PRICE DIFFERENTIATION BETWEEN ON-NET AND OFF-NET CALLS: AN APPLICATION TO THE CHILEAN TELEPHONY MARKET *

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Abstract

This paper characterizes discriminatory plans offered by Movistar in Chile in May 2010, before the Competition Court of Chile banned the offer of plans based on different prices for on-net and off-net calls. Using a model of strategic interaction among firms that set discriminatory and nonlinear prices, this paper assess the extent to which on-net and off-net price differentials in this plans represent predatory practices in the mobile telephony market in Chile. The main result is that for high levels of call externality, most Movistar's offered plans should be explained by efficiency and strategic reasons. However, for low levels of call externality at least half plans for individual customers could present evidence of anticompetitive practices. Therefore, whether our result justifies or contradicts the Competition Court's decision is a matter of future empiric work, since information regarding the call externality parameter is not fully reliable.

Keywords: Telecommunication network competition, on-net/off-net price discrimination, call externality, Chile

JEL Classification: D43, L41, L51, L96

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1. INTRODUCTION

Pursuant to a complaint filed on January 8, 2010 by Will S.A., a small operator in wireless local telephony, with the Competition Court of Chile (Tribunal de Defensa de la Libre Competencia) against Claro Chile S.A., the third company in the industry, we analyzed the economic rationality of on-net and off-net price differentiations that the vast majority of telecommunication companies incorporate in their plans. We perform this analysis using data at the level of each postpaid contract, provided by Movistar, the largest company in the industry.

The interesting of this case, in terms of competition policy, is that after rejecting the complaint of Will against Claro (Sentence 110, 2011), the Competition Court, by using its power of advocacy, analyze the competitive effects of the on-net and off-net prices in the telecommunication industry in Chile. By 2012, this court determined that the companies could no longer set different tariffs for on-net and off-net calls and gave them two years to adjust the plans they offer (General Instruction 2, 2012).[1] Thus, since our recommendation is a little bit different to the Competition Court's, it is an interesting case study to review the situation before their decision.

The theoretical and empirical analysis presented in this paper focuses on price differentiation in the form of two-part tariffs, which in practice correspond to subscribers on postpaid contracts. According to information provided by Movistar, even though the vast majority –approximately 70%– of their mobile phone users are prepaid customers, who pay a linear rate, they account for less than 20% of the company revenues. Hence, the segment of postpaid users is clearly more relevant when analyzing possible anti-competitive behaviors (particularly, predatory behavior or barriers to entry); however, the prepaid modality is certainly relevant from a social welfare analysis perspective.

There are two different mechanisms of on-net and off-net price differentials in the post-paid modality: on one hand, the number of free minutes for calls within and outside the network can differ depending on the fixed monthly fee; and on the other hand, the price of the minutes that exceed those included in the plan may differ depending on the type of call. Throughout this article we refer to the first mechanism as the average tariff differentials and to the second mechanism as the marginal tariff differentials. Table 1 describes the prevalence of the different types of discrimination among Movistar clients during the month of May 2010.

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[1] See www.tdlc.cl/tdlc/instrucciones-generales/ (visited: January 24, 2016).

Table 1. Prevalence of Postpaid Plans with Average or Marginal Tariff Differentials or both Average and Marginal Tariff Differentials, May 2010

	Individuals	Companies	Total
Average Tariff Differentials			
Yes	**19.7%**	**0.1%**	**5.4%**
No	80.3%	99.9%	94.6%
Marginal Tariff Differentials			
Yes	67.3%	14.1%	19.4%
No	32.7%	85.9%	80.6%
Average and/or Marginal Tariff Differentials			
Yes	68.1%	14.1%	19.4%
No	31.9%	85.9%	80.6%

Source: Authors' calculations based on data from Movistar.

While the prevalence of marginal tariff differentials is greater than that of average tariff differentials, the latter proves to be more relevant since the vast majority of subscribers do not exceed the minutes included in their plans, as will be shown later.

Competition in the industry is strong; this is evident in the promotions, plans and strategies to attract customers. One of these business strategies is to charge different prices depending on whether calls are made within the same network (known as on-net calls) or outside the network (known as off-net calls).[2] Having to pay different prices for calls made to different people, simply because they are on different networks, certainly does not make sense to customers.

Despite what users may think, there are reasons for the different prices of providing the service. These include strategic reasons that are completely legitimate from a perspective of strategic interaction among rival companies and reasons that could be considered to be part of an anti-competitive strategy. Figure 1 shows how on-net and off-net prices are decomposed (the figure shows the simpler of two symmetric networks).

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[2] Movistar considers Telefonica Chile local calls as on-net calls.

Figure 1. On-Net and Off-Net Prices: Possible Explanations
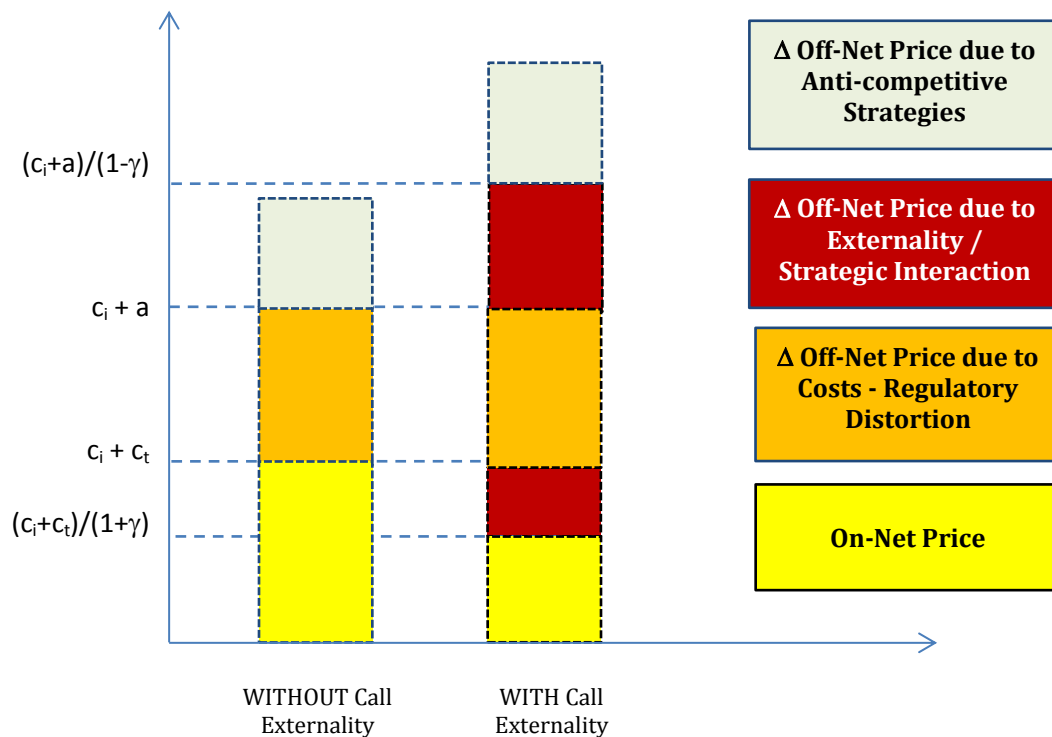
Note: a = access charge; c_i = cost of call origination;
c_t = cost of call termination; γ = call externality

Source: Author's elaboration.

There are two explanations for on-net and off-net price differentiation related to costs: i) the cost of providing access to a call originating from a rival network is not necessarily the same as the cost of terminating an own-network call; the former should actually be more expensive than the latter due to interconnection costs associated with granting access to the rival network, and ii) the policy of setting access charges in Chile generates a bias when the operational cost of granting access is dissociated from the tariff set as it is increased to consider fixed costs that are irrelevant in the business decision of the company.

As will be discussed in more detail in Section 4, considering the current access charges, the strategic interaction among telecommunication networks is to charge their customers more when they call subscribers of other networks. This is true for companies when they are able to charge their subscribers –who are typically those with postpaid contracts– two-part tariffs. Hence, the companies set the price of on-net calls at marginal cost –or even below marginal cost– for postpaid customers and recover their fixed costs from the fixed tariff levied on these customers, as well as from the tariff

applied to all their subscribers for off-net calls. This situation arising from the strategic interaction among rival companies is particularly true when there are call externalities.

However, it is possible that price differentials between on-net and off-net calls are part of the anti-competitive strategies adopted by relatively larger companies in the industry; this cannot be ruled out a priori without studying the types of plans, prices and other characteristics of the industry. This could be a strategy to artificially decrease the entry rate of rival companies into the industry and could lead to an increase in the long-term average cost of the new company –since entry into the industry would require more working capital– or even to financial bankruptcy of a small company in the event that the company is unable to face the predatory behavior of the established companies.

In light of this brief review of the reasons for the differential prices based on the network called, it can be concluded that the issue is essentially empirical, once the factors influencing these prices are known. However, as we mentioned in the beginning of this section, authorities ordered telecomm companies to stop offering new contracts based on discriminatory on-net and off-net prices (General Instruction 2, 2012). In fact, by 2009 during the judgement that liberalized local telephony in Chile, the Competition Court was not totally convinced that the on-net and off-net price differentials were consistent with competition. This authority argues that, to achieve more competition in the telephony market, "*Another recommendation needed to prevent a decrease in the degree of competition in this market is to eliminate the price differentiation of own-network calls (on-net) and calls to other networks (off-net); the Court could consider this differentiation unlawful. This is because, when consumers are deciding on a company, they have a strong incentive to choose the company with the largest market share, thereby increasing the company's market share even more.*"(Judgement 2, 2009, pp. 59).[3]

In the eyes of the Court, as can be inferred from the previous paragraph, there should be no cost differentials in a competitive market in order to observe similar prices. However, that statement is true only in a context in which the access charges are set equal to the marginal cost of terminating a call on the company's own network and there are no call externalities; i.e. only the caller obtains utility from the call. By contrast, the statement made by the Court needs to be revised when these assumptions are not met.

Consequently, this paper shows that the developments in the economic theory of access charges and competition in the telephony market provide more complex policy recommendations, since not all price differentials between on-net and off-net calls can be associated with anti-competitive practices. In order to distinguish between these cases and those that are a true reflection of competition in the industry, it is necessary to consider the possible regulation imperfections (for example, access

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[3] Author's translation. See www.tdlc.cl/tdlc/nc-246-08-solicitud-de-informe-del-ministerio-de-transporte-y-telecomunicaciones-sobre-regimen-tarifario-de-servicios-de-telefonia-fija (visited: January 24, 2016).

charges above the marginal cost of call terminations) and the strategic incentives generated by call externalities.

Contrary to this paper's recommendation, in order to analyze whether each offered on-net and off-net plan is anticompetitive, the Competition Court determined that the companies could no longer set different tariffs for on-net and off-net calls. In fact, our main empirical finding is that depending upon the call externality parameter, most discriminatory plans that Movistar offered previous to the Competition Court's decision where either efficient or based on strategic reasons, but not anticompetitive. Only in the case that the call externality is relatively low, that is equal 0,5 or below, at least half of the discriminatory plans offered to individual customers were anticompetitive.

The rationale for this court's decision is based on a cost-benefit analysis. The risk of predatory practices is clear and a case by case analysis would require determine the value of the call externality, a key parameter in the model that had never being estimated before the Competition Court made its decision.

This paper is structured as follows. Section 2 reviews the main economic and regulatory characteristics of the industry. Section 3 discusses the main features of existing Movistar plans, estimating the distribution of fixed charges and that of on-net and off-net price differentials for different types of contracts, time frames and considering both the average and the marginal tariffs. Section 4 calibrates a model of competition among more than two asymmetric firms. Such model is suitable for the mobile telecommunication market in Chile and it provides a rationale for determining the extent to which the price policy, adopted by Movistar with respect to on-net and off-net calls, is in line with competition. To this end, we use the data obtained from the empirical evidence presented in Section 3. Finally, Section 5 concludes.

2. INDUSTRY BACKGROUND

The telecommunications industry has experienced a phenomenon of convergence in prevailing technologies, to the point that, at least from a public policy perspective, the fact that the vast majority of telecommunications services are developed and delivered through fixed and mobile telephone networks is widely accepted. This section presents a description of the industry, its key players and their importance, the current regulation on access charges and other relevant information that may be of interest.

The telecommunications industry in Chile, as in most of the world, is strongly influenced by technological convergence and is dominated by a few key players. These players participate in practically all market segments or telecommunication services offered to customers and use either physical or fixed line networks (or Cable TV) and wireless mobile networks as an anchor for the delivery of these services.

This situation of a modern industry, along with strong economies of scope that create incentives to offer bundled products, drives relatively smaller companies to face a weakened competitive position. While this may be a consequence of competition, the affected companies can interpret it as anti-competitive behavior of the established companies. Whatever the case, the market share of these companies is quite low since the remainder in each market segment does not exceed 10% by 2009, as shown in Table 2.[4]

The importance of the mobile telecommunications sector is growing in Chile. Local telephony has been losing ground and, currently, its importance is based mainly on bundles that combine fixed line services with other services and on the fact that it is the main channel through which Internet access is provided to households. Moreover, the mobile telephony offers both postpaid contracts and prepaid plans. The latter is the fastest growing service in the industry, in terms of the number of subscribers. The relative importance of each of these two mechanisms is shown in Figure 2.

Nevertheless, postpaid contracts account for a significant use of mobile telephony in terms of traffic volume, representing about 80% of all mobile traffic. Consequently, given that the ratio of prepaid plans to postpaid contracts is 2:8, a mobile postpaid subscriber calls 3.5 times more than a prepaid subscriber in 2009, on average.

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[4] The Entel group, the second largest in the industry, purchased TRANSAM Communications in 2010, and thereby its subsidiary WILL S.A.

Table 2. Market Shares at the National Level by Traffic, Year 2009

Group	Fixed Telephony	Paid TV	Internet	Mobile Telephony
Telefonica Group	64.5%	17.5%	41.5%	43.3%
VTR	17.2%	68.4%	40.2%	-
GTD Manquehue	2.3%	-	2.3%	-
Entel/Entel Phone	4.7%	-	4.2%	39.6%
Telsur	4.0%	-	6.9%	-
Telmex/Claro	-	4.1%	-	18.1%
Others	7.3%	10.0%	4.9%	-

Source: Authors' calculations based on SUBTEL.

Figure 2. Local and Mobile Traffic in Chile
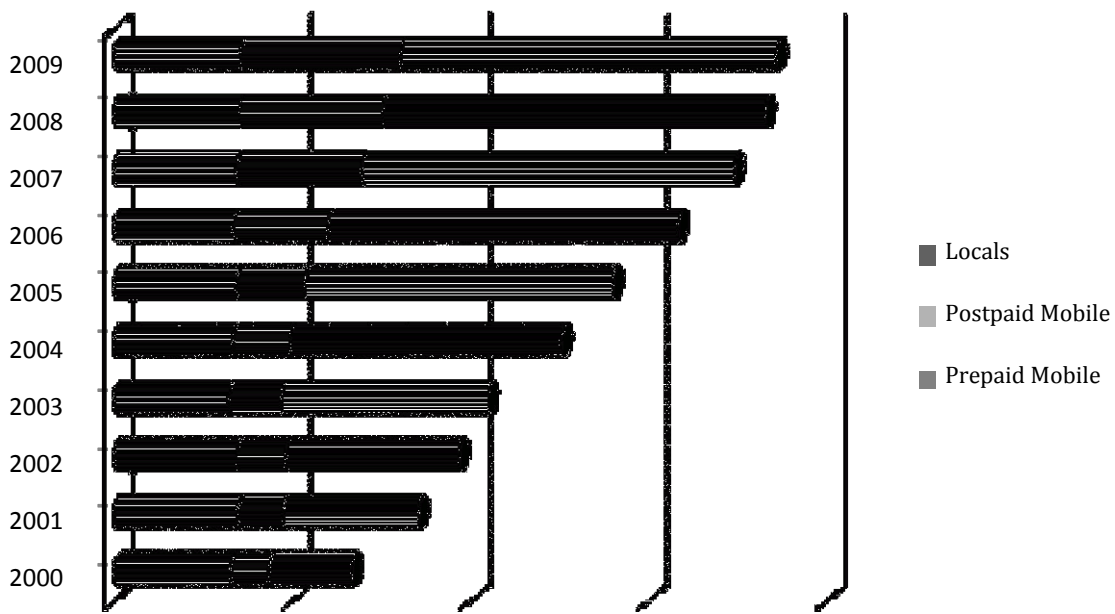
Source: Authors' calculations based on SUBTEL.

As stated by the TDLC in its decision ruling regarding the liberalization of prices in fixed telephony on February 2009, "*the mobile telephony is able to discipline the local telephony and that this … will limit … the possibility of abusing its dominant position*"(Judgment 2, 2009, pp. 49). There are many arguments that the Court delivers in the judgment and that point towards the existence of a single relevant market with respect to the telephony market.

Like any industry with significant economies of scale, scope and density in one of its segments, the industry has been regulated since its inception. However, as stated in the previous section, the advance of new technologies and the phenomenon, known as the convergence of telecommunications, has led to important deregulatory policies in the sector. In particular, one such policy was the deregulation of tariffs, in the case of the dominant companies in Chile that was enabled in May 6th, 2009 with the last tariff decree stipulated for Telefonica Chile.

The Government still regulates, among other services, the access charges set by companies to rival companies and other operators in the industry to access their networks. The reasons for maintaining this regulation will not be discussed in this report. However, in order to easily understand the need to maintain the role of the Government, it is important to consider that access charges are, ultimately, prices imposed on rival companies to use a network. Hence, access charges are prices that, if not regulated, could be used by the owner of the network to directly affect the cost of rival companies. In other words, unregulated access charges would lead to prices that are higher than the socially efficient since each company would be an unregulated monopoly when imposing the charge for terminating calls on its network.

The regulation of access charges in Chile was ruled by the same criteria from 1982 to 2014. Even though the efficiency of setting access charges in the country will not be discussed in this paper, it is important to clarify that such legislation is not the most adequate to regulate the interconnection service between companies. For more than a decade, the literature has shown the great differences in the economic efficiency of setting optimum tariffs as it relates to the service provided to end users versus the interconnection service and the network access. Only in 2014 the regulator changed the regulation of access charges in telecommunication to a one more based in operating costs than in total average costs.

The regulator determines the costs of providing access to a company network that is idealized for the concession area of the actual company. After adjusting for fixed costs associated to this service, the regulator then determines the maximum tariffs that the actual company can charge. The tariff process is much longer and has a number of formalities and stages that do not need to be detailed in this paper. However, an important aspect is that the process ends with a Tariff Decree that determines the access charges and other regulated fees for each company for a period of five years.

The regulator determines the access charges in Chilean pesos per second for three different time frames: Normal hours, defined as 9:00 to 22:59:59 every weekday; Reduced-rate hours, defined as 9:00 to 22:59:59 on weekends and holidays; and Night-time hours, defined as 23:00 to 8:59:59 on any day. While each company providing local services are assigned access charges that generally differ from that of other companies, the access charges provided to mobile telephone companies are identical for

all companies and have the same duration.[5] Table 2 provides the valid access charges for major telecommunications companies in the country by the time of the trial of Will against Claro (2010 and 2011).

It is clear that the mobile technology has access charges that are greater than those set for local telephone companies, at least as it relates to calls made during normal hours. Among the access charges of local telephone companies during normal hours and bearing in mind that these are tariffs for the concession area of Santiago, Telefonica Chile has the lowest access charge (7.38 Chilean pesos per minute), while the access charges for smaller companies such as FULLCOM or CMET are 75% higher. Moreover, the fees of all mobile companies that are outdated by a year with respect to Telefonica Chile include access charges of 75.88 Chilean pesos per minute (including VAT). These access charges are quite close to those of WILL S.A. that also uses mobile technology with access charges set by SUBTEL two years earlier.[6]

Table 3. Regulated Access Charges, as at October 2010

(Chilean pesos/minute)

COMPANY (local & mobiles)	Commencement Date of the Last Decree	ACCESS CHARGE		
		Normal Hours	Reduced-rate Hours	Night-time Hours
TELEFONICA CHILE	Apr-10	7.38	5.53	3.69
VTR	Nov-08	9.46	3.16	1.57
WILL S.A.	Mar-07	75.26	25.09	12.54
CMET	Jan-06	12.12	4.04	2.01
FULLCOM	Jun-08	12.80	4.27	2.13
ENTELPHONE	Jan-06	10.49	3.49	1.75
MOBILE COMPANIES	May-09	75.88	56.91	37.93

Notes: (1) All charges for the concession in Santiago (AT1 if applicable).

(2) Companies that do not operate in Santiago were excluded.
(3) The access charges include VAT.

Source: author's calculations available at www.subtel.cl

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[5] By 2010, Nextel has higher access charges than Movistar, Entel and Claro mainly because its tariff decree is outdated with respect that of these companies. We refer to these last three companies as Mobile Companies.

[6] The differences during other time frames are greater, but since the volume of traffic is low during these times, they are less relevant.

3. EMPIRICAL ANALYSIS OF THE CURRENT MOVISTAR PLANS

In May 2010, there were 2,550,572 Movistar mobile telephone customers with postpaid contracts, distributed in 3,710 different plans (2,354 individual and 1,356 business plans). Figures 3 and 4 show histograms associated with the distribution of the individual and business plans, respectively. Both frequency distributions clearly show that the vast majority of plans have very few customers. This is important to be able to subsequently analyze the magnitude of the price differentials between on-net and off-net calls since not all plans incorporate price differentials.[7]

Figure 3. Frequency of Plans by Number of Individual Customers
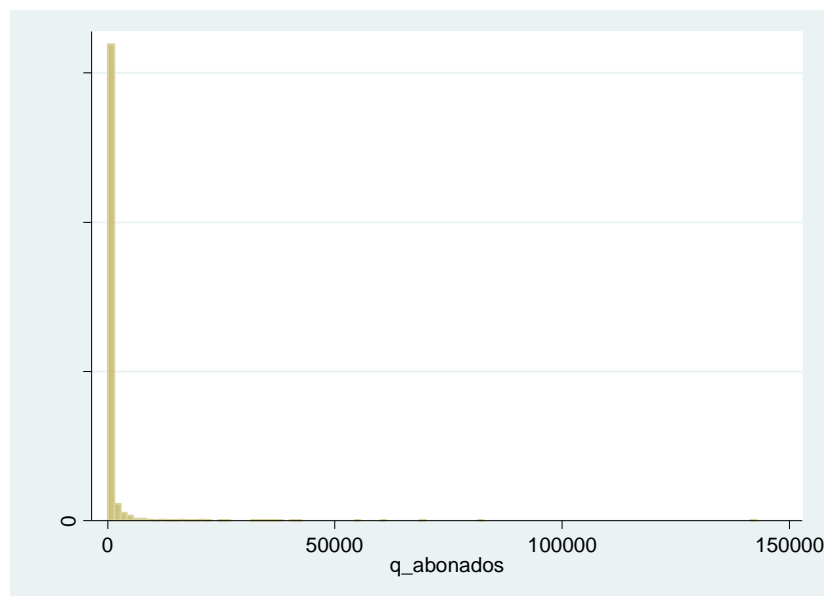
Source: Author's elaboration from data provided by Movistar.

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[7] It is important to mention that in May 2010 only 6.5% of customers with postpaid contracts subscribed to plans that differentiate between on-net and off-net minutes.

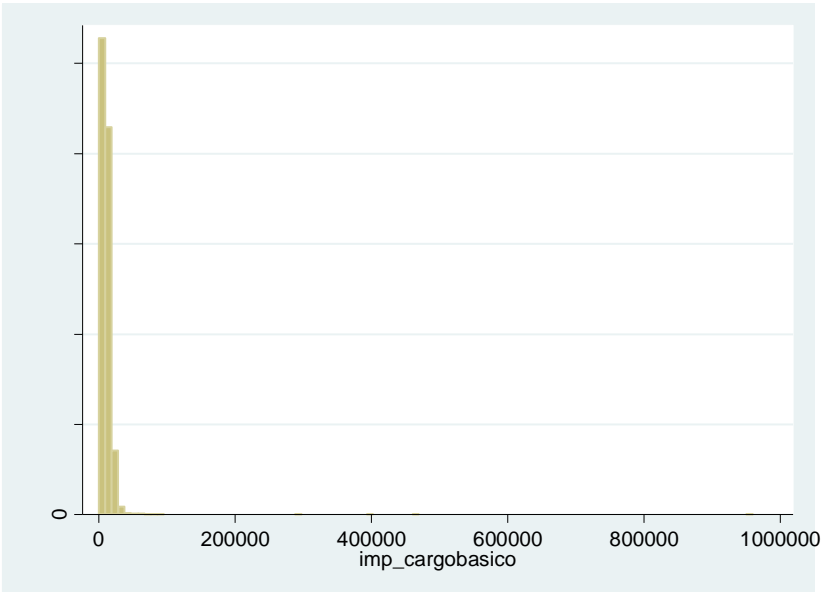**Figure 4. Frequency of Plans by Number of Business Customers**
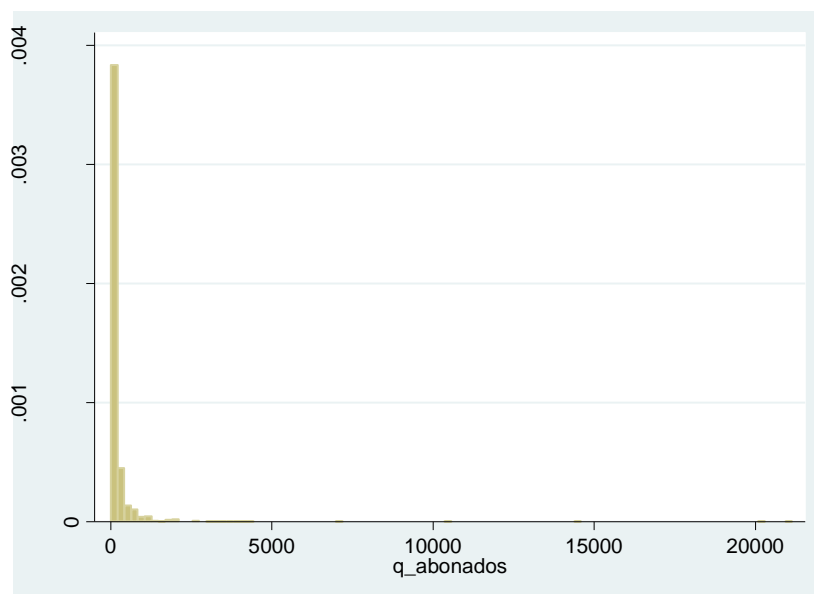
Source: Author's elaboration from data provided by Movistar.

Figures 5 and 6 show the estimated distribution of the fixed charges in plans as at May 2010 for individual and business customers, respectively. It is observed that the simple average fixed charge for individual customers is ch$32,754. However, the distribution shows that most plans incorporate fixed charges that are lower than the simple average. Indeed, the average fixed charge is ch$11,209 if weighted by the number of customers in each plan, showing that most customers pay far less than the average fixed charge of the plan. For business customers, the simple average fixed charge is ch$1,051,079 and if weighted by the number of customers in each plan then the fixed charge reaches ch$2,944,308. This is contrary to the case of individual customers: most businesses have plans with a monthly fixed charge that is much higher than the average charge of the plans offered.

An important aspect to consider when analyzing the difference between the tariffs of on-net and off-net minutes is whether the marginal tariffs (when they exceed the minutes included in the plan) or the average tariffs (the implicit tariffs in the minutes included in the plan) are relevant for customers. If the vast majority of customers generally use only the minutes included in their plans and do not routinely exceed their minutes –and when they do exceed their minutes they do so by a little-, then the relevant differential to analyze is the average tariffs that are implicit in the plan. However, if customers consistently exceed the minutes in their plans, then the relevant differential corresponds to

the marginal tariffs. If customers routinely exceed their included minutes but only by a few minutes, then the relevant differential would be one that arises from weighting the two previous situations.

Figure 5. Fixed Charges in Plans for Individual Customers

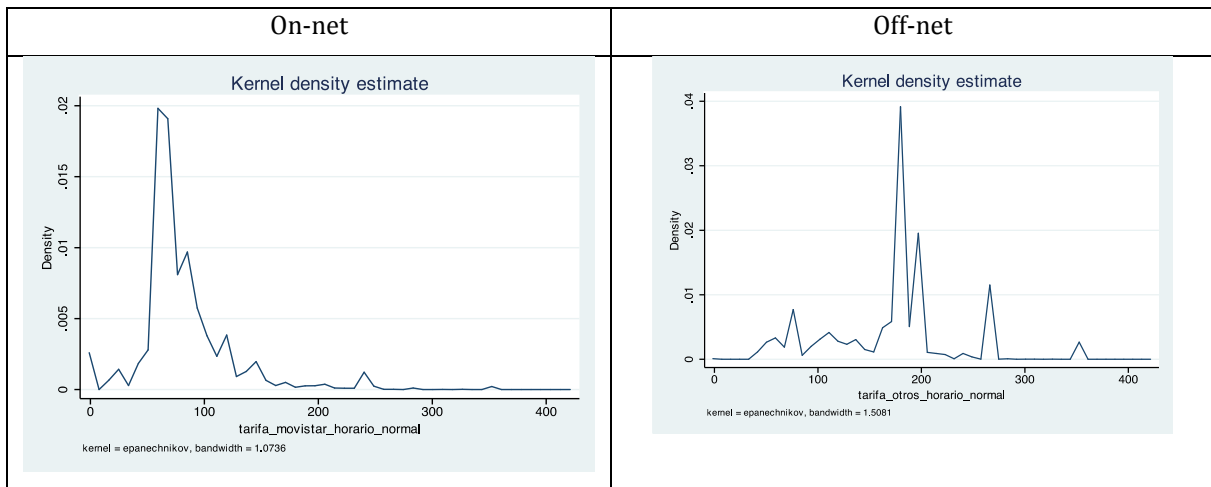Source: Author's elaboration from data provided by Movistar.

Figure 6. Fixed Charges in Plans for Business Customers
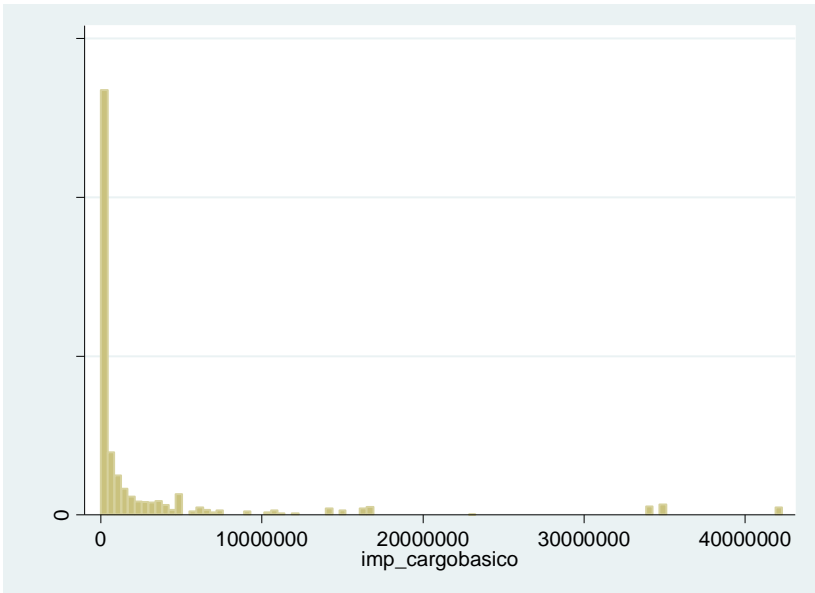
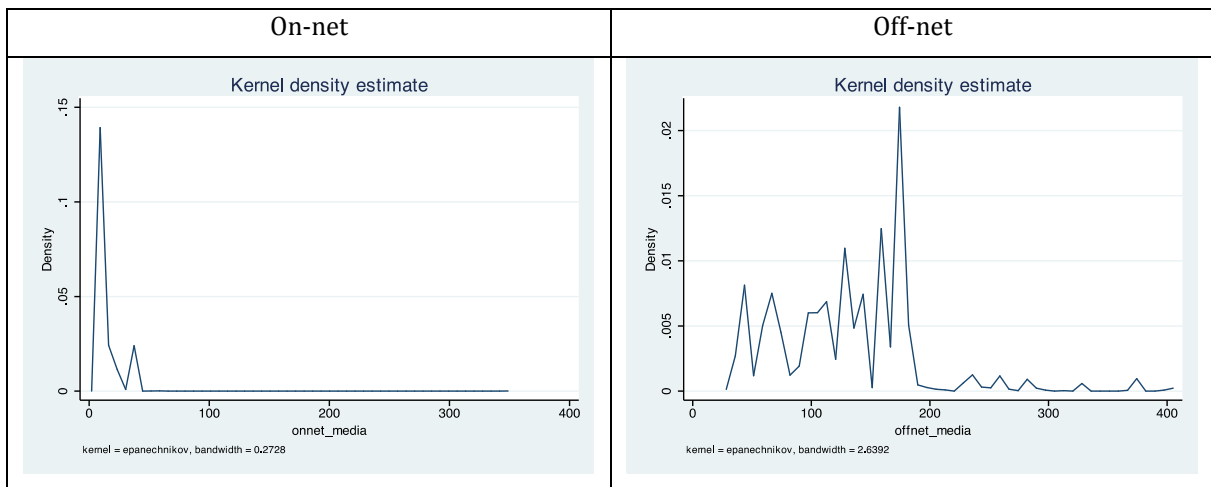Source: Author's elaboration from data provided by Movistar.

The following two figures show the estimated distributions (weighted by the number of customers, