Welfare effects of the Telecommunication Reform in Mexico

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Abstract

Up to 2013, the telecommunication sector in Mexico was characterized by a high degree of concentration; indeed the sector was fairly described by a dominant player, a rationed market (low density of services), high tariffs, a poor institutional design and weak regulator agents. The Herfindahl-Hirschman (HHI) index, that ranges from 0 (perfect competition) to 10, 000 (pure monopoly), was 5,859 for mobile telephone and 7,029 for fix telephone services, among the highest in the world. The Organization for Economic Cooperation and Development (OECD) released an assessment about the regulation and the design of public policies in the telecommunication sector in Mexico. The study estimates a dead-weight welfare loss of 1.8% of the Gross Domestic Product (GDP) annually occasioned by the lack of competition in the sector. In order to introduce more competition in the sector, a new reform for the sector was approved in 2014 by Congress establishing a new regulator who can impose asymmetrical rules in case of predominance of one of the firms. A declaration of preponderance of the dominant player was issued promoting the free of charge usage of its infrastructure for the rest of the suppliers. The new institutional design is inducing more competition in the sector, bringing down the mobile and fix telephone prices, and increasing the coverage and penetration of these services. In this article, we build an applied general equilibrium model for the Mexican economy in order to assess the impact of the higher competition in the sector in the consumer welfare and the income distribution. The model is static, encompass 20 types of consumers (rural and urban and the ten income deciles), 44 sectors where 16 are disaggregate telecommunications industries, assumes a fix wage and capital rental and idle resources hence an increase in the volume of the telecommunication market should not shrink other sectors of the economy. Thereby, we make some simulations about the economic effects of setting fix and mobile telephone services according to different scenarios; one of them is assuming that internal tariffs equilibrium resembles the average OECD level. We find the results are not minor, the drop in the telephone prices would reduce the general consumer price index in almost 3%, and value added would increase more than 2%, benefiting mainly household from the sixth to tenth income decile.

1. Introduction

The opening of the Telecommunications Sector in Mexico begins with the privatization of Telmex and then, the opening of the long distance market by 1996. However until 2014, more than 15 years after the opening, the results are largely disappointing, because the market was still highly concentrated in virtually all services, rationing the quantity, the quality, the variety, and charging high prices to consumers.

Indeed, the OECD (2012) study presented evidence about the high concentration, making prices in the sector between 20 to 40% higher the average country in the organization and calculates the welfare loss for the lack of competition in the sector by an average of 129.2 billion dollars between 2005-2009, the equivalent to 1.8% of GDP per year.

In order to introduce more competition in Telecommunications, a new constitutional reform was approved in June 2013 by the Mexican Congress and a new Federal Law for the sector in July 2014, establishing a new regulator who can impose asymmetrical rules in case of predominance of one of the firms. A declaration of preponderance of the dominant player was issued promoting the free of charge usage of its infrastructure for the rest of the suppliers. The new institutional design is inducing more competition in the sector, bringing down the mobile and fix telephone prices, and increasing the coverage and penetration of these services.

This study aims to contribute to the estimation of the effect of a reduction of rates in the telecommunications sector in Mexico as a result of regulatory improvements that would make a more competitive sector, but in a general equilibrium framework. More specifically,

we simulate the change in prices, income and real consumption of 20 family groups (based on their income and whether they live or not in urban areas) and 44 economic sectors as a result of a hypothetical alignment of fixed and mobile prices to a new lower equilibrium produced by the telecommunication reform.

In the following section we review the telecommunications market structure in Mexico and its recent evolution, as well as the key ingredients of the reform design to induce more competition. In the third section we describe the model specification and the parameters calibration, and finally, we present the results of the simulation and the study conclusions.

2. Telecommunications Market in Mexico: Evolution, Concentration and Prices

The regulation problem specifically in the telecommunications sector in Mexico is at the same time an institutional design problem, regulatory execution, and market undue influence. A regulatory environment which combines a failed institutional design and a regulator without the power to impose many decisions leads to the development of an incipient competition which does not allow maximizing the benefits of a competitive telecommunications market.

This problem is reflected into the market performance. Virtually, in all segments (long distance, local, fixed, broadband, mobile) there is a high concentration with a significant percentage in the hands of only one firm. In all cases, companies with the largest market share belong to the same economic group (América Móvil: Telmex and Telcel), which makes the regulatory environment even more complex. Just as in OECD study

(2012) we focus on the three main markets of the sector: fixed, mobile telephony, and broadband Internet access.

The importance of these industries is obvious. Fix telephony represents a direct access to homes and a conventional communication via between enterprises and families; mobile telephony is the segment with greater growth and a customized means of communication, with generalized interaction; on the other hand, the importance of the broadband is that it is the means through which you access not only to the Net, but to different services such as video, information sources, IP telephony and where other massive apps may be offered, such as tele-education, telemedicine and others.

Figure 1 shows the progress of the three services, fixed and mobile telephony (millions of lines) and Internet (millions of people with access to Internet). Recent developments indicate the expansion of fixed telephony, which occurred after TELMEX privatization, finished in 2005, while mobile telephony and internet access grew at an annual average growth rate of 12 and 37%, respectively, from 2005 to 2011.

[Insert Figure 1 and here]

However, compared to international standards, the penetration of the offer of these services in Mexico remains limited, for example, teledensity in fixed telephony in Mexico is 18 per 100 inhabitants in 2011, while in Colombia it is 19 per 100 inhabitants, in Chile it is 21 per 100 inhabitants, in Brazil it is 24 per 100 inhabitants, and in Argentina it is 22 per 100 inhabitants. For mobile telephony, the penetration in Mexico is 88 users per 100 inhabitants, while in Colombia it is 98 users per 100 users, in Chile it is 100 users, in Brazil 114 per 100 users, and in Argentina it is 132 users per 100 inhabitants. It is clear that the

lag is even greater if we compare Mexico with countries in North America, Europe and emerging countries in Asia.

