROECON. 1, 32 (2010) The Authors state "[E]xercise caution, particularly with comparisons between countries whose economies are very different**,** and particularly with the national accounts data provided by countries whose statistical capacity is weak. On the former, there are deep conceptual difficulties that cannot be resolved by collecting better data."

48. OECD Statistics Dep't, *Eurostat-OECD Methodological Manual on Purchasing Power Parities*, p. i & 33 (2006).

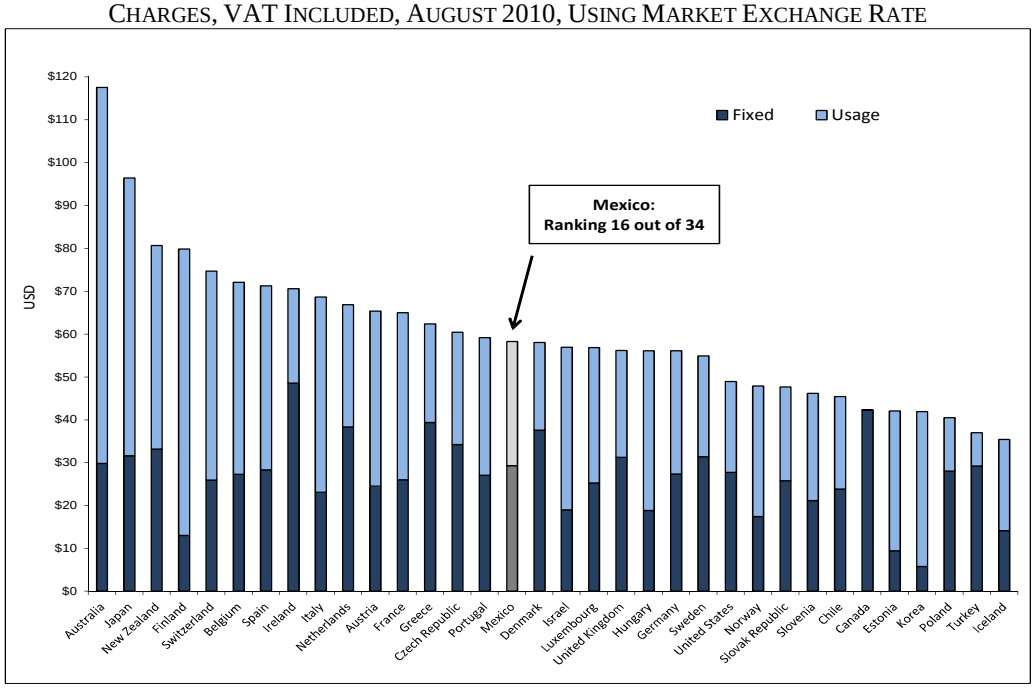
49. *Id.* p. 33.

50. *Id*.

51. Specifically, we replicate Figures 1.7, and 1.9 and Table 1.7 in the OECD 2012 CONSULTING REPORT, op. cit. Those figures and table are based upon February 2011 data, which we do not have; consequently, our comparison is to August 2010.

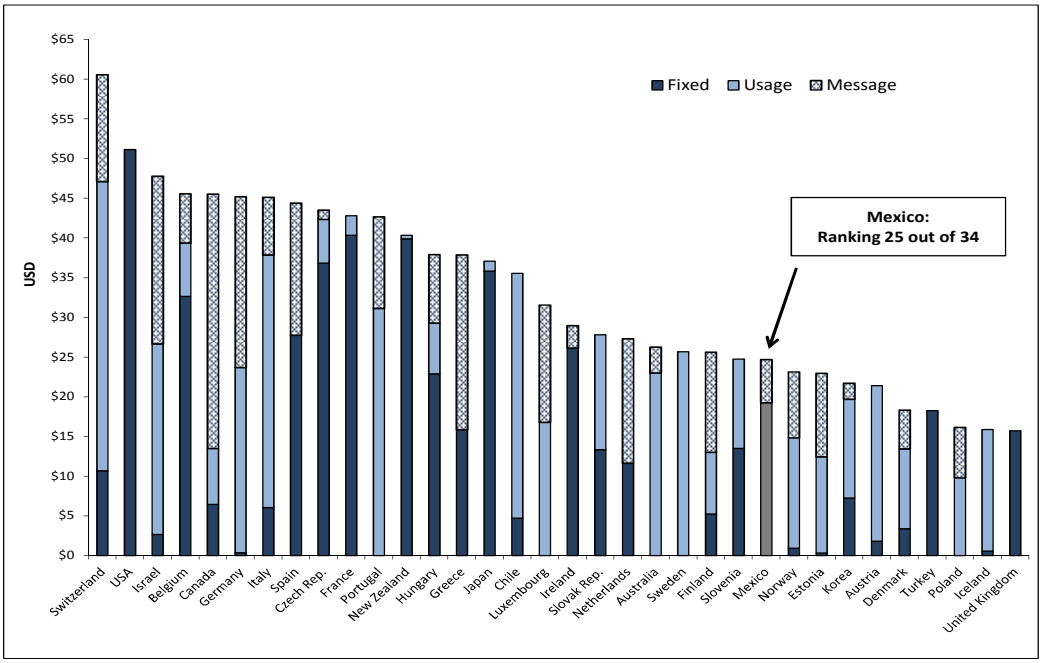
52. When we use the 260-call business basket, Mexico ranks thirteenth out of 34.

FIGURE 1: REPLICATION OF OECD FIGURE 1.7, 140-CALLS BASKET OF RESIDENTIAL TELEPHONE CHARGES, VAT INCLUDED, AUGUST 2010, USING MARKET EXCHANGE RATE



Notes: The OECD basket of business telephone charges includes fixed access and 140 calls (broken down according to distance, destination [fixed, mobile, and international], and time of day) over a one-month period. The values from "fixed" and "usage" were added.
Sources: OECD and Teligen, *available at* StatLink2 http://dx.doi.org/10.1787/888932398746 (OECD 2011 COMMUNICATIONS OUTLOOK, *supra* note 38).

FIGURE 2: REPLICATION OF OECD FIGURE 1.9, 100-CALLS MOBILE BASKET, VAT INCLUDED, USING MARKET EXCHANGE RATE



Notes: The OECD basket of mobile telephone charges includes subscription and usage (100 voice calls and 140 SMS messages, distributed between peak and off-peak hours and based on an average call duration) over a one-month period. The values from "fixed," "usage," and "message" were added.
Sources: OECD and Teligen, *available at* StatLink2 http://dx.doi.org/10.1787/888932398841 (OECD 2011 COMMUNICATIONS OUTLOOK, *supra* note 38).

In Table 1, we replicate Table 1.7 of the OECD Report, which summarizes Mexico's prices relative to the average OECD country. Using PPP, the OECD found that Mexico's fixed-line residential basket was about 150-percent more expensive than the OECD average. When market exchange rates are used, however, Mexico's residential basket was about 7 percent cheaper than the OECD average. With respect to the fixed-line business basket, the OECD used PPP to find that Mexico was about 130 percent more expensive than the OECD average. Using market exchange rates, we find that Mexico was only 1 percent more expensive than the OECD average.

Most important is the change in conclusion for mobile services when using market exchange rate instead of PPP. Mobile services far exceed fixed-line services in Mexico and using PPP the OECD finds that Mexico's mobile prices were 19 percent more expensive than the OECD average. In contrast, when using market exchange rates, we find that mobile prices in Mexico were about 33 percent *cheaper* than the OECD average.

TABLE 1: MEXICAN PRICES IN THE OECD PRICE BASKETS RELATIVE TO THE OECD AVERAGES: PPP VERSUS MARKET EXCHANGE RATE (MER)

	Mexican prices as % of	
	OECD average (PPP)	**OECD average (MER)**
Residential call baskets		
20 calls	124.44%	81.35%
60 calls	194.90%	87.79%
140 calls	137.27%	94.08%
420 calls	145.13%	111.25%
Simple Average	**150.44%**	**93.62%**
Business call baskets		
100 calls	132.80%	104.74%
260 calls	130.00%	98.79%
Simple Average	**131.40%**	**101.77%**
Mobile call baskets		
30 calls	132.50%	70.59%
100 calls	165.52%	74.96%
300 calls	109.51%	74.71%
900 calls	96.03%	67.56%
Pre-paid 40 calls	94.92%	50.49%
Simple Average	**119.70%**	**67.66%**

Notes: OECD average (PPP) is based on February 2011 price baskets; OECD average (MER) is based on August 2010 price baskets.
Sources: OECD 2011 COMMUNICATIONS OUTLOOK, *supra* note 38; OECD 2012 CONSULTING REPORT, *supra* note 4.

D. The OECD Draws Unreliable Conclusions from Penetration Statistics[53]

In most countries, reported penetration exceeds 100 percent because of customers with multiple SIM cards (multiple accounts) and because mobile providers do not always delete customers who do not use their account for significant periods of time. For example, Korea is ranked relatively low in mobile penetration in our peer country sample, yet use of mobile is very high in Korea.[54] Comparing Mexico's mobile penetration to such countries with penetration exceeding 100 percent is misleading. The marginal benefits to consumers after mobile penetration has surpassed approximately 90 percent are quite small.

The OECD also asserts that fixed-line penetration in Mexico is low relative to other countries.[55] The OECD, however, ignores that fixed-line penetration in *both* developing and developed countries have not grown nearly as rapidly as mobile penetration. In fact, in many countries the fixed-line penetration rate has remained flat or has actually decreased in recent years. The trend actually makes the growth in Mexico's fixed-line penetration from 2000 to 2008 all the more remarkable. It also contradicts the OECD's hypothesis that low levels of competition for fixed-line services in Mexico have *caused* low fixed-line penetration. Reaching the average OECD level of fixed-line penetration is nearly impossible because fixed-line penetration in all countries is constant or declining. Although Mexico's fixed-line penetration has not neared that of the average OECD country, mobile penetration in Mexico has increased rapidly.[56] Mobile penetration in Mexico increased from practically 0 percent in 1995 to 80 percent in 2010. Figure 3 shows fixed-line and mobile penetration in Mexico between 2000 and 2010. It is irrelevant in measuring competition in Mexico's telecommunications marketplace that fixed-line penetration in Mexico increased less, from 10 percent to 17.5 percent over the same period.

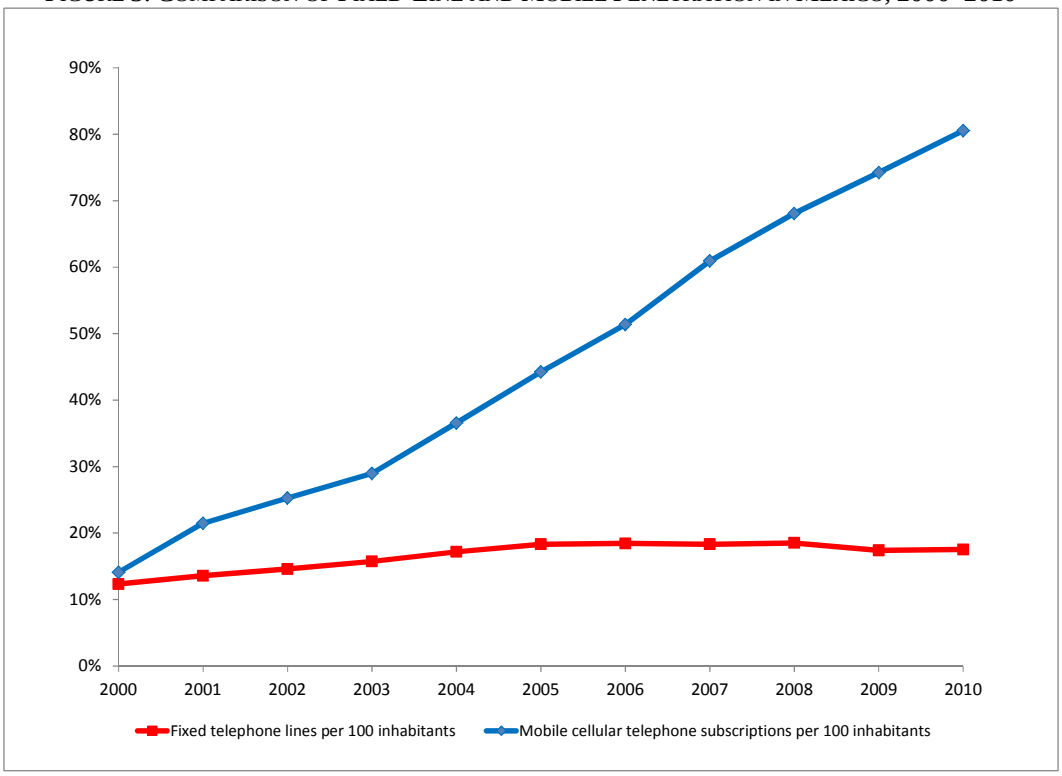
53. *OECD 2012 Mexico Consumer Surplus Study*, op. cit. pp. 6-8.

54. *See, e.g.*, Evan Ramstad, *More Data Shows Koreans Love Smartphones*, WALL ST. J., Apr. 13, 2011, http://blogs.wsj.com/korearealtime/2011/04/13/more-data-shows-koreans-love-smartphones/; Choe Sang-Hun, *In South Korea, All of Life Is Mobile*, N.Y. TIMES, May 24, 2009, http://www.nytimes.com/2009/05/25/technology/25iht-mobile.html?pagewanted=all; Elena Malykhina, *South Korea Leads the Wireless Way*, INFO. WK., Nov. 14, 2005, *available at* http://www.informationweek.com/news/173602129.

55. *OECD 2012 Mexico Consumer Surplus Study*, op. cit. pp. 6-8.

56. The same results apply to other lower-income economies. Chile's fixed-line penetration was 12.6 and 20.2 percent in 1995 and 2010, respectively. During the same period mobile penetration went from practically zero to 116 percent, respectively. While Chile still has a large fixed-line penetration gap between it and the average OECD countries, it has achieved universal mobile penetration. Turkey is a particularly interesting example in that its fixed-line penetration was 22 percent in 1995, and in 2010 it remains at 22 percent. Although there was growth in fixed-line penetration during this time period, Turkey has been losing fixed-lines since reaching a peak of 29 percent penetration in 2001. At the same time mobile penetration in Turkey went from practically zero to 84.9 percent. Source: World Telecommunication/ICT Indicators Database 2011 (15th Edition)]

FIGURE 3: COMPARISON OF FIXED-LINE AND MOBILE PENETRATION IN MEXICO, 2000–2010



Source: World Telecomm./ICT Database 2011, *supra* note 21.

It is incorrect for the OECD to use fixed-line penetration as an indicator telecommunications competition in Mexico today. The average OECD country obtained universal fixed-line penetration at a time when mobile services were non-existent or in their infancy. The only means to provide citizens with telecommunications in the 1970s, 1980s, and early part of the 1990s was through the fixed-line network. As a result, most high-income economies in the OECD had achieved universal fixed-line penetration long before mobile services were a reality. By 1995, many OECD countries had achieved universal service, a level which appears to be around 50 main lines per 100 inhabitants. By the mid-1990s, the United States, Canada, and major Western European countries had fixed-line penetration ranging from 43 percent for Italy to 68 percent for Sweden.

In contrast, fixed-line penetration in developing economies tends to be significantly lower than in developed economies, due to lower income levels in developing economies and other factors that may affect demand for fixed-line telecommunications.[57] It is not likely that the average developing economy country will ever reach the fixed-line penetration levels observed in such developed economies. Instead, many developing countries have engaged in a form of technological "leap-frogging"—investing more in mobile than in fixed-line networks. Global demand for mobile services exceeds demand for fixed-line services. Moreover, deploying mobile networks is substantially less expensive than deploying fixed-line networks. Therefore, comparing fixed-line penetration in Mexico (or any developing economy) to penetration in the OECD is incorrect.

57. For example, privatizations, competition, and existence of independent regulatory regimes can be important determinants of telecommunications growth, and these variables tend to differ between developed and developing economies.

III. NO EVIDENCE OF MARKET FAILURE EXISTS IN MEXICAN TELECOMMUNICATIONS

Market failure in the form of insufficient competition manifests itself in high prices and low demand. By comparing Mexico's prices and demand to OECD countries, the OECD concludes that Mexico's telecommunications sector has experienced a lack of competition. However, when compared to other countries in a similar economic situation (including nine OECD countries), Mexico's mobile and fixed-line prices are low. Similarly, we find that penetration levels in Mexico are not low by international standards. Therefore, the OECD's conclusions regarding harm to Mexican consumers from a lack of competition have no basis in reality.

A. Proper Selection of the Sample of Countries

We select a sample of comparable companies to conduct our analysis based upon income levels. We began our selection of peer countries by ranking countries by GDP per capita. Although we use market exchange rates in the rankings, our sample of peer countries does not change if we used PPP. We selected a sample of countries that were above and below Mexico in a ranking of GDP per capita. We then relied upon available price data to select our sample of peer countries. For mobile price information, we rely on data from the International Telecommunications Union (ITU) and data from Bank of America/Merrill Lynch (BoA/ML). We were left with a total of 16 peer countries (17 including Mexico). Table 2 lists the economic and telecommunications characteristics of Mexico and the 16 peer countries used in our analysis. It is worth noting that Mexico's GDP per capita is below all selected countries' GDP per capita values but four of them: Malaysia, South Africa, Colombia and Peru.

TABLE 2: MEXICO AND PEER COUNTRIES, 2010 ECONOMIC AND TELECOMMUNICATIONS INDICATORS

Country Name	GDP per Capita (Market Exchange Rate - MER)	GDP per Capita (Purchasing Power Parity - PPP)	Population	Mobile Cellular Telephone Subscriptions per 100 Inhabitants	Fixed Telephone Lines per 100 Inhabitants
Mexico	$9,123	$14,498	113,423,047	80.6	17.5
Argentina	$9,124	$16,012	40,412,376	141.8	24.7
Brazil	$10,710	$11,210	194,946,470	104.1	21.6
Chile	$12,431	$15,732	17,113,688	116.0	20.2
Colombia	$6,225	$9,462	46,294,841	96.1	15.5
Czech Republic	$18,245	$25,283	10,492,960	137.2	22.9
Greece	$26,600	$27,805	11,359,346	108.2	45.8
Hungary	$12,852	$20,029	9,983,645	120.3	29.8
Israel	$28,504	$28,546	7,418,400	133.1	44.2
Korea	$20,757	$29,004	48,183,584	105.4	59.2
Malaysia	$8,373	$14,731	28,401,017	119.2	16.1
Peru	$5,401	$9,538	29,076,512	100.1	10.9
Poland	$12,293	$19,783	38,276,660	122.7	20.0
Portugal	$21,505	$25,610	10,675,572	142.3	42.0
Russia	$10,440	$19,840	142,958,164	166.3	31.4
South Africa	$7,275	$10,570	50,132,817	100.5	8.4
Turkey	$10,094	$15,321	72,752,325	84.9	22.3

Note: All variables are 2010 values.
Sources: World Telecomm./ICT Database 2011, The World Bank.

Our sample of peer countries consists of countries whose GDP per capita ranges from a high of $28,504 (Israel) to a low of $5,401 (Peru). Mexico's GDP per capita is on the low side at $9,123. Some of the peer countries are OECD countries such as Chile, the Czech Republic, Greece, Hungary, Israel, Korea, Poland, Portugal, and Turkey. Peer countries in Latin America are Argentina, Brazil, Chile, Colombia, and Peru. Peer countries in Asia are Korea and Malaysia. Table 3 shows the average and standard deviation for the peers compared to Mexico for mobile and fixed-line penetration and for GDP per capita. Compared to its peers, Mexico has lower GDP per capita both in terms of market exchange and PPP but falls within a 95 percent confidence level. Mobile penetration and fixed-line penetration in Mexico also are lower compared to its peers but also fall within the 95 percent confidence level.

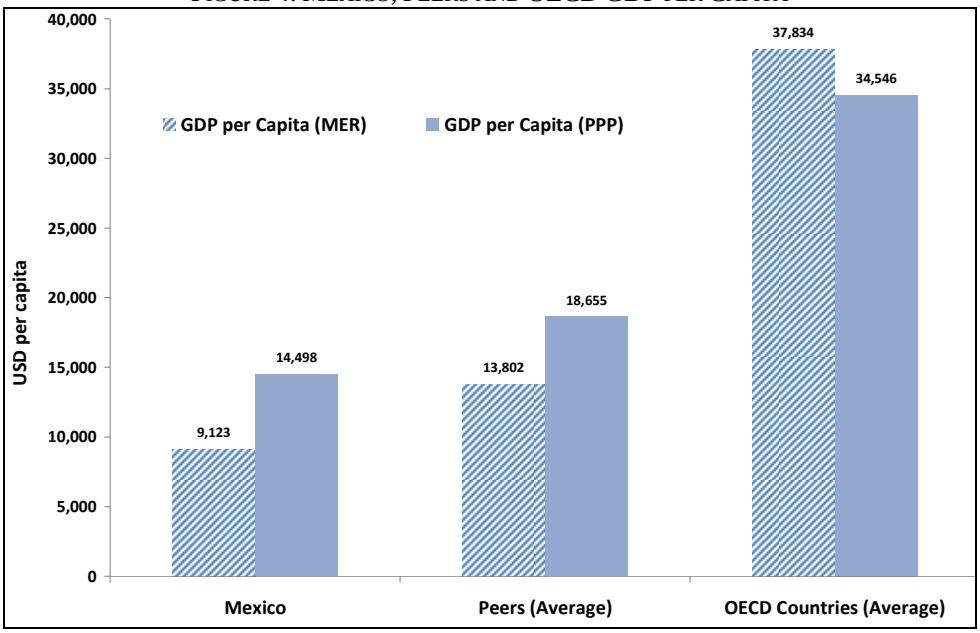
TABLE 3: COMPARISON OF 2010 MEXICO AND PEER COUNTRY AVERAGES

Telecommunication Variable	Mexico [1]	Peer Countries Average [2]	Peer Countries Standard Deviation [3]	Lower 95% Confidence Value [4]	Upper 95% Confidence Value [5]
Mobile Penetration	80.55	118.63	21.23	77.02	160.24
Fixed-Line Penetration	17.54	27.20	14.05	–0.35	54.75
GDP per Capita (MER)	$9,123	$13,802	$7,160	–$232	$27,835
GDP per Capita (PPP)	$14,498	$18,655	$6,909	$5,113	$32,196

Note: All variables are 2010 values.
Sources: World Telecomm./ICT Database 2011, The World Bank.

Our peer countries are more representative of Mexico in terms of GDP per capita than is the entire OECD set of countries. Figure 4 below depicts the significant difference between Mexico and our peer countries and the entire set of OECD countries in terms of GDP per capita. The average GDP per capita for the entire set OECD countries was $37,834 and $34,546 in market exchange and PPP rates, respectively, while the average GDP per capita for the peer countries was $13,802 and $18,655 in market exchange and PPP rates, respectively. This is a difference of 63 and 46 percent, respectively. As Figure 4 shows, Mexico has significantly lower income than the average OECD country and slightly less income than the average peer country.

FIGURE 4: MEXICO, PEERS AND OECD GDP PER CAPITA



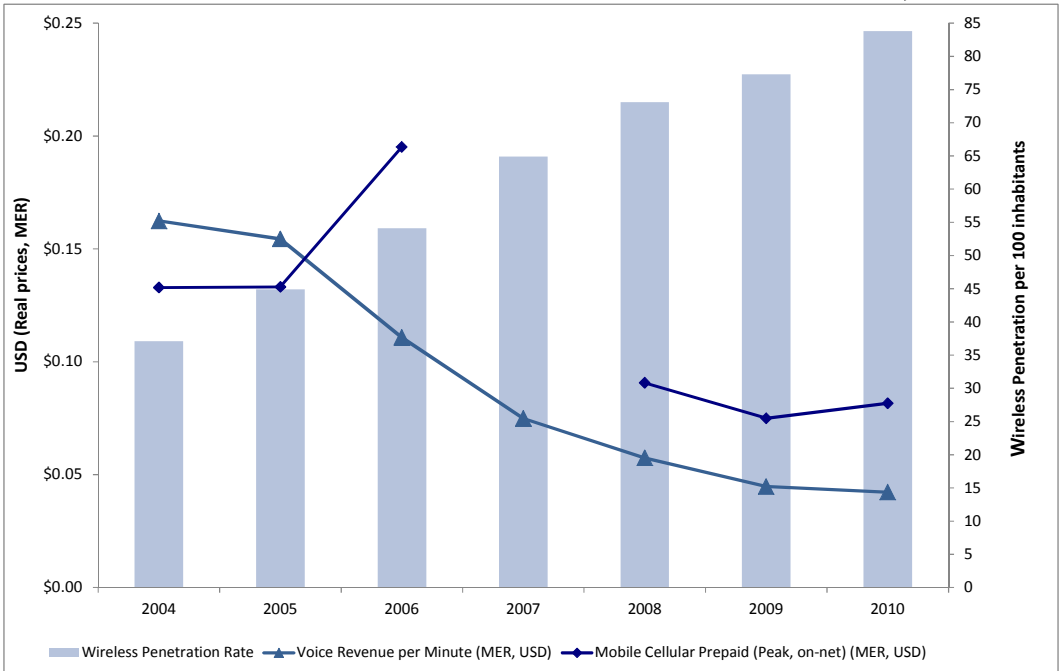
Note: Data are for 2010.
Source: World Bank.

B. Mexico's Mobile Sector Shows No Lack of Competition

Mobile subscribers and penetration have grown significantly in Mexico since the early 2000s. At the same time, mobile prices have declined significantly. For mobile price, we have two sources of data. The first are data from the ITU—the price of pre-paid on-net calls during peak period. The ITU surveys countries annually for the price of many different telecommunications tariffs. The ITU data have missing observations for many countries in 2007 and tend to have much more variation year to year, likely due to the difficulties in tracking mobile prices over time.[58] Nevertheless, we believe the ITU data can provide a first look at price trends across countries. The second data source for mobile price is from the BoA/ML reports, which publish quarterly data on average voice revenue per minute (VRPM). We use VRPM as a proxy for mobile prices.

Figure 5 depicts wireless penetration in Mexico between 2004 and 2010 and real inflation-adjusted prices during the same period. Mobile subscribers increased from a penetration rate of 37.1 (31.6 million subscribers) in 2004Q1 to a penetration rate of 83.38 (96.5 million subscribers) in 2011Q3, an increase in mobile subscribers of 205 percent. The compound annual growth rate during this period was 11 percent. The ITU data indicate that real, inflation-adjusted mobile prices in Mexico fell by 38.6 percent between 2004 and 2010, a compound annual decline of 7.8 percent. The BoA/ML data indicate that real, inflation-adjusted mobile prices fell by 74 percent between 2004 and 2010, for a compound annual decline of 20.1 percent.

FIGURE 5: MEXICO WIRELESS PENETRATION AND REAL INFLATION-ADJUSTED PRICES, 2004 – 2010

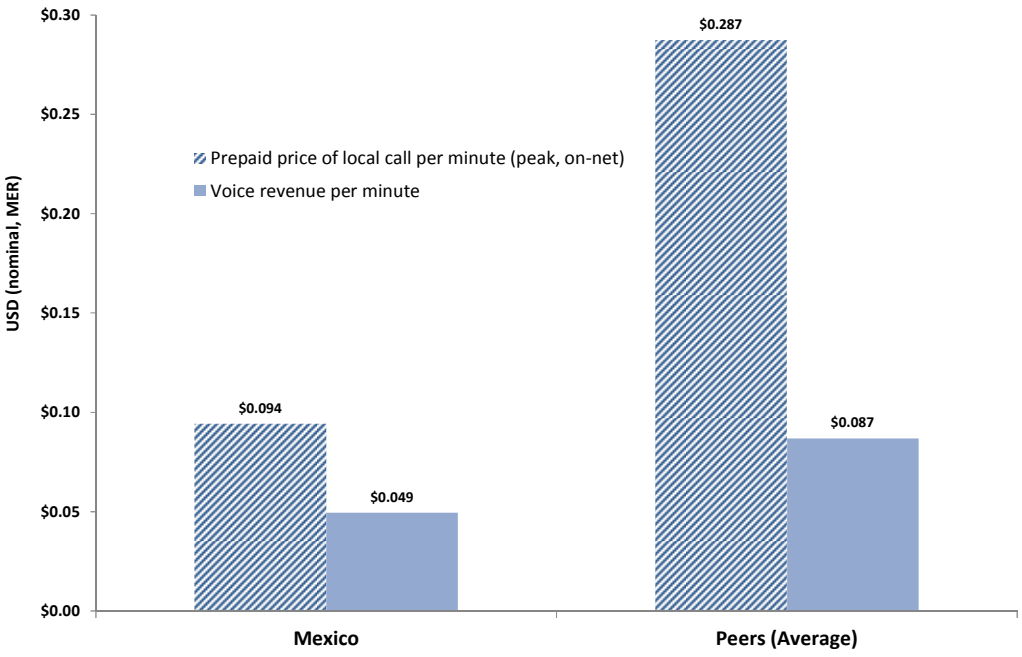


Notes: Year 2004 used as base for real prices; Prices were deflated using the US CPI.
Sources: World Telecommunication/ICT Indicators Database 2011 (15th Edition) (mobile cellular prepaid price of local call per minute); Bank of America - Merrill Lynch Global Wireless Matrix Reports (voice revenue per minute); TeleGeography (penetration rate).

58. The OECD Study confirms this point by including two variables in its econometric model that attempts to control for the changing mobile price methodology.

Compared to its peers, Mexico has low mobile prices. Figure 6 shows the comparison. Using the ITU data, mobile prices in Mexico in 2010 in USD market exchange rates was $0.094, while the peer average was $0.287, a difference of 67.2 percent. Using the BOA/Merrill Lynch data, mobile prices in Mexico in 2010 in USD market exchange rates was $0.049, while the peer average was $0.087, a difference of 43.1 percent.

FIGURE 6: COMPARISON OF MOBILE PRICES IN MEXICO AND PEER COUNTRIES, 2010



Note: Data are for 2010.
Sources: World Telecommunication/ICT Indicators Database 2011 (15th Edition) (prepaid price of local call per minute); Bank of America - Merrill Lynch Global Wireless Matrix Reports (voice revenue per minute).

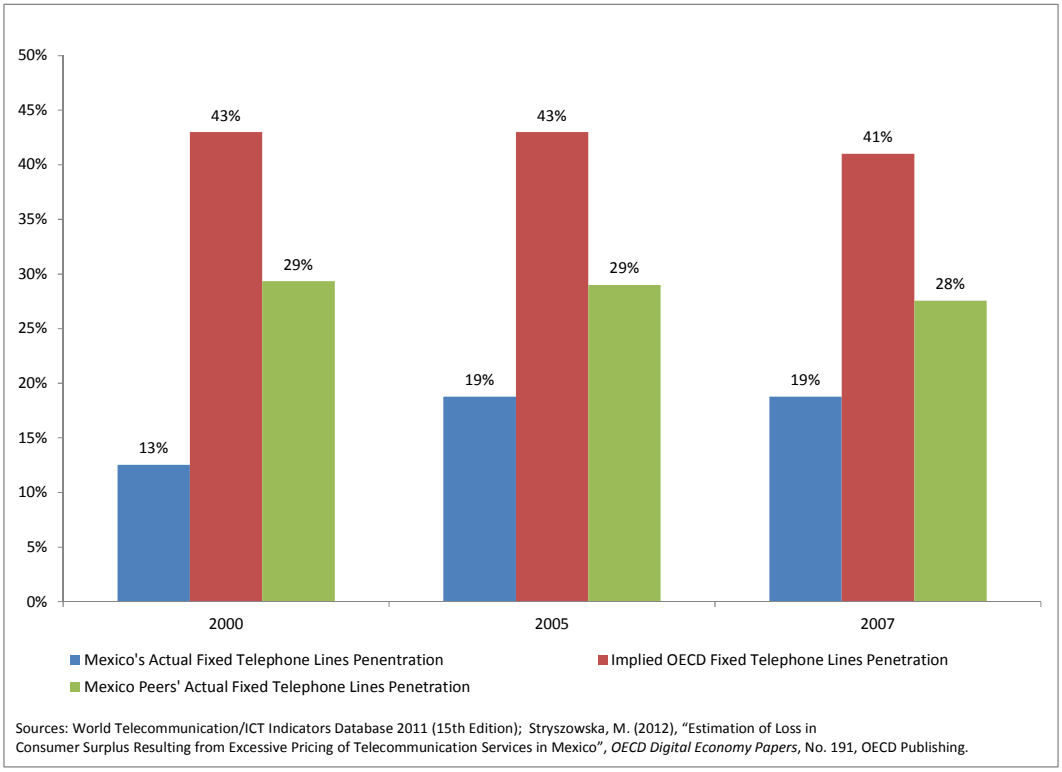
Mexico's mobile penetration is lower than its peers but still within the 95 percent confidence level. Penetration data, however, must be treated with caution because in most countries, reported penetration is well above 100 percent because of customers with multiple SIM card (multiple accounts) and because mobile providers do not always delete customers who do not use their account for significant periods of time. For example, Korea is ranked relatively low in our peer sample, yet use of mobile is very high in Korea.[59]

59. *See, e.g.*, *South Korea Leads the Wireless Way*, op. cit.

C. Mexico's Fixed-Line Sector Shows No Lack of Competition

The OECD concludes that, but for the level of competition, in 2000 Mexico should have had more than three times the number of fixed access paths (42.35 million) than actual (12.33 million).[60] In 2007, the latest year estimated by the OECD, it predicts 43.03 million access paths compared to actual access paths of 19.87 million. These estimates are not realistic, for the reasons discussed above. Figure 7 shows the significant differences between actual and predicted fixed-line penetration; it further shows the significant differences even between Mexico's peer average and the OECD's predicted values.

FIGURE 7: IMPLIED OECD FIXED-LINE PENETRATION
COMPARED TO ACTUAL AND PEERS' FIXED-LINE PENETRATION

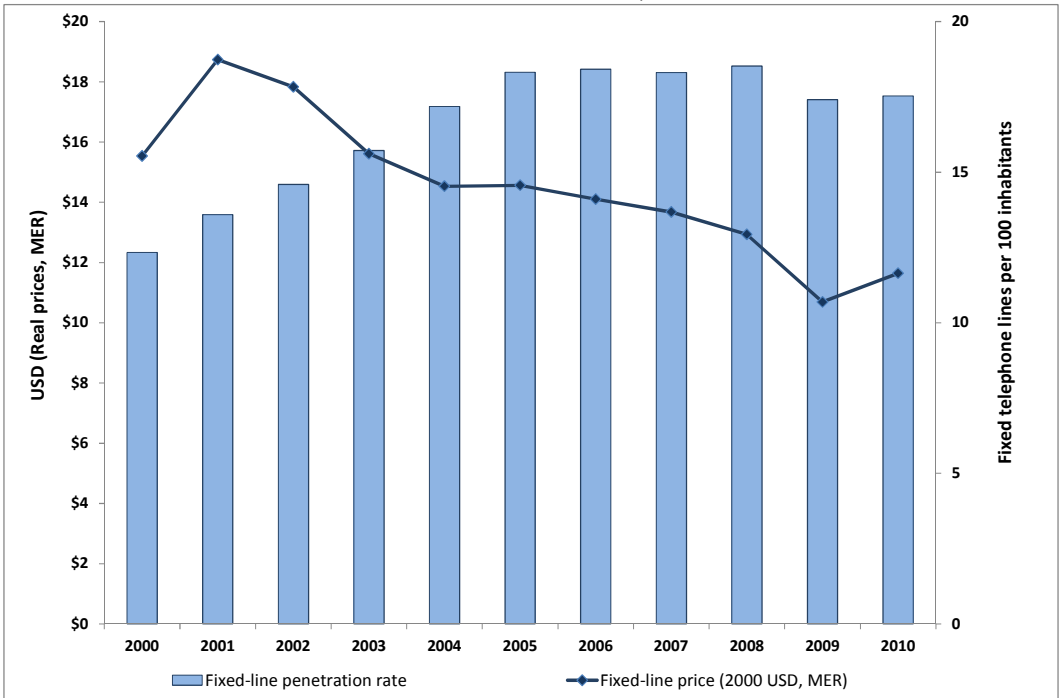


Sources: World Telecommunication/ICT Indicators Database 2011 (15th Edition); Stryszowska, M. (2012), "Estimation of Loss in Consumer Surplus Resulting from Excessive Pricing of Telecommunication Services in Mexico", *OECD Digital Economy Papers*, No. 191, OECD Publishing.

Although Mexico (or most of our peer countries) will not likely reach OECD fixed-line penetration levels, it experienced growth since 2000. However, like many other countries, it has recently exhibited decreases in its fixed-line penetration. Figure 8 shows that the fixed-line penetration rate in Mexico increased from a low of 12.3 percent in 2000 to a high of 18.5 percent in 2008. Over the same period, real inflation-adjusted monthly residential prices in USD market exchange rate fell from a high of $18.74 in 2001 to a low of $10.69 in 2009, a decrease of approximately 43 percent. The price data come from the ITU and are used in the fixed-line demand model below.

60. *OECD 2012 Mexico Consumer Surplus Study*, op. cit. p. 47 tbl.42.

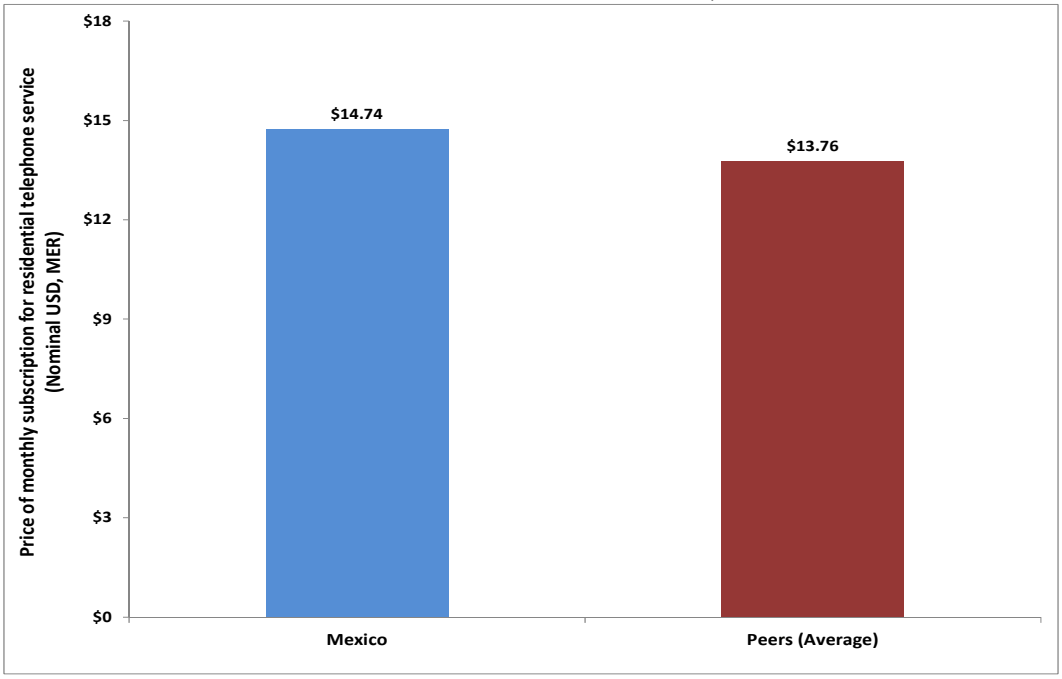
FIGURE 8: FIXED-LINE PENETRATION AND REAL INFLATION-ADJUSTED RESIDENTIAL PRICES IN MEXICO, 2000-2010



Notes: Year 2000 used as base for real prices; Prices were deflated using the US CPI.
Source: World Telecommunication/ICT Indicators Database 2011 (15th Edition).

Mexico's nominal fixed-line prices are very close to its peers' average fixed-line price. Figure 9 shows that in 2010 Mexico's nominal residential fixed-line price in USD market exchange rates was $14.74, compared to $13.76 for its peers. This is a difference of only 7 percent and without any statistical significance.

FIGURE 9: NOMINAL FIXED-LINE PRICES IN MEXICO AND THE AVERAGE OF PEER COUNTRIES, 2010



Source: World Telecomm./ICT Database 2011, *supra* note 21.

With respect to penetration, Mexico has lower penetration than its peers. But the peer countries include some high penetration countries such as Greece, Portugal, and Korea. For the reasons discussed above, these countries are not fair comparisons. Nevertheless, as we show in the econometric model, controlling for income and other factors, Mexico's actual level of fixed-line penetration is *higher* than predicted using peer countries.

IV. MEXICAN CONSUMERS HAVE GAINED CONSUMER SURPLUS FROM LOWER PRICES[61]

We develop econometric models that correct the OECD's errors. Our corrected models show that mobile and fixed-line prices in Mexico are actually *lower* than one would expect based on comparable countries. In 2011, mobile prices in Mexico were 32 to 60 percent lower than the model's prediction—corresponding to additional consumer surplus of $4 to $5 billion. Similarly, in 2010, fixed-line prices were about 15 percent lower than the model's predictions. These lower-than-expected prices yielded an additional $1 billion in consumer surplus compared with the model's expectation for 2010. Our models together show that, based on comparable countries, low mobile and fixed-line pricing in Mexico resulted in at least an additional *$5 to $6 billion* in consumer surplus in 2010 and 2011.

A. Consumer Surplus from Lower Mobile Prices

I analyze mobile demand and mobile prices in Mexico. My data spans the period from 2004 to 2011, and I use a sample comprising Mexico and sixteen additional countries that each has a per-capita GDP comparable to that of Mexico. My analysis finds that Mexico's mobile prices are low compared with the prices of the other sixteen countries in my sample.

My econometric models demonstrate that price and per-capita GDP are important determinants of mobile demand. Although Mexico's mobile penetration is low compared with the other sixteen countries, I do not find high prices to be the cause; indeed, as I explain, Mexico has low prices. Rather, characteristics specific to Mexico, which are captured by country-specific variables, explain Mexico's lower-than-expected mobile penetration.

I also estimate price equations. Based on the predictions of my model, I find that Mexico's prices have been lower than one would expect based on prices in comparable countries since 2006 and have decreased more rapidly than mobile prices in comparable countries. Thus, Mexican consumers have experienced consumer surplus of $4 to $5 billion greater than expected based on comparable countries.

1. Cross-Country Comparison of Mexico's Mobile Prices

I estimate mobile demand and price equations for my seventeen-country sample using quarterly data for the period from the second quarter of 2004 to the third quarter of 2011. I selected my sample of countries based upon their having per-capita GDPs similar to that of Mexico. Mexico ranks thirteenth among the seventeen countries in terms of GDP per capita. The panel data set has 507 observations because of three missing observations in 2004. The primary variables I use in my model are price,[62] per-capita GDP, and mobile

61 Jerry A. Hausman was the author of Section IV A (Consumer Surplus from Lower Mobile Prices) and Agustin J. Ros was the author of Section IV B (Consumer Surplus from Lower Fixed-Line Prices).

62. I used voice revenue per minute from Bank of America-Merrill Lynch (ML). The ML data are frequently used and represent *actual* expenditures rather than some other non-market based measures, such as the price for a hypothetical mobile call of a given length. Although errors in variables (EIV) may exist in the ML data as a measure of price, EIV should not present a significant problem because I always treat the price variable as (jointly) endogenous. *See, e.g.*, Jerry A. Hausman, *Errors in Variables in Simultaneous Equation Models*, 5 J. ECONOMETRICS 389 (1977).

penetration. Table 4 reports the most recently available relevant data on the seventeen countries in my sample, including Mexico.[63]

TABLE 4: DATA AVAILABLE FOR SAMPLE COUNTRIES, Q3 2011, RANKED LOW TO HIGH BY VRPM

Country	Voice Revenue Per Minute (USD)	GDP per Capita Market Exchange Rate	Total Subscribers (Wireless)	Population	Penetration Rate (%)
Turkey	$0.040	$10,947	64,728,000	73,852,520	88
Mexico	$0.041	$10,193	96,516,100	115,122,300	84
Russia	$0.043	$13,553	227,444,856	142,777,500	159
Colombia	$0.052	$7,556	46,610,058	45,910,847	102
Israel	$0.056	$32,616	10,000,000	7,714,280	130
Poland	$0.068	$13,649	49,945,000	38,152,320	131
Peru	$0.073	$6,204	25,634,800	29,713,754	86
Malaysia	$0.076	$10,115	35,109,500	28,460,470	123
Chile	$0.076	$13,771	23,131,500	17,308,710	134
Korea	$0.078	$23,788	52,121,000	48,692,220	107
Hungary	$0.085	$14,617	11,231,779	9,985,421	112
Brazil	$0.085	$12,977	231,314,398	197,106,500	117
Greece	$0.099	$26,263	15,558,218	11,339,550	137
Argentina	$0.110	$11,011	54,442,300	40,853,340	133
Portugal	$0.113	$22,788	17,174,000	10,658,500	161
Czech Republic	$0.125	$21,067	13,700,200	10,525,470	130
South Africa	$0.138	$8,239	57,152,193	50,535,380	113

Notes: Voice revenue per minute and GDP per capita are both presented in U.S. dollars. I converted all voice revenue and GDP figures into U.S. dollars by using contemporaneous exchange rates from Bank of America-Merrill Lynch "Global Wireless Matrix" reports. The U.S. CPI used for conversion is available from the U.S. Bureau of Labor Statistics at http://www.bls.gov/cpi/. I calculated the mobile penetration rate by dividing total wireless subscribers by the total population.

Sources: BANK OF AMERICA-MERRILL LYNCH, GLOBAL WIRELESS MATRIX FOR 4TH QUARTER 2011 (2011); BANK OF AMERICA-MERRILL LYNCH, GLOBAL WIRELESS MATRIX FOR 3RD QUARTER 2011 (2011); BANK OF AMERICA- MERRILL LYNCH, GLOBAL WIRELESS MATRIX FOR 1ST QUARTER 2007 (2007). With the exceptions of Israel, Colombia, and Peru, GDP per capita and population data are from Oxford Economics (via Thomson DataStream). OXFORD ECONOMICS, http://www.oxfordeconomics.com/. For Israel's GDP data, I used the Central Bureau of Statistics of Israel. CENTRAL BUREAU OF STATISTICS, http://www1.cbs.gov.il (Isr.) (to view the website in English, use http://www1.cbs.gov.il/reader/cw_usr_view_Folder?ID=141). I used the OECD for Israel's population data. OECD, http://www.oecd.org. For both Columbia's GDP and population data, I used the *Departamento Administrativo Nacional de Estadistica de Colombia*. DEPARTAMENTO ADMINISTRATIVO NACIONAL DE ESTADISTICA [NAT'L BUREAU OF STATISTICS], http://dane.gov.co (Colom.). I used the *Instituto Nacional de Estadistica e Informatica del Peru* both for Peru's GDP data and for Peru's population data. Instituto Nacional de Estadistica e Informatica [National Institute of Statistics and Informatics], http://www.inei.gob.pe (Peru). Mobile subscriber data are from TeleGeography's total wireless subscribers. TELEGEOGRAPHY, http://www.telegeography.com/.

In terms of price, or voice revenue per minute (VRPM), Mexico is one of the three countries with the lowest mobile prices (along with Russia and Turkey). The average price per minute is $0.04 in each of those three countries. Notably, Mexico has the *lowest price* of any Latin American nation in the sample. In terms of prices adjusted by PPP (which I consider to be an inferior measure of price), Mexico, Russia, Israel, and Turkey

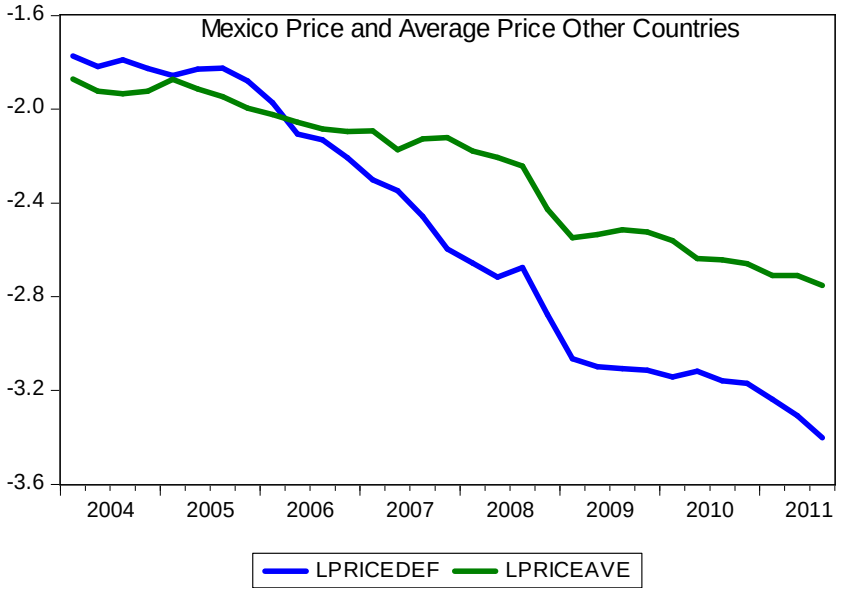
63. Although not reflected in Table 4, I also estimated voice revenue per minute using purchasing power parity (PPP) deflated prices. I believe that the PPP-deflated approach is inferior to the exchange rate approach because, with the exception of Korea, all mobile equipment is manufactured outside the countries in the sample and subsequently traded in world markets. The cost of the telecommunications equipment will be a major determinant of mobile prices. Regardless, I find similar results using PPP-adjusted prices.

are the four countries with the lowest prices.[64] Mexico also has the lowest PPP-adjusted prices of any Latin American nation in the sample.

Mexico has the lowest mobile penetration rate in the sample (84 percent), followed closely by Peru (86 percent) and Turkey (88 percent). However, for the reasons I explained in part II.D, mobile penetration data must be treated with caution because the reported penetration of many countries exceeds 100 percent. Below, I use an econometric method (called fixed effects), which accounts for this problem with reported penetration data.

In Figure 10, I graph the log of Mexico's mobile prices (LPRICEDEF) alongside the average of the log mobile prices of the other sixteen countries (excluding Mexico) (LPRICEAVE). Mexico's log prices were above the average of other countries' log prices only until the second quarter of 2006. Since then, Mexico's mobile prices have been below the average of the other countries' prices. In 2011, Mexico prices were 59.3 percent below the average of the other sixteen counties. Figure 10 shows that prices in Mexico have declined more rapidly than has the average price of the other sixteen countries.

FIGURE 10: MEXICO'S LOG PRICES (LPRICEDEF) AND THE AVERAGE LOG PRICES OF OTHER COUNTRIES (LPRICEAVE)



2. Econometric Estimation of Mexico's Mobile Demand

I first estimate demand equations for mobile services for a seventeen-country sample to determine the price-elasticity of demand and the GDP-per-capita elasticity of demand for mobile service in Mexico. In these demand equations, mobile penetration is the left-hand side, dependent variable. (That is, I am measuring how mobile penetration changes when other variables, such as income and price, change.)

Because countries can have penetrations equal to and exceeding 100 percent (including babies in the population!), fixed-effects estimation, which allows for a

64. Mexico's PPP-adjusted price in 2011 Q3 is $0.0582. The mean PPP-adjusted price is $0.105. Mexico is below the 95% confidence interval for the mean.

separate intercept for each country, is the preferred model specification approach. The Hausman specification test is the standard test to determine whether fixed effects or random effects is the preferred model specification.[65] For the mobile penetration equation, I find the Hausman test statistic to equal 11.4 with 2 degrees of freedom, so the probability that the random-effects estimator is appropriate is 0.0033. This low probability rejects the use of random effects. Consequently, for my demand estimation specification, I use a fixed-effects specification. If fixed effects are not used, the model will produce biased and inconsistent estimates.[66]

To estimate the fixed-effects specification, I use a first-difference generalized method-of-moments (GMM) estimator.[67] Using GMM with first differences eliminates the fixed effects and yields an efficient estimation method. For the right-hand side, explanatory variables, I take GDP per capita to be an exogenous variable. I expect mobile price to be jointly endogenous, so I will need an appropriate instrument.[68] As an instrument for price, I use the approach developed by Hausman and William Taylor, which Hausman has used in a number of academic papers and are now often known as "Hausman instruments."[69] The idea is that (variable) cost may be the best instrument for price. However, econometricians often do not have access to cost information, as in the current situation. For the price in a given market, prices in other markets are effective instruments. Prices across countries should be correlated due to common cost variables, and these prices should be independent of the stochastic error terms as long as there are no common demand shocks in the data. For each country, I use the mean of the price for the other 16 countries as an instrument.[70] All of the countries will have similar cost behavior over time since the mobile equipment industry is highly competitive and the countries all use a common technology. Table 5a shows the estimated coefficients in the demand equation.[71]

65. Jerry A. Hausman, *Specification Tests in Econometrics*, 46 ECONOMETRICA 1251, 1273-91 (1978). *See also* PETER KENNEDY, A GUIDE TO ECONOMETRICS 159 (5th ed., MIT Press 2003); BADI H. BALTAGI, ECONOMETRICS 275 (5th ed., Springer 2011); WILLIAM H. GREENE, ECONOMETRIC ANALYSIS 80 (5th ed., Prentice Hall 2003). High values for the test statistic will indicate that fixed-effects modeling is superior to random-effects modeling.

66. *See* Jerry A. Hausman & William E. Taylor, *Panel Data and Unobservable Individual Effects*, 49 ECONOMETRICA 1377 (1981); *see also* CHENG HSIAO, ANALYSIS OF PANEL DATA (2d ed., Cambridge Univ. Press 2003); BADI H. BALTAGI, ECONOMETRIC ANALYSIS OF PANEL DATA (4th ed., J. Wiley 2008).

67. *See, e.g.*, KENNEDY, op. cit. pp. 151-52.

68. A Hausman specification test for the joint endogeneity of price rejects the hypothesis that price is exogenous. The test statistic is 24.8, which is distributed as chi square with 1 degree of freedom. The *p*-value is 0.00000065. Endogeneity can be a problem because, if unobserved variables jointly affect both the dependent and independent variables, then the coefficient estimates for the independent variables may be biased. An instrument is used to adjust for this problem. An effective instrument will be correlated with the independent variable (in this case, price) but not correlated with the unobserved variables, which are captured by the stochastic error terms.

69. Hausman & Taylor, *Panel Data and Unobservable Individual Effects*, op. cit. For applications of this approach, see Jerry A. Hausman, *Competitive Analysis with Differentiated Products*, 34 ANNALES D'ECONOMIE ET DE STATISTIQUE 159 (1994); Jerry A. Hausman & Gregory K. Leonard, *The Competitive Effects of a New Product Introduction: A Case Study*, 50 J. INDUS. ECON. 237 (2002). For another application of the approach, see Aviv Nevo, *Measuring Market Power in the Ready-to-Eat Cereal Industry*, 69 ECONOMETRICA 307 (2001).

70. This approach passes the "weak instrument" tests. Also, the estimate of the price variable coefficient in the demand equation is very precise.

71. I use the econometric software Eviews for all of the estimation.

TABLE 5A: ESTIMATION OF FIXED-EFFECTS DEMAND EQUATION OVER 17 COUNTRIES

Dependent Variable: DLPEN
Method: Panel Generalized Method of Moments

Sample (adjusted): 2004Q2 2011Q3
Periods included: 30
Cross-sections included: 17
Total panel (unbalanced) observations: 507
White period instrument weighting matrix
Period SUR (PCSE) standard errors & covariance (d.f. corrected)
Instrument specification: C DLGDPDEF DLPRICEIV1

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
DLPRICEDEF	–0.524090	0.069200	–7.573586	0.0000
DLGDPDEF	0.425284	0.050499	8.421615	0.0000

The left-hand side, dependent variable is the change in the log of mobile penetration. The coefficient on the change in the log of price is the price elasticity of demand, and it is estimated to be –0.524 and statistically significant (with a *t*-statistic = 7.57). This estimate is within the range of previous estimates, which are typically around –0.5. I also find a positive, significant effect of GDP per capita on changes in mobile penetration, with an estimated elasticity of 0.425 (and a *t*-statistic = 8.42).[72] I find similar results if I use PPP-deflated variables instead of market exchange rates.[73]

To test the use of the "Hausman instrument" for price, I re-estimate the demand specification using a time trend as the instrument instead. Time should provide a reliable instrument for prices because prices are trending downward over time. Table 5b presents the results. Using a time trend as the instrumental variable for price produces a very similar price elasticity of demand estimate of –0.593, although it is not as precisely estimated as in Table 5a (*t*-statistic = –5.97). The GDP-per-capita elasticity is also very similar to my initial estimation in Table 5a, estimated at 0.445.[74]

72. This estimate contrasts with the OECD's results, which finds *no* effect of GDP per capita in its sample of rich countries.

73. I estimate a price elasticity of –0.492 (*t*-statistic = 7.94) and a GDP elasticity of 0.608 (*t*-statistic = 4.21) using PPP-deflated data.

74. I do a Sargan test of over-identification beginning with the results in Table 5b and then including the DLPRICEIV1 instrument from Table 5a. The test statistic is 0.46, which is distributed as a chi square with 1 degree of freedom. The *p*-value is 0.497, which does not reject that the over-identifying restrictions are orthogonal to the stochastic disturbance.

TABLE 5B: ESTIMATION OF FIXED-EFFECTS DEMAND EQUATION
USING A TIME TREND AS AN ALTERNATIVE INSTRUMENT

Dependent Variable: DLPEN
Method: Panel Generalized Method of Moments

Sample (adjusted): 2004Q2 2011Q3
Periods included: 30
Cross-sections included: 17
Total panel (unbalanced) observations: 507
White period instrument weighting matrix
Period SUR (PCSE) standard errors & covariance (d.f. corrected)
Instrument specification: C DLGDPDEF TIME

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
DLPRICEDEF	–0.593077	0.099297	–5.972754	0.0000
DLGDPDEF	0.444903	0.053338	8.341190	0.0000

Next, I estimate a dynamic demand model where the left-hand side variable (mobile penetration) is included in the model as a lagged dependent variable. I again used a fixed-effects specification because the econometrics literature recognizes that a random effect will be correlated with the lagged left-hand side variable.[75] A Hausman test of random effects versus fixed effects rejects random effects, with the test statistic equal to 30.5 with 3 degrees of freedom. The *p*-value of the test statistic is 0.0000011, which overwhelmingly rejects use of the random-effects specification. Table 6 shows the estimation results for the fixed-effects specification for the dynamic demand model.[76]

TABLE 6: DYNAMIC DEMAND MODEL WITH FIXED EFFECTS

Dependent Variable: DLPEN
Method: Panel Generalized Method of Moments

Sample (adjusted): 2004Q3 2011Q3
Periods included: 29
Cross-sections included: 17
Total panel (unbalanced) observations: 490
White period instrument weighting matrix
Period SUR (PCSE) standard errors & covariance (d.f. corrected)
Instrument specification: C DLGDPDEF DLPRICEIV1 DLGDPDEF(–1)
DLPRICEIV1(–1)

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
DLPEN(–1)	0.778484	0.064494	12.07063	0.0000
DLPRICEDEF	–0.105536	0.049031	–2.152449	0.0319
DLGDPDEF	0.117142	0.034248	3.420453	0.0007

75. *See, e.g.*, HSIAO, op. cit; BALTAGI, op. cit..

76. The model passes the Sargan test of over-identification: the test statistic is 2.38, which is distributed as chi square with 2 degrees of freedom, so the *p*-value of the test is 0.304.

I estimate the price elasticity of demand to be –0.476 and statistically significant, with a *t*-statistic of 4.29.[77] The estimated elasticity of a change in GDP per capita is 0.529, with a *t*-statistic of 7.92. Thus, both elasticities are similar to the estimates of the static demand models in Table 5a and Table 5b.[78]

My demand estimation finds that fixed effects are necessary in the model specification. Otherwise, biased and inconsistent estimates would result. The estimated price elasticity of demand of approximately –0.50 and the estimated GDP-per-capita elasticity of demand of around 0.45 are both estimated precisely (that is, they are statistically significant) and find that economic variables have an important effect on mobile subscriptions.

3. Econometric Estimation of Mexico's Mobile Prices

I now estimate a price equation for the seventeen countries, using quarterly data for the period from the second quarter of 2004 to the third quarter of 2011. The left-hand side, dependent variable is log of voice revenue per minute (VRPM), which was provided in by Bank of America-Merrill Lynch data. This price variable is the same price variable that I used above. I again use a fixed-effects specification because the Hausman specification test statistic is 1238.9, which is distributed as chi square with 4 degrees of freedom, with a *p*-value of 5.8E–267, so use of the random-effects model is rejected with very high probability. I estimate the price equation in first differences—which accounts for the fixed effects. Table 7 shows the estimated coefficients in the price equation.

TABLE 7: ESTIMATION OF FIXED-EFFECTS PRICE EQUATION

Dependent Variable: DLPRICEDEF
Method: Panel Least Squares
Date: 03/25/12 Time: 08:20
Sample (adjusted): 2004Q2 2011Q3
Periods included: 30
Cross-sections included: 17
Total panel (unbalanced) observations: 507
Period SUR (PCSE) standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
C	–0.019626	0.005784	–3.393115	0.0007
DLGDPDEF	0.291911	0.090899	3.211386	0.0014
DCOMPS	–0.018031	0.024332	–0.741043	0.4590
DLPRICEIV1	0.548047	0.141905	3.862078	0.0001

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.238770	Mean dependent var	–0.031421
Adjusted R-squared	0.209071	S.D. dependent var	0.088009
S.E. of regression	0.078270	Akaike info criterion	–2.218647

77. The total effect is –0.1055/(1 – 0.7784), and the *t*-statistic is estimated using the delta method.

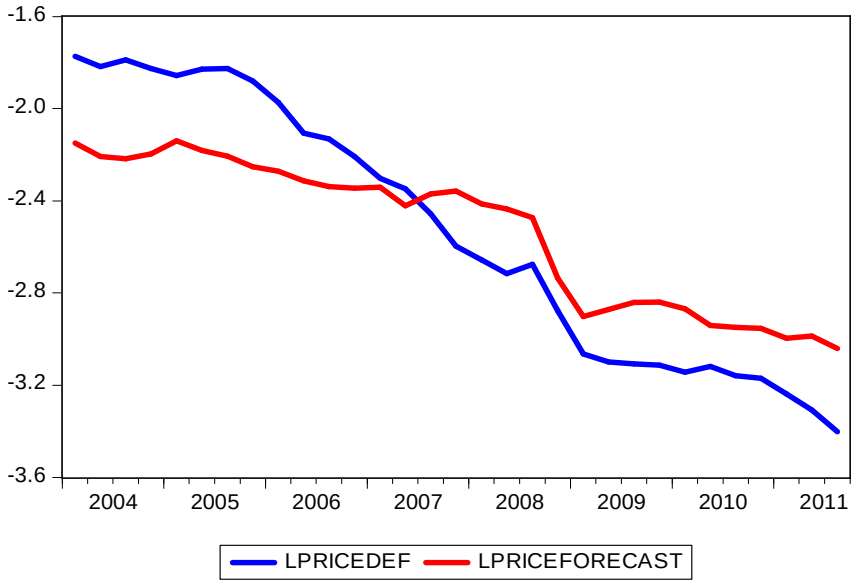
78. I also tested the model specification by including a time trend variable, but its effect is small and not significant (with a *t*-statistic = 0.503). I also included log of population, but again, the effect is very small and not significant (*t*-statistic = 0.456). Lastly, the model passes the Sargan test of over-identification, although the *p*-value is 0.055.

Sum squared resid	2.983483	Schwarz criterion	–2.051842
Log likelihood	582.4270	Hannan-Quinn criter.	–2.153232
F-statistic	8.039669	Durbin-Watson stat	2.263002
Prob(*F*-statistic)	0.000000		

Since the data are in first differences, the constant coefficient represents the effect of a time trend. I find that the price decreases on average by approximately –1.96 percent per quarter or –7.84 percent per year. Increases in log GDP per capita have a positive and significant effect on price. A change in the number of competitors has a small negative effect on prices, but the coefficient is not estimated precisely. The average log price in other countries, DLPRICEIV1, has a large coefficient of 0.548 and is estimated quite precisely (with a *t*-statistic = 3.86). Of all the explanatory variables, the average log price in other countries—which represents changes in cost over time—provides the largest explanation for the decrease in mobile prices over time. For example, for Mexico, the mobile price decreased by 20.4 percent per year from 2004 to 2011. Of this 20.4-percent decrease per year, 5.9 percent per year is explained by this variable.

I now use the fixed-effects results from the price equation to compare the actual mobile price with the "but for" price forecast produced with the estimated price equation. Figure 11 plots the results. Mexico's actual log prices are in blue and decrease at approximately 20 percent per year. Mexico's prices as forecasted by the price equation are in red. From 2004 to 2007, the forecasted prices were below actual prices. However, since 2007, actual prices have decreased more rapidly than have forecasted prices. In 2011, Mexico's actual prices were approximately 36.1-percent below forecasted prices.

FIGURE 11: MEXICO'S ACTUAL (LPRICEDEF) AND FORECASTED AVERAGE MOBILE PRICES (LPRICEFORECAST)



In the Appendix, I repeat my comparison of Mexico's actual and forecasted mobile prices using alternative estimations. This exercise indicates the robustness of my results. My results are consistent across the alternative forecasting methods: Mexico's actual

mobile prices have fallen below the predicted prices. First, I estimate a model using least squares instead of fixed effects. By 2011, Mexico's actual mobile was 55.5-percent below the least-squares forecasted price. Second, I repeat this exercise using least squares but remove Mexico from the sample when I estimate the equation. Using this method, I find that Mexico's actual mobile in 2011 was 59.8-percent below the least-squares forecasted price. Third, I do the same estimation but instead use the PPP-adjusted prices. Under this estimation, in 2011, Mexico's actual mobile prices were 32.3-percent below forecasted prices on a PPP basis. All my estimations show that, when I compare Mexico's average mobile prices with forecasted prices based on other countries' prices and the average of other countries' prices, Mexico has had lower prices since about mid-2006. By 2011, Mexico's actual mobile prices were significantly lower than the forecasted prices, by 32 percent or more.

4. Consumer Surplus Calculation

Mexican consumers are not losing consumer surplus due to high prices, as the OECD concluded erroneously based on its sample of rich countries. To the contrary, Mexican consumers are currently receiving significant amounts of consumer surplus from these lower prices. I use the estimated coefficients from my demand equation to estimate how much better off Mexican consumers are from the lower prices compared with the model's prediction. The formula for the change in consumer surplus using a log-log demand model is given by:

$$\Delta CS = \left(p_2 q_2 - p_1 q_1\right)/\left(1-\varepsilon\right), \tag{1}$$

where ε is the own-price elasticity of demand (expressed as a positive number), p_1 and q_1 refer to actual mobile price and quantity in 2011, and p_2 and q_2 refer to predicted mobile price and quantity in 2011.[79] For the predicted quantity, I use:

$$q_2 = q_1\left(\frac{p_2}{p_1}\right)^{-\varepsilon}. \tag{2}$$

Substituting from equation (2) into equation (1) and rearranging, the change in consumer surplus can be written as follows:

$$\Delta CS = \left(\frac{p_1 q_1}{1-\varepsilon}\right)\left[\left(p_2 / p_1\right)^{1-\varepsilon} - 1\right]. \tag{3}$$

I calculate the change in consumer surplus as a percentage of mobile services expenditures, $p_1 q_1$. For a log-log demand model, this ratio can be derived by rearranging equation (3):

79. For the development of the consumer surplus equations, see Jerry A. Hausman, *Sources of Bias and Solutions to Bias in the CPI*, 17 J. ECON. PERSP. 23 (2003).

$$(4) \qquad \frac{\Delta CS}{p_1 q_1} = \frac{1}{1-\varepsilon}\left[\left(p_2 / p_1\right)^{1-\varepsilon} - 1\right].$$

For the predicted price, I use the lower bound found above from the fixed-effects price forecast that actual prices were 36.1 percent lower than predicted, so $p_2 = p_1/(1 - 0.361)$, and a price elasticity of demand of –0.476 (in absolute terms). I find that the change in consumer surplus is approximately 50.5 percent of mobile service expenditures in 2011. Total mobile revenue in Mexico was $17 billion (USD) in 2011, of which more than half was mobile voice revenue. Thus, consumers received at least $4 to $5 billion in consumer surplus relative to what one would expect based on comparable countries.

B. Consumer Surplus from Lower Fixed-Line Prices[80]

Using a sample of twelve peer countries, I estimate demand and price models for Mexico's fixed-line sector.[81] I find that fixed-line demand, measured in terms of the number of fixed lines per 100 inhabitants, has exceeded the model's predicted demand since 2004. Since 2005, Mexico's fixed-line prices have been below my model's predicted prices. As a result of low prices, Mexican consumers have received more than $1 billion (USD) in consumer surplus annually.

1. Econometric Estimation of Mexico's Fixed-Line Demand

I estimate an econometric model of demand for fixed-line services using the data on Mexico's peer countries. I estimate a demand equation for fixed-line service for twelve of the seventeen peer countries using ITU price data for the period from 2000 to 2010. Pricing data from the ITU contained missing and anomalous data for some countries, hence my selection of twelve countries for my sample.[82] The variables that I use are a price variable, GDP per capita, and a time trend. The price variable is the real, inflation-adjusted ITU monthly residential price. Table 8 presents the summary statistics of the variables used in my fixed-line demand regression model.

TABLE 8: SUMMARY DATA STATISTICS USED IN THE FIXED-LINE DEMAND REGRESSION

Summary Statistic	Fixed Telephone Lines per 100 Inhabitants [1]	GDP per Capita (Deflated USD) [2]	Monthly Subscription for Residential Telephone Service (Deflated USD) [3]
Mean	31.19	$9,691	$10.52
Standard Deviation	14.16	$5,961	$4.83
Minimum	5.99	$1,775	$2.96
Maximum	59.24	$24,284	$18.90
n	132	132	123

Sources: World Telecommunication/ICT Indicators Database 2011 (15th ed.); The World Bank.

80. Agustin J. Ros authored Part IV.B of this report.

81. Anomalous price data for five countries required me to reduce my sample size of peer countries.

82. The countries that I dropped from the analysis due to missing and anomalous data were Argentina, Chile, Colombia, Poland, and South Africa.

The demand model that I estimate has the natural log of fixed-line penetration as the left-hand side, dependent variable. The right-hand side, independent variables are the natural log of real inflation-adjusted fixed-line price, the natural log of real inflation-adjusted GDP per capita using market exchange rates, a time trend for the years 2000 to 2010, and time trend squared.

I first estimate a fixed-effects model (model (1) in Table 9), treating price as exogenous. The Hausman test statistic equals 45.47 with 4 degrees of freedom, which rejects the random-effects estimator for this model. I then estimate a fixed-effects model (model (2) in Table 9), treating price as endogenous. The instruments I use follow the same approach as Hausman in Part IV.A. I use the average of the log of deflated fixed-line prices of countries other than the country in question for a given observation. A Hausman specification test for the joint endogeneity of price, however, does not reject the hypothesis that price is exogenous. Specifically, the Hausman test statistic is equal to 0.32 with 4 degrees of freedom.

The own price elasticity of demand for fixed-line service in model (1) is -.270 with very precise standard errors leading to a significant coefficient. The own price elasticity of demand for fixed-line service in model (2) is -.368, and significant at the 5 percent level. Given that -.270 is more consistent with the economic literature and a Hausman specification test does not reject the hypothesis that price is exogenous we rely on model (1). The income elasticity is .13 and significant at the 6 percent level.

The rejection of the random effects models and acceptance of the fixed effects models indicate that unobserved country-specific attributes are important and are likely to be correlated with the exogenous variables and that failure to control for these factors leads to biased estimates and wrong conclusions. What this means in practice is that in an econometric regression it is crucial to control for country-specific unobservable factors that are unique and are important determinants of telecommunications demand and prices. Even within this sample of similar countries, there are unique factors that influence telecommunications demand that must be accounted for. The OECD's models do not control for this and, as a result, produce incorrect parameter estimates and conclusions. Econometrically, the OECD assumes that the constant term for each country is identical, an assumption that my regression model rejects.

TABLE 9: FIXED EFFECTS AND IV REGRESSION RESULTS FOR FIXED-LINE SERVICES

Name of Variable	Model (1) Fixed Effects Estimation Technique		Model (2) Fixed Effects - IV Estimation Technique	
L_fixed_price_real	-0.270 (0.047)	***	-0.368 (0.1776)	**
L_gdp_real	0.135 (.0717)	*	0.213 (0.156)	
Trend	0.036 (0.0153)	**	0.044 (.021)	**
Trend square	-0.003 (0.001)	***	-0.004 (0.002)	**
Constant	-1.97 (0.571)	***	-2.472 (1.051)	**
Number of Observations (n)	123		123	
F(4,107) / F(11,107)	9.19		42.49	
Chi2	-		17714.01	
R-sq within	0.2556		0.2257	
Instrumented (Variable)	-		l_p_real	
Instruments	-		l_gdp_real, trend, trend square iv_p_real	

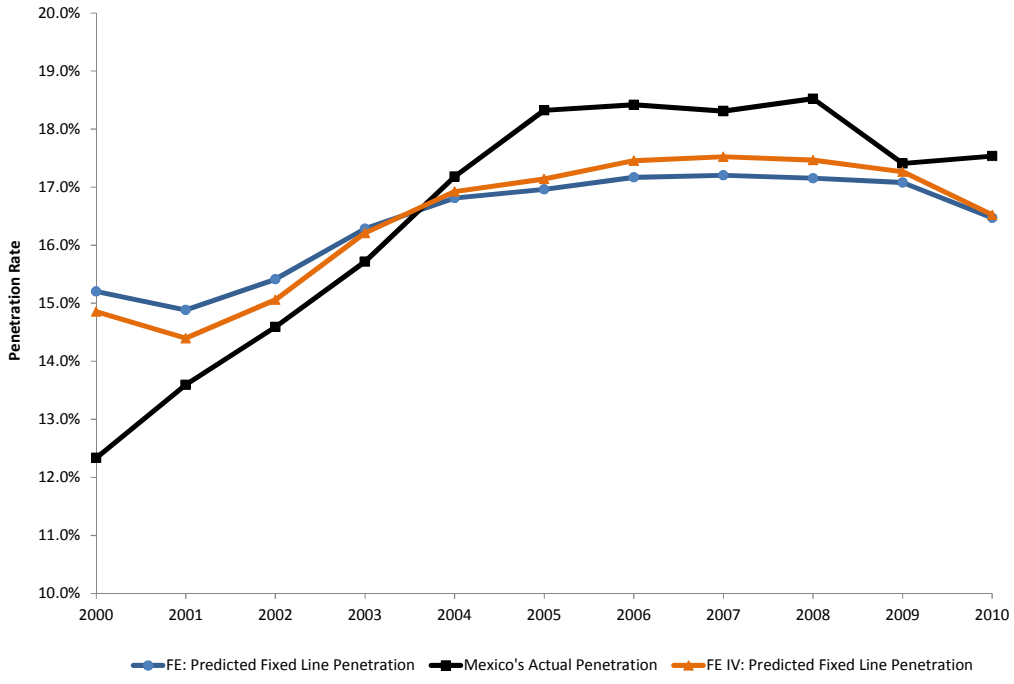
Notes:
Standard Errors are presented in parenthesis.
**** statistically significant at 1% level, ** 5% level, * 10% level.*

The results of the model can be used to compare Mexico's actual fixed-line penetration with predicted levels. Figure 12 shows that in the early years Mexico's actual fixed line penetration was below its predicted. Beginning in 2004, however, Mexico's actual penetration was above its predicted, reaching a high of 1.4 percentage point difference in 2008 and averaging approximately 1.0 percentage point difference between 2004 and 2010.

The results in Figure 12 show that Mexico's fixed-line penetration is not low by international standards when compared to a sample of similar countries and when performing correct econometric modelling. In fact, Mexico performs quite well. The results also make clear that it is important to control for GDP per capita and that even within this sample of countries it is important to control for unique factors in Mexico. My findings refute the OECD's conclusions that Mexico should have had 3.6 times as many

fixed lines in 2000 and an average of 2.6 times as many fixed lines between 2000 and 2007.

FIGURE 12: ACTUAL FIXED-LINE PENETRATION RATE IN MEXICO AND PREDICTED FIXED-LINE PENETRATION RATE FROM PEER REGRESSION ANALYSIS



Sources: World Telecommunication/ICT Indicators Database 2011 (15th Edition); The World Bank.

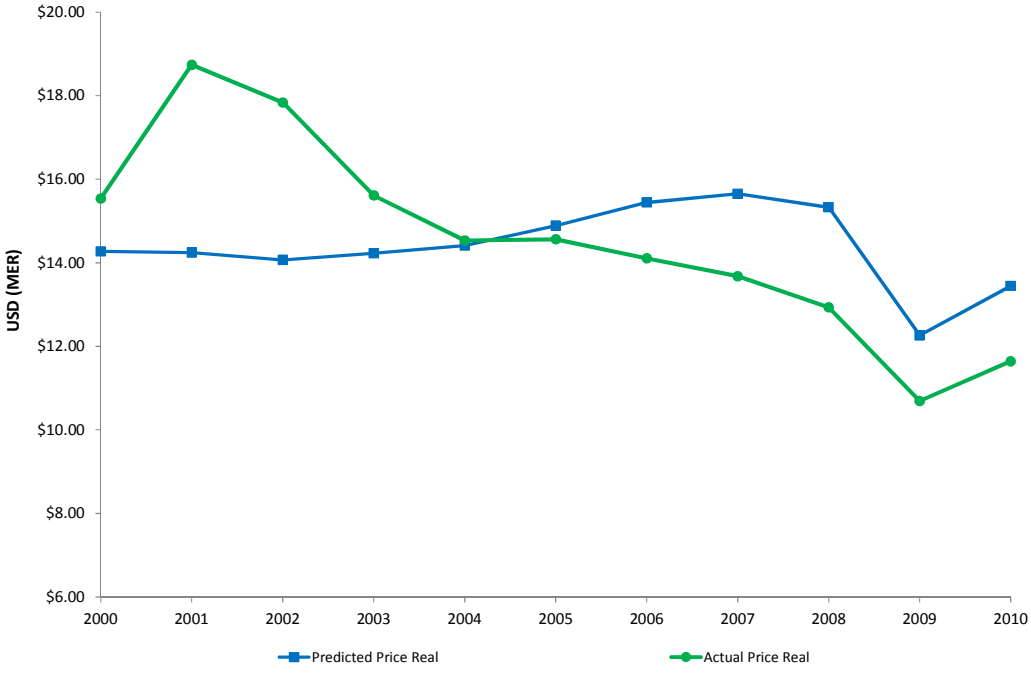
2. Econometric Estimation of Mexico's Fixed-Line Prices

I now estimate an equation for fixed-line prices in Mexico. Specifically, my dependent variable is the natural log of real price of residential services and my independent variables are the natural log of real GDP per capita and a time trend, to control for cost changes over time. Similar to my demand model, I estimate a model using fixed effects. The Hausman test statistic is equal to 11.76 with 2 degrees of freedom which rejects the random effects estimator for this model and again confirms the importance of taking into account and controlling for each country's unique determinants of fixed-line prices. My coefficient estimate for GDP per capita is 0.8726 estimated very precisely with a standard error of 0.1322. A one percent increase in real GDP per capita leads to a 0.87 percent increase in real price. This finding provides additional evidence that GDP per capita is an important determinant of demand. The coefficient for the time trend is -0.0246 estimated precisely with a standard error of 0.0116. Real fixed-line prices in my sample of countries are trending down at a rate of about 2.5 percent per year.

I now graph Mexico's actual real residential fixed-line prices and predicted in Figure 13. Actual fixed-line prices in Mexico were above predicted prices between 2000 and 2004 by an average of 12.6 percent. The trend changes, however, in 2005, at which point Mexico's actual prices were below predicted prices by an average of 12.5 percent between 2005 and 2010. In 2010, actual prices were 13.4 percent below predicted prices. The results in the figure show that Mexico's fixed-line prices are not high by

international standards when compared to a sample of similar countries and when performing correct econometric modeling. In fact, Mexico performs quite well. The results also make clear that it is important to control for GDP per capita and that even within this sample of countries it is important to control for unique factors in Mexico. My findings refute the OECD's conclusion that by 2007 Mexico's fixed-line prices should be about 25 percent lower than actual prices.[83]

FIGURE 13: ACTUAL FIXED-LINE PRICES IN MEXICO COMPARED WITH PRICES PREDICTED BY PEER REGRESSION ANALYSIS



Sources: World Telecommunication/ICT Indicators Database 2011 (15th Edition); The Bureau of Labor Statistics.
Note: The complete name of the price variable is "Monthly subscription for residential telephone service (US$)." This variable has been deflated by the US "Consumer Price Index." The base year used for real prices is 2000.

3. *Consumer Surplus Calculation*

I follow the approach of Hausman in Part IV.A and use the results from my fixed-line demand equation to estimate how much better off Mexican consumers are from the lower prices compared to the model's prediction. The formula for change in consumer surplus using a log-log demand model is given by:

(1) $$\Delta CS = \left(p_2 q_2 - p_1 q_1\right)/\left(1-\varepsilon\right),$$

where ε is the own-price elasticity of demand (expressed as a positive number), p_1 and q_1 are the actual price and quantity in 2010, and p_2 and q_2 are the predicted price and quantity in 2010. To estimate the predicted quantity, I use:

83. *OECD 2012 Consumer Surplus Study*, op. cit. p. 44 tbl.39.

(2) $$q_2 = q_1\left(\frac{p_2}{p_1}\right)^{-\varepsilon}.$$

Substituting (2) into (1) and rearranging, the change in consumer surplus can be written as follows:

(3) $$\Delta CS = \left(\frac{p_1 q_1}{1-\varepsilon}\right)\left[\left(p_2 / p_1\right)^{1-\varepsilon} - 1\right].$$

I calculate the change in consumer surplus as a percentage of total expenditures of fixed-line services, p_1q_1. For a log-log demand model, this ratio can be derived by rearranging equation (3):

(4) $$\frac{\Delta CS}{p_1 q_1} = \frac{1}{1-\varepsilon}\left[\left(p_2 / p_1\right)^{1-\varepsilon} - 1\right].$$

For predicted price I use the fact that actual prices were 13.4 percent lower than predicted, so p2=p1/(1-0.134) and use a price elasticity of -0.270 (in absolute terms). When I plug into equation (4) the price ratio and the price elasticity, I find that the change in consumer surplus is about 15 percent of fixed-line expenditures. Total fixed-line revenue in 2010 was approximately $7.5 billion (USD). Thus, consumers received more than $1 billion in consumer surplus relative to what one would expect based on comparable countries.

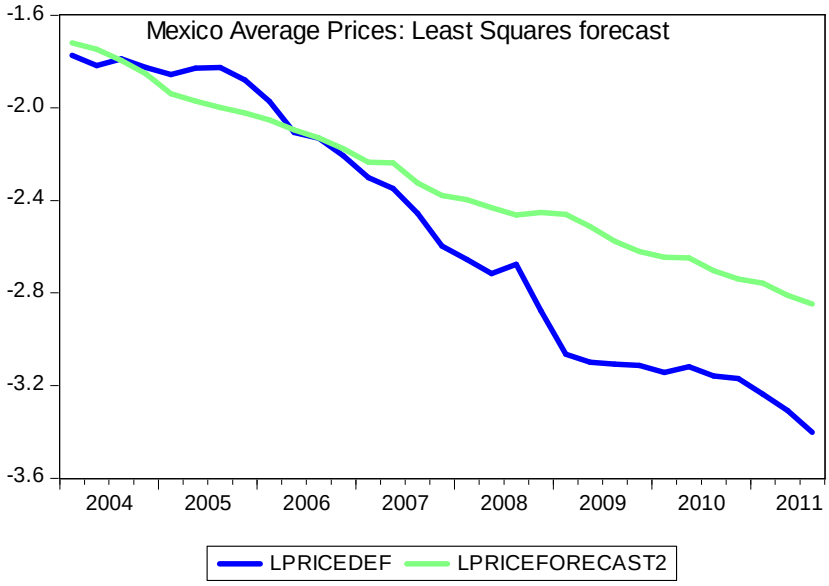
V. CONCLUSION

The OECD's conclusions regarding competition in Mexico's telecommunications markets are incorrect. The OECD's conclusions were achieved through the incorrect use of facts and data and the application of incorrect economic analysis. The prices used in the study were not the cheapest available to Mexican mobile consumers and the price changes observed over time were not real price changes; instead the changes were the result of changes in the OECD pricing methodology. And the countries used in the study are significantly different than Mexico in term of GDP. Contrary to the OECD's erroneous conclusions, correct econometric demonstrates no evidence of market failure in Mexico. Mobile prices in Mexico are far below the average prices in other comparable countries (including nine OECD countries) and lowest in our sample of Latin American countries. The fixed-line sector performs better than a comparable sample of its peers. Mexican consumers are receiving billions of dollars of benefits from these lower prices.

APPENDIX: ROBUSTNESS TEST OF THE MOBILE PRICE EQUATION

I first repeat the forecasts that I did in Part IV.A.3 using least squares. Because random effects failed the Hausman specification test, least squares coefficient estimates will be biased and inconsistent.[84] However, under certain conditions, least squares estimation provides the "best linear unbiased predictions." Figure A1 plots the results. The green line represents the Mexico's mobile prices as forecasted by the least squares model. The forecast price was sometimes below the actual price until the second quarter of 2006. From the second quarter of 2006 to the present, Mexico's actual mobile price has been below the forecasted price. In 2011, Mexico's actual mobile price was 55.5 percent below the least squares forecasted price.

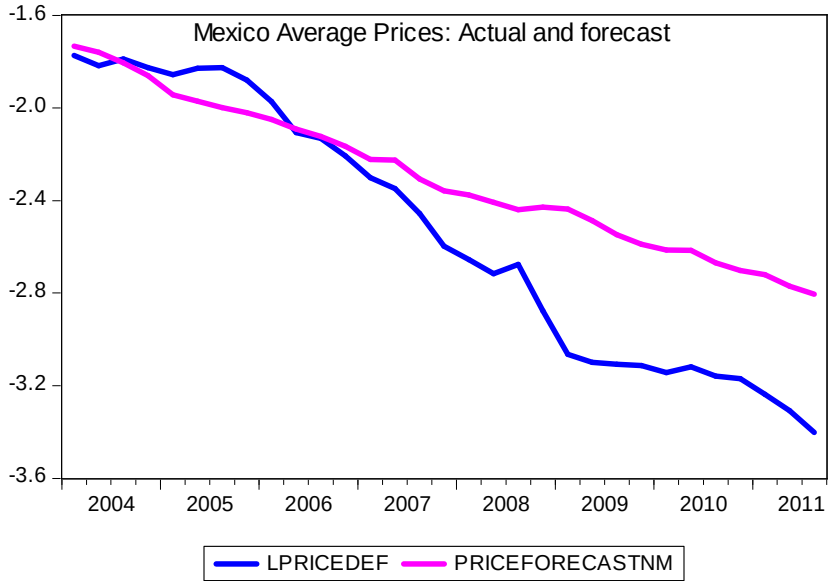
FIGURE A1: ACTUAL AND FORECASTED AVERAGE PRICES IN MEXICO USING A LEAST SQUARES FORECAST



I now re-estimate the same least squares estimation, but I remove Mexico from the sample. Thus, the least squares estimates are based on the other 16 countries only. When I forecast Mexico's mobile prices, I use Mexico's right-hand side explanatory variables: log GDP per capita, log population, and number of competitors as well as time. Figure A2 plots the actual and forecasted mobile prices in Mexico. Mexico's actual mobile prices sometimes exceeded the least squares forecasts before the second quarter of 2006. Since then, however, Mexico's actual mobile prices have been below the least squares forecasted prices. In 2011, Mexico's actual mobile prices were 59.8 percent lower than forecasted prices.

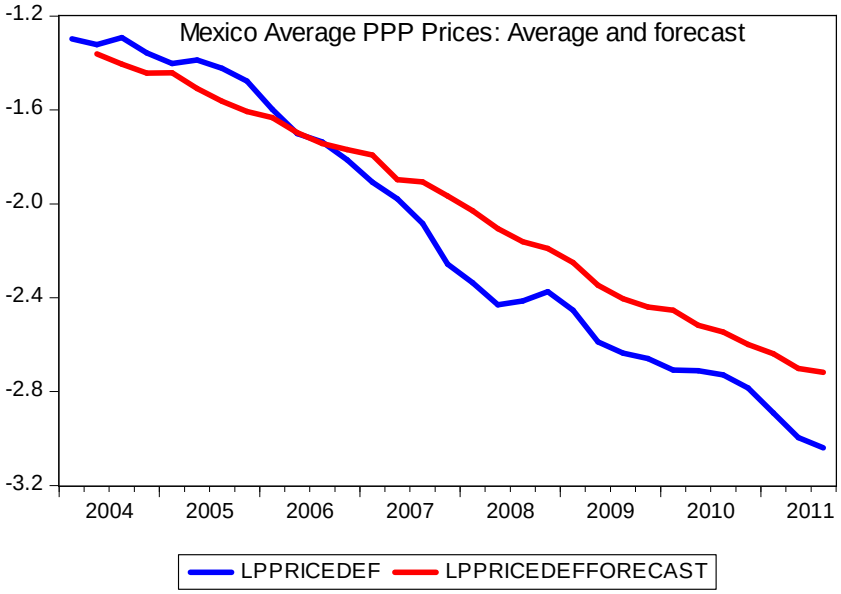
84. *See* Hausman & Taylor, *Panel Data and Unobservable Individual Effects*, op. cit., for a discussion regarding the bias of least squares in this situation.

FIGURE A2: ACTUAL AND FORECASTED AVERAGE PRICES IN MEXICO USING A LEAST SQUARES FORECASTS AND EXCLUDING MEXICO FROM THE SAMPLE ESTIMATION



As a last test, I repeat the approach used in Figure A2, expect that I use PPP-deflated prices. Thus, I estimate the model using least squares and exclude Mexico from the sample. I then use the estimated coefficients to predict mobile prices in Mexico. Figure A3 shows the results.

FIGURE A3: ACTUAL AND FORECASTED AVERAGE PRICES IN MEXICO USING LEAST SQUARES FORECASTS OF PPP PRICES AND EXCLUDING MEXICO FROM THE SAMPLE ESTIMATION



Similar to my results using market exchange rate prices, I find that, until the middle of 2006, forecasted price were below actual mobile prices in Mexico. However, from mid-2006 to the present, Mexico's actual mobile prices on a PPP basis have been significantly below forecasted mobile prices. In 2011, Mexico's mobile prices were 32.3 percent below forecasted prices on a PPP basis.

I conclude that, when Mexico's average mobile prices are compared to forecasts based on comparable countries' prices and the average of those countries' prices, Mexico has had lower prices since mid-2006. By 2011, mobile services in Mexico have become significantly less expensive relative to mobile services in comparable countries, by 32 percent or more. Thus, when a comparable group of countries, based on GDP per capita, are compared to Mexico, Mexico's mobile prices are significantly *lower* than other countries' prices. Thus, Mexican consumers are not losing consumer surplus due to "excessive" prices, as the OECD erroneously concluded based on its sample of rich countries. To the contrary, Mexican consumers have received significant amounts of consumer surplus from lower mobile prices.