A culprit that Mexico has a lower coverage of telecommunications services relative to countries with similar levels of development is precisely the dominance Telmex and Telcel have in fixed and mobile telephony markets, respectively; where there are incentives to limit the amount of services offered compared to what would occur in a market structure of perfect competition to exploit the market power they have charging higher rates to its marginal cost. In fact, the Herfindahl-Hirschman Index (HHI) concentration for mobile telephony in Mexico is 5,859 (the maximum is 10,000), making Mexico the country with the most concentrated mobile market in the world. For fixed telephony HHI index is even higher: 7,029[1].

Regarding final consumer prices, various sources have estimated these tend to be higher in Mexico compared to other Latin American countries, and more markedly with respect to OECD countries. Bank of America / Merrill Lynch (2011), using as proxy price the revenue per user in the industry, indicates that prices have been in most of the recent history, 19% higher in Mexico than in the rest of Latin America, although the trend is a converger, so that in 2011 the indicator in Mexico settled at $ 13.41 per user, slightly below the average of $ 13.57 per user in Latin America. According to OECD (2012) fixed telephony prices are 40.3% higher in Mexico compared to the average country in the organization, and 19.7% in mobile telephony. Likewise, the organization found that prices and speeds of broadband internet are far away from the OECD average.

[1] Index to 2010 for Mobile Phone. The rest is information up to 2008. Source: fixed telephony and broadband, own construction with industry information. Mobile phones, own construction with Bank of America Merrill Lynch Global Matrix Wirless 3Q 2011 information.

Furthermore, none of the two studies include a price premium that has been charged for interconnection to the fixed operators. Interconnection is the key element to consolidate the opening in the telecommunications sector. It allows users of all networks to communicate with other users within the country and all over the world; besides, being a basic supply for telecommunications services, it is a critical factor so users have services at affordable prices. Therefore interconnection regulation that has been adopted in all countries has focused on that licensees of public telecommunications networks allow interconnection and interoperability to other licensees; that interconnection is not provided on discriminatory terms, and interconnection rates are based on costs to avoid anti-competitive practices and excessive fees.

Historically the dominant company in the sector, which is advantageous in terms of demand on its network, has charged fairly high interconnection rates, beyond those allowed by the Federal Telecommunications Act in Mexico, and even bears the title of Concesión de Telefonos de Mexico.

Figure 2 shows the interconnection rates in recent years, noting a sharp decline in 2011 when connection fees were reduced at a level of about 40 cents per minute thanks to the decision of the Federal Competition Commission (COFECO) and the decision of the Supreme Court. However, in the immediately preceding years, the rate that prevailed was up to 4 times the one that justified the long-term marginal cost which finally in 2011 accepted the dominant firm.

[Insert Figure 2 and here]

The new regulatory framework induced by the 2013 and 2014 reform seeks to promote competition in the sector. The main ingredient is removing the former weak regulator (COFETEL) by a new strong and autonomous regulator agent, the Federal

Telecommunication Institute (IFT by the acronym in Spanish). The new regulator does not depend on the government, it is by the constitution autonomous, i.e. it is not subordinated to the Communication and Transport Secretary. On the other hand, in contrast to the former regulator of the sector, it has the responsibility of sanction any anti-competition measure of the firms in the sector, and more important t is entitled to impose asymmetric regulation to preponderant firms that is special regulation for firms that possess more than 50% of the relevant markets in the sector. Hence IFT might revise and establish tariffs, interconnection rates and disaggregate the assets of the preponderant players.

Empowered by these new attributions, the IFT declared America Movil as preponderant agent in telecommunications and TELEVISA in broadcasting in March 2014. As a consequence of this declaration, asymmetric regulation was imposed to America Movil consisting in an IFT order obligating the firm to share, free of charge, the usage of its infrastructure for the rest of the suppliers. The measure actually has been traduced in the elimination of the interconnection rates to the calls ending in the America Movil net.

In another executive order, the IFT eliminated the charges for national long distance calls to all the companies (including the roaming charges in mobile phones) aligning these tariffs to local calls.

In the short period after the reform (after July 2013), the mobile telephone rates have dropped 13.7% in nominal terms and 20.8% in real prices, while nominal fix local phone rates have decrease 4.5%, but 12.6% in real terms. The national long distance rates disappeared (a drop of 100%) while the nominal rates for the international long distance calls have decreased 40.3% (47.4% in real terms).

3. Modelling the effects of a telecommunications sector less concentrated

The abrupt decrease in interconnection rates first, and then in the different services of telephone rates brings elements to settle it is possible to improve the market structure of the industry. In case this is achieved, the telecommunications market would surely increase the service volume and rates for the final user would be reduced, as it started to occur, but the main questions are: by how much? And which would be the effects in economy as a whole?

An option to evaluate the effects of the new market structure would be to assume that the telecommunications market moves from the current situation to a perfect competition, where prices were equal to marginal costs. However, this would be very unlikely, since in most countries there is some form of imperfection in the telecommunications markets due to economies of scale, and network externalities.

Two alternatives offer us the application of computable general equilibrium models for imperfect markets. One is to use the Harris price regulation (1984), which is to form the prices as a weighted average of those that would prevail if all competitors exert their market power, i.e., prices via Lerner markups; and those which would prevail if the parity of import prices Eastman-Stykolt (1966) was given, just as Bloch (1992) and Abayasiri-Silva and Horridge (1996) apply it. The second would be not fixed prices, but to increase the elasticity of relevant substitution to simulate increased competition, as in Forni et al. (2009).

In our case, we use a variant of the Harris rule, assuming that the rates for fixed and mobile telephony descend to the level the OECD study (2012) marks as the average for their countries, i.e., rates would be reduced to 40.3 % and 19.7% respectively. Why this benchmark and not the recently registered rates drop in all services? We decided to do it this way because we feel the competition effects on prices has just begun and it will persist

for some more time. Actually, the drop in real terms after the reform is about the same to what would occur if rates finally align average OECD levels for the mobile phone service, but they are still far in the case of the fixed phone service. Hence, using the actual falls in the rates in Mexico might underestimate the final effect of the reform.

3.1 General Equilibrium Model

The model specifies the behavior of 20 types of homes, differentiated by income level and the socio-demographic strata to which they belong (urban and rural), and 44 companies or economic sectors, within which 16 productive activities of the telecommunications sector are broken. In the model, 44 intermediate goods, 12 final consumer goods, savings or future consumption, a type of work and a type of capital are marketed (a list of the agents in the model is presented in Table 1). Perfect competition in the markets for intermediate goods, finished goods and production factors is assumed, so that both, homes and firms determine their decisions taking prices as given. It is a short-term static model, which assumes that the wage and capital income are fixed, that there is no full employment of resources, i.e., it has idle capacity[2]. To keep a fluent reading, the model specification and the tables cab be found in Annexes A and B, respectively.

Such type of models is an extremely useful tool for identifying and quantifying the effects of economic policy in a context of general interdependence tool. To build them, it is established that consumers and firms make decisions following optimization processes, such that consumers choose their demands for consumption and savings maximizing their utility subject to their budget constraint, and firms set their prices and choose their derived demands of intermediate goods and primary factors minimizing costs dependent on their

[2]In this model the government behavior, investment, and external sector is not specified. Only for the government it is established that it collects taxes on incomes and production and net subsidiary products.

technology. In this sense, all agent choices are optimal. Additionally, the model captures the circular flow of income: consumer demands and savings in homes depend on the pay they receive for selling their work and their capital to companies, and companies use such labor and capital to produce goods sold to other companies and homes. Therefore, the model takes into account the homes' decisions and companies are interconnected.

3.2 Calibration

Model equation parameters are calibrated using the available official information on productivity activity and income and expenditure patterns of the country. In this case, the model depicts the productive relations of 2003 and patterns of income and expenditure in 2008. The parameters of the functions of prices and demands derived from intermediate goods, labor and capital are obtained from the National Input Product Matrix 2003 (MIP 2003) built by INEGI (2008) added to 44 productive activities, and the parameters of the demand functions and income equations come from the micro-data from the National Survey of income and Expenditure of Homes 2008 (ENIGH 2008) also developed by INEGI (2009).

The procedure is as follows. In the initial equilibrium, it is assumed that the prices are equal to one and therefore, model replicates 2003 MIP values. The assumption established is that MIP 2003 represents a balance between the generation, functional distribution and allocation of products by industry in the country for a specific year, so it is taken as a basis. While from ENIGH 2008 percentage structures are obtained on how labor income, business income and expenditure on final goods by deciles of income and socio-demographic strata is distributed, and these structures are applied to the values of MIP 2003

to derive the consumption and income decile and stratum, which therefore are in line with 2003 levels but have the 2008 structure.

3.3 Equilibrium

In this type of models, equilibrium is defined as a vector of prices, production and consumption plans, that meet the optimization process of all economic agents.

By introducing a change in a variable, the new equilibrium is obtained by solving the model so that the new prices, production and consumption plans continue to meet consumers maximize their utility subject to their budget constraint and firms minimize costs dependent on their technology.

Mathematically, the model consists of a system of nonlinear, simultaneous equations; therefore, it is solved using Newton's method.

3.4 Simulation

As mentioned before, it is simulated that the price of fixed telephony is reduced to 40.3% and the price of mobile telephony to 19.7%, according to the results of the OECD study (2012).

The effects of the capture model are as follows. The reduction in the prices of fixed and mobile telephony causes a drop in prices of productive sectors that use such services. Since the model considers 12 aggregates of final consumer goods, each of them is a combination of goods provided by various sectors, so that the decline in sector prices is transmitted to the prices of final consumer goods, which in turn causes the demand for

consumer goods to increase.[3] The increase in consumer demand generates an increase in aggregate demand and due to equilibrium condition, in the aggregate supply or production; to supply this increase, companies raise the demand derived from intermediate goods, which again impacts the aggregate demand, also, the demand derived from labor and capital increases, the latter raises the income of homes and thus, again consumption, aggregate demand and production, starting the process again until it converges. The effects transmission is shown in figure 1.

[Insert Figure 1 here]

4. Results Discussion

4.1 Disaggregated Effects

The reduction in prices of fixed and mobile telephony generates an improvement in the level of welfare for Mexicans, since increases in the final consumption of homes via the direct price effect and an income effect generated by the momentum in the productive activity are caused.

Savings in costs is directly produced, and thus a drop in the prices of all economic activities, between 0.09% and 1.8%. The sectors with the greatest reductions in prices are telecommunications providers (sectors 18 to 33), financial services (sector 34) and services related to the management of companies and enterprises (Sector 37). In turn, this is transmitted in a reduction in the price of final consumer goods, from 0.22% for the final

[3]For example, the final good C_4 called *Furniture, equipment and household goods*, including cleaning, home care, household goods and furniture and glassware, consists of goods provided by various industries such as chemical, machinery and equipment, furniture, repair services and maintenance, etc.

housing good, maintenance services, electricity and fuels (C3) to 0.49% for various goods and services (C10). (See Tables 2 and 3).

However, since the reduction in prices generates an increase in consumer demand and savings in the country, this boosts aggregate demand, and as we assume that we are in the short term, and we have idle capacity, productive sectors can supply it increasing the demand for intermediate goods, labor and capital. The economic sectors that are benefited and which show the largest increases in activity levels are: Corporate and enterprises managing (8.73%), production of channel programs for TV, cable or satellite systems, except through Internet (2.70%), other manufacturing industries (2.58%), chemical industry (2.47%), and financial services (2.43%).

Consequently, an additional effect on the demand for house consumption is generated, as well as a positive income effect due to the higher labor and business income, which increase 1.91% and 2.50%, respectively. The types of homes from sixth to tenth decile of income, from both, urban and rural strata, are those benefited from this income effect, showing increases between 1.44% and 2.32% (see Table 4).

Finally, the impact on home consumption is explained by the direct effect of the reduction in prices and the positive income effect previously mentioned. Homes that are part of the sixth to the tenth decile of income are the main benefited, with increases in consumption between 3 and 4% (see Table 5).

Homes from sixth to ninth decile of income, from both, urban and rural areas, are the benefited because they spend relatively more on fixed and mobile telephony (C11 and C12) as well as on other final consumer goods which show reductions in prices (see table 6). While homes from the tenth decile of income, those in the urban and rural areas, are more benefited from the increase in corporate income (note that the corporate income

increases more than the labor one) than from the drop in the prices of final consumer goods, since these homes are characterized by savings and for allocating a small proportion of their income to consumption (see tables 6 and 7).

To see these results in terms of welfare, the equivalent variation, which captures the effect on welfare of both lower prices and the increase in income, is calculated[4]. The results indicate that the types of homes with greater increases in welfare are the eighth, ninth, and seventh decile of income belonging to the urban area, with a comparable improvement of 3% of their initial spending (see Table 8). To have an idea of the level of income of these types of homes, it is important to note that their monthly average income is between 8,937.40 and 16,263.31 constant pesos of 2008 (see Table 9)[5].

4.2 Aggregate Effects

In summary, reduction in prices of fixed and mobile telephony causes a decrease of 2.88% in the cost of the consumer basics for Mexicans. By socio-demographic strata, the decline in the cost of the consumer basics is slightly higher for homes in the urban stratum (2.89%) compared to the rural stratum (2.71%). (See **table 10**).

The boost of the economic activity generates an increase in the value added of 2.22%. So that, the homes income increases by 2.01%, being higher for homes in the urban stratum (2.05%) than in the rural stratum (1.58%)[6].

[4] The equivalent variation compares the income required so that for earlier prices the new utility level is obtained, the latter according to new income and new prices.

[5] The monetary income considers remuneration for subordinate work, income for independent work, other income coming from work, income for property, transfers, and other common income.

[6] It is important to note that the change in home income is different from the change in value added because within the home income plus the labor and companies income the remittances and other income were considered.

Consequently, consumption and savings aggregates show a rise of 3.29% and 2.59%, respectively, being higher the effects in the urban areas (3.41% and 2.60%) than in the rural areas (2.31% and 2.47%).

5. Conclusions

This paper presents the analysis made by the OECD (2012) on the telecommunications sector in Mexico, showing that it suffers from high levels of concentration by the dominant player, and consequently, higher prices to those experienced in other countries. Our contribution is to generate simulations of the effect of aligning the high rates of fixed and mobile telephony in Mexico, to those prevailing on average in the OECD on a general equilibrium framework, considering not only the effects that occur in the telecommunications market but those which overflow into other sectors.

The most obvious conclusion is that the effects to aggregate level are important. i.e., the expected reduction in fixed telephony of 40.3% and 19.7% for mobile telephony is translated into a reduction of 2.88% in the cost of living index of the average Mexican, and almost 3% for the urban consumer. Accordingly, the real consumers' income increases, and also, the demand for all consumption goods and services is expanded, and value added also grows by more than 2%. Families who benefit the most from this measure are those located in deciles 6 to 10 in the income scale and slightly more the urban ones than the rural ones.

Additionally, the general equilibrium model we used in the simulations assumes that there is spare capacity in the economy so that it can expanded to consumption and production without creating upward pressure on wages, the price of capital income and prices. Clearly, if the supply of primary factors of production was highly inelastic, the

benefits of reduced rates could at least partially be offset by the rebound in prices of factors and sectors.

But on the other hand, the study does not consider other possible consequences of a market with more competition, including the likely expansion of investment and total factor productivity that occur after deregulating the services of an economy (Alesina et al. 2005 and Barone y Cingano 2007). In this sense our results could be more dramatic in the context of a dynamic general equilibrium model.

We believe that the results of our simulations are robust enough to show a major area of opportunity to improve the economic performance of an emerging country such as Mexico. Our study is consistent with the thesis recently noted by Jones (2010, 2011): distortions in intermediate goods sectors (e.g., transport, telecommunications) are amplified to other sectors via linkages and complementarities severely damaging the economic development of the countries. Hence, by removing the sources of double marginalization that cause the proliferation of monopolies in intermediate sectors, significant improvements are made to economic growth.

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Annexes

A. Model Specification

A.1 Homes

Homes from decile of income h and strata e make their decisions following an optimization process of two levels. In the first level, they choose the aggregate consumption (C_h^e) and savings(S_h^e), maximizing their utility subject to their income available(ID_h^e). It is assumed that the utility functions are of homogeneous Cobb Douglas grade 1, and that homes consider the prices of aggregate consumption good (PAC_h^e) and savings (PS) as given:

$$Max\ U_h^e = \left(\left[\left[C_h^e\right]\right]\right]^{\beta_h^e}\left(S_h^e\right)^{1-\beta_h^e}$$

$$s.a.\ ID_h^e = PAC_h^e * C_h^e + PS * S_h^e$$

For h=1,2,3,…,10; y e=1,2.

where the subscript h takes the value of 1 if it is the first income decile, the value of 2 for the second decile and so on, until the value 10 that takes the richest decile; while the superscript e takes the value of 1 for the urban area and the value of 2 for the rural area. Note that each family faces its own level of prices of the aggregate consumption good, since these prices are calculated by weighting the prices of final goods according to expenditure patterns, as will be discussed later in the section on prices.

Thus, the optimal consumption choices and aggregate savings are dependent on the income available (ID_h^e) and the prices:

$$C_h^e = \frac{\beta_h^e * ID_h^e}{PAC_h^e} \quad \textbf{(1)}$$

$$S_h^e = \frac{(1-\beta_h^e) * ID_h^e}{PS} \quad \textbf{(2)}$$

In the following level, they decide how much to consume of each final good $\left(c_{f,h}^e\right)$, minimizing the total expenditure of the consumption, according to the prices of each goods $\left(P_f\right)$, subject to the aggregate consumption level which was optimal for the first level (C_h^e). It is assumed that the total home consumption h of stratum e is an aggregate of the final

goods, with a functional form of the Cobb Douglas homogeneous of 1 degree. Such that, the optimization process on the second level is:

$$Min \sum_{f=1}^{12} P_f * c_{f,h}^{e}$$

$$s.a. C_h^e = A0_h^e \prod_{f=1}^{10} c_{f,h}^{e}{}^{\alpha_{f,h}^{e}}$$

for h=1,2,3,…,10; e=1,2; y f=1,2,3,…,12.

Where $0 \leq \alpha_{f,h}^{e} < 1, \sum_{f=1}^{12} \alpha_{f,h}^{e} = 1 \;\; y \; A0_h^e$ is the coefficient of the aggregate consumption function with a level of income h and stratum e.

The subscript f identifies the final goods, which are 12 in total. Thus, the optimal levels of consumption in final goods are:

$$c_{f,h}^{e} = \left(\frac{\alpha_{f,h}^{e} C_h^e}{P_f}\right) * PAC_h^e \qquad \textbf{(3)}$$

The total homes' income comes from the payment they receive for being the owners of productive factors, work (LF_h^e) and capital (KF_h^e), transferences (TR_h^e) and incomes coming from external sector (REM_h^e).

$$IT_h^e = LF_h^e * W + KF_h^e * R + TR_h^e + REM_h^e \qquad \textbf{(4)}$$

for h=1,2,3,…,10 y e=1,2.

Where W is the wage, R is the rent paid to capital and REM_h^e are foreign remittances received from abroad by the homes from the income decile h and stratum e.

Families contribute to public sector paying an income tax on the sale of productive factors, labor, and capital$\left((TH)_h^e\right)$; therefore, the available income is:

$$ID_h^e = \left(1 - TH_h^e\right) * IG_h^e + TR_h^e + REM_h^e \qquad \textbf{(5)}$$

Where the taxable income (IG_h^e) is:

$$IG_h^e = W * LF_h^e + R * KF_h^e \quad \textbf{(6)}$$

A.2 Enterprises

The model considers 44 companies or economic sectors; it is assumed that each one produces a homogeneous good using a nested production function in two levels. First, the value added of sector j is generated by combining primary factors (labor and capital); then, the total production of sector j is determined, using intermediate goods and value added.

Therefore, the optimization process followed by the enterprises to make their decisions is implemented in work (LA_j) and capital (KA_j), minimizing the cost of generating value added (V_j) subject to technological restrictions, considering as given the W wage and capital income R:

$$Min \sum_{l=1}^{44} W * LA_j + R * KA_j$$

$$s.a. V_j = D_j KA_j^{\gamma_{k,j}} LA_j^{\gamma_{l,j}}$$

for j=1,2,3,...,44; l=1; y k=1.

Where D_j is the coefficient function of the value added of sector j.

The added value is generated by combining labor and capital, through a Cobb Douglas technology with constant returns to scale. Thus, replacement is permitted between primary inputs (KA_j y LA_j) . As a result of this process, de demands derived from factors depending on the level of value added and relative prices of the types of labor and capital:

$$LA_j = \left(\frac{\gamma_j * V_j}{W}\right) * PV_j \quad \textbf{(7)}$$

$$KA_j = \left(\frac{\gamma_{k,j} * V_j}{R}\right) * PV_j \quad \textbf{(8)}$$

In the next step, the company j decides how much to demand for intermediate goods supplied by it and / or other companies $(z_{i,j})$, as well as the value added (V_j), by

minimizing the cost of production in the region, subject to technological restrictions, considering as given the prices of intermediate goods (PY_i) and value added (PV_j):

$$Min \sum_{i=1}^{44} PY_i * z_{i,j} + PV_j * V_j$$

$$s.a.\ Y_j = Min\left\{\frac{z_{1,j}}{a_{1,j}}, \dots, \frac{z_{i,j}}{a_{i,j}}, \dots, \frac{z_{44,j}}{a_{44,j}}, \frac{V_j}{v_j}\right\}$$

for j=1,2,3,...,44; e i=1,2,3,...,44.

Where production of sector j (Y_j) uses intermediate goods and value added in fixes proportions through a Leontief-type function; so that $a_{i,j}$ is the requirement of the good sold by sector i to produce a unit of the sector j good and v_j is the needed amount of the value added per unit product of j sector. In this sense, the demands for intermediate goods and value added only depend on the level of production; they are not affected by relative prices as they are complementary:

$$z_{i,j} = a_{i,j} * Y_j \quad \textbf{(9)}$$

$$V_j = v_j * Y_j \quad \textbf{(10)}$$

For final consumption goods (c_f), we will assume that firms choose how much to demand from sector i products for the final good f $(q_{i,f})$, minimizing the cost of providing consumer goods subject to technological constraint, which is a Leontief-type function with constant returns to scale; such that:

$$Min \sum_{i=1}^{44} P_i * q_{i,f}$$

$$s.a.\ c_f = Min\left\{\frac{q_{1,f}}{\varphi_{1,f}}, \dots, \frac{q_{i,f}}{\varphi_{i,f}}, \dots, \frac{q_{44,f}}{\varphi_{44,f}}\right\}$$

for i=1,2,3,...,44; y f=1,2,3,...,12.

Where $\varphi_{i,f}$ is the requirement of the sector i good per unit of final consumer good f.

Thus, the demand for goods supplied by sector i to generate the final good f is:

$$q_{i,f} = \varphi_{i,f} * c_f \quad \textbf{(11)}$$

A.3 Prices

The model assumes perfect competition, i.e., all agents in the model make their decisions considering they cannot affect the prices of the goods and the factors of production. Therefore, prices related to the consumption equal the unit expenditure, while prices of production equal to the unit costs. In this sense, the equilibrium prices result from replacing those optimal in the respective expenditure functions and unit costs.

The value added prices of private goods (PV_j) are obtained by substituting the demands derived from primary factors in the respective functions of unit cost of generating value added:

$$PV_j = \left(\frac{1}{D_j}\right) * \left(\frac{W}{\gamma_{l,j}}\right)^{\gamma_{l,j}} * \left(\frac{R}{\gamma_{k,j}}\right)^{\gamma_{k,j}} \quad \textbf{(12)}$$

The price of production follows the specification of the equation which forms prices of a linear model, because a production Leontief-type function is assumed:

$$PY_j = \left(1 + TP_j\right) * \left(\sum_{i=1}^{44} a_{ij} * PY_j + v_j * PV_j\right) \quad \textbf{(13)}$$

Where TP_j are the taxes on production net of subsidies and taxes on products net of subsidies that the government charges to j sector.

B. Tables

Table 1

Identifier	Number	Agent
H	1	First income decile
	2	Second income decile
	3	Third income decile
	4	Fourth income decile
	5	Fifth income decile
	6	Sixth income decile
	7	Seventh income decile
	8	Eighth income decile
	9	Ninth income decile
	10	Tenth income decile
E	1	Urban strata
	2	Rural strata
F	1	Food, beverages, and tobacco
	2	Clothing and footwear
	3	Housing, electricity, gas, water, and other fuels
	4	Furniture, equipment and household goods
	5	Health
	6	Transport
	7	Leisure and culture
	8	Education
	9	hotels, cafes, and restaurants
	10	Miscellaneous goods and services (personal care, communications, except fixed and mobile telephony, social, financial, and other services)
	11	Fixed telephony

	12	Mobile telephony
i,j	1	Agriculture, animal husbandry, forestry, and fishing
	2	Mining
	3	Electricity, gas, and water
	4	Construction
	5	Food, beverages, and tobacco
	6	Textile industry
	7	Wood industry
	8	Paper industry
	9	Chemical industry
	10	Non-metallic mineral products
	11	Metallic industries
	12	Metallic products
	13	Machinery and equipment
	14	Furniture
	15	Other manufacturing industries
	16	Commerce
	17	Transport
	18	Publishing of newspapers, magazines, books and the like, except through Internet
	19	Software edition, except through Internet
	20	Films and video industry
	21	Sound industry
	22	Radio and TV programs transmission, except through Internet
	23	Production of channel programs for TV, cable or satellite systems, except through Internet
	24	Contents creation and broadcasting, exclusively through Internet
	25	Traditional telephony, telegraphy and other wired telecommunications

	26	Cellular and other wireless telecommunications services except satellites
	27	Resale of telecommunications services
	28	Satellite services
	29	Distribution by subscription of TV programs, except through Internet
	30	Other telecommunications services
	31	Internet access providers and search services network
	32	Electronic data processing, web hosting and other related services
	33	Other information services
	34	Financial services
	35	Rental services
	36	Professional services
	37	Corporations and enterprises managing
	38	Enterprises support services
	39	Educational services
	40	Medical services
	41	Entertaining services
	42	Temporary accommodation services and restaurants
	43	Repair services and others
	44	Government activities
L	1	Work
K	1	Capital

Model agents listing

Table 2

Sector	Prices	Value added*	Sector	Prices	Value added*
1	0.19	1.94	23	1.80	2.70
2	0.19	1.23	24	0.09	1.82
3	0.25	1.93	25	40.30	40.49
4	0.30	0.04	26	19.70	20.24
5	0.26	1.92	27	0.54	1.98
6	0.27	2.18	28	0.54	0.55
7	0.22	1.50	29	0.71	2.39
8	0.39	2.36	30	0.60	2.31
9	0.27	2.47	31	0.93	2.22
10	0.21	0.81	32	0.61	1.60
11	0.17	1.21	33	1.53	2.03
12	0.32	1.74	34	0.74	2.43
13	0.25	2.03	35	0.21	2.12
14	0.28	1.55	36	0.58	2.31
15	0.29	2.58	37	0.98	8.73
16	0.36	1.68	38	0.34	1.94
17	0.31	2.02	39	0.23	0.75
18	0.26	1.88	40	0.28	0.99
19	0.54	2.24	41	0.32	2.08
20	0.43	2.38	42	0.40	2.33
21	0.39	2.31	43	0.40	2.32
22	0.38	2.35	44	0.48	0.05

Effect of lowering phone rates on prices and value added by economic sector (percent)

Table 3

C_f	Effect	C_f	Effect
C_1	0.29	C_7	0.26
C_2	0.22	C_8	0.38
C_3	0.30	C_9	0.49
C_4	0.32	C_{10}	40.30
C_5	0.31	C_{11}	19.70
C_6	0.34	C_{12}	0.26

Effect of reducing telephony rates
over prices of final consumption goods
(Percentage)

Table 4

h	Stratum	
	Urban	**Rural**
1	0.60	0.52
2	0.98	0.84
3	1.18	1.02
4	1.23	1.31
5	1.40	1.48
6	1.44	1.84
7	1.73	1.72
8	2.04	1.86
9	2.11	2.09
10	2.32	2.26

Effect of reducing telephony rates over homes income (percentage)

Table 5

h	**Stratum**	
	Urban	**Rural**
1	1.64	1.08
2	2.05	1.53
3	2.48	1.74
4	2.59	2.18
5	2.85	2.38
6	3.03	3.01
7	3.32	2.84
8	3.77	2.97
9	3.76	3.68
10	3.76	3.27

Effect of reducing telephony rates
over homes consumption (percentage)

Table 6

Urban stratum												
h	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
1	0.424	0.020	0.265	0.050	0.024	0.129	0.006	0.019	0.009	0.040	0.010	0.005
2	0.375	0.022	0.264	0.050	0.034	0.146	0.012	0.026	0.012	0.045	0.009	0.006
3	0.347	0.024	0.240	0.047	0.034	0.161	0.017	0.028	0.025	0.059	0.012	0.007
4	0.348	0.027	0.227	0.051	0.029	0.168	0.020	0.032	0.026	0.052	0.013	0.009
5	0.328	0.027	0.215	0.050	0.028	0.178	0.021	0.037	0.040	0.054	0.013	0.010
6	0.316	0.027	0.196	0.050	0.031	0.202	0.026	0.032	0.037	0.059	0.015	0.010
7	0.292	0.029	0.185	0.051	0.033	0.197	0.032	0.036	0.054	0.065	0.015	0.011
8	0.259	0.029	0.169	0.048	0.035	0.193	0.036	0.038	0.077	0.080	0.016	0.011
9	0.195	0.024	0.137	0.044	0.031	0.179	0.039	0.034	0.096	0.075	0.013	0.010
10	0.059	0.010	0.049	0.024	0.018	0.072	0.020	0.017	0.055	0.050	0.005	0.004
Rural stratum												
h	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}
1	0.438	0.032	0.143	0.072	0.043	0.156	0.005	0.019	0.017	0.069	0.003	0.003
2	0.410	0.033	0.141	0.067	0.045	0.180	0.008	0.025	0.028	0.052	0.004	0.007
3	0.377	0.038	0.141	0.064	0.043	0.179	0.009	0.032	0.053	0.052	0.004	0.007
4	0.355	0.034	0.125	0.065	0.047	0.218	0.009	0.034	0.037	0.062	0.005	0.009
5	0.333	0.035	0.123	0.064	0.051	0.220	0.011	0.030	0.064	0.056	0.006	0.007
6	0.301	0.032	0.115	0.051	0.042	0.197	0.013	0.030	0.049	0.101	0.009	0.008
7	0.271	0.036	0.103	0.045	0.043	0.223	0.014	0.028	0.036	0.057	0.007	0.008
8	0.214	0.025	0.090	0.041	0.033	0.206	0.011	0.024	0.097	0.076	0.006	0.009
9	0.155	0.020	0.064	0.029	0.023	0.122	0.008	0.010	0.071	0.062	0.008	0.008
10	0.042	0.008	0.021	0.017	0.008	0.111	0.008	0.007	0.026	0.039	0.002	0.003

Average propensity to spend per final good and type of home

Table 7

h	Urban			Rural		
	Business	Labor	Remittances and others	Business	Labor	Remittances and others
1	4.50	25.34	70.16	3.45	22.91	73.64
2	7.92	41.17	50.92	4.32	38.31	57.38
3	12.40	45.82	41.78	4.43	47.60	47.97
4	8.50	53.26	38.24	13.17	51.51	35.31
5	12.98	56.46	30.56	13.37	60.26	26.37
6	11.40	60.71	27.90	29.58	57.93	12.49
7	18.23	67.01	14.76	14.80	70.84	14.36
8	30.65	66.66	2.68	24.21	65.85	9.94
9	38.89	59.60	1.51	42.76	53.66	3.58
10	71.77	27.84	0.39	72.81	23.39	3.80

Percentage distribution of current income of homes per income source (Percentage)

Table 8

h	Stratum	
	Urban	**Rural**
1	1.47	1.03
2	1.89	1.46
3	2.27	1.66
4	2.37	2.07
5	2.62	2.27
6	2.76	2.80
7	3.06	2.59
8	3.47	2.71
9	3.35	2.99
10	2.97	2.73

Effect of reducing telephony rates

over homes welfare (percentage of initial expenditure)

Table 9

h	**Income**
1	1,331.16
2	2,571.64
3	3,555.77
4	4,514.18
5	5,623.54
6	7,064.28
7	8,937.40
8	11,379.98
9	16,263.31
10	36,778.88

Quarterly average monetary income

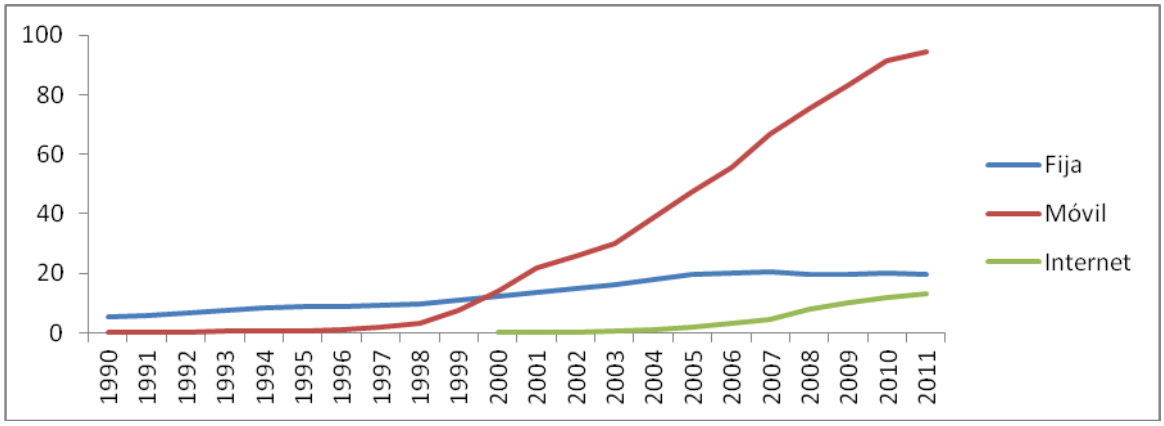
per income decile (2008 pesos)

Table 10

Variable	Total	Stratum	
		Urban	Rural
Consumer price index	2.88	2.89	2.71
Value added	2.22	2.22	2.22
Total income	2.01	2.05	1.58
Consumption	3.29	3.41	2.31
Savings	2.59	2.60	2.47

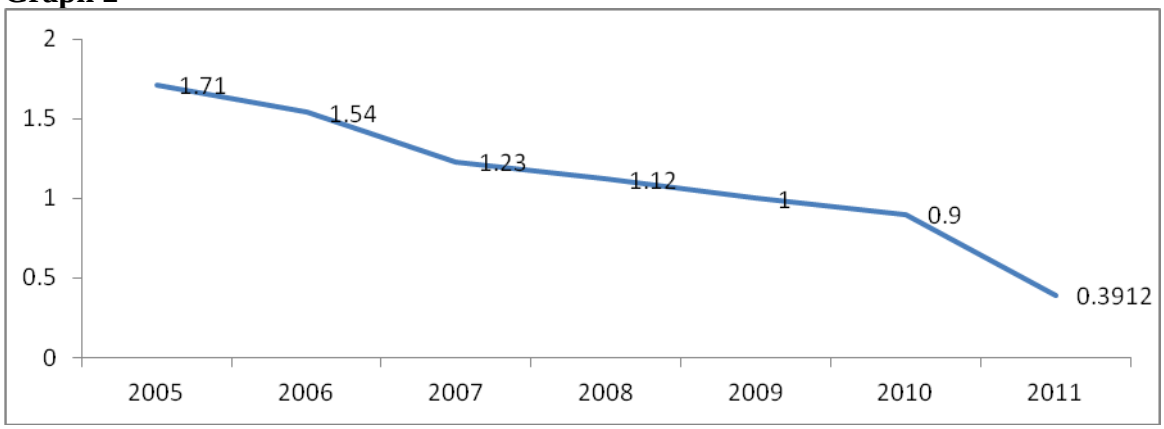
Effect of reducing telephony rates over aggregated variables (percentage)

Graph 1



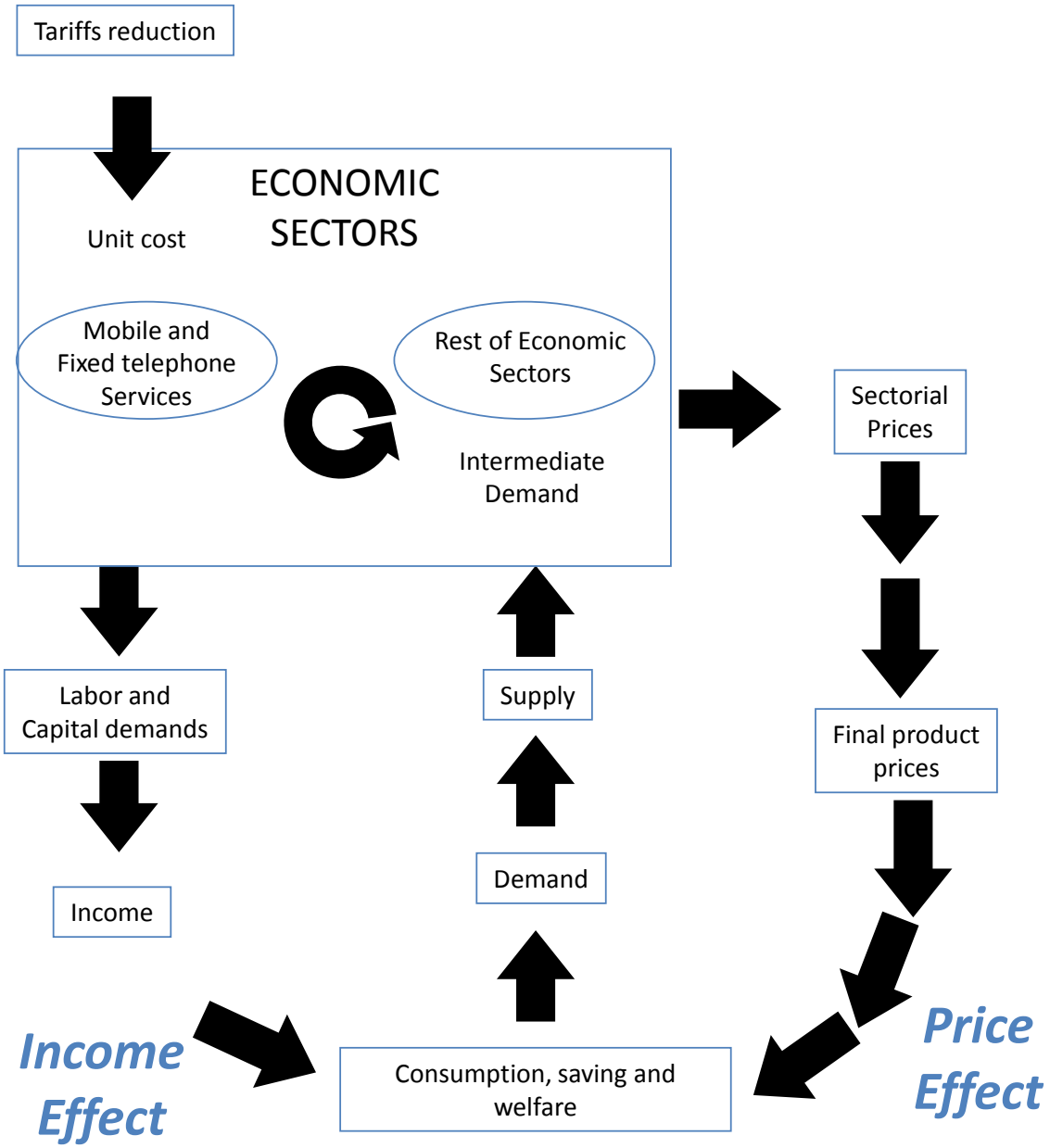
Millions of telephone user (lines) and internet (people) in Mexico.

Graph 2



Mobile interconnection rate (pesos per minute)

Figure 1



Economic effects of reducing rates of fixed and mobile telephony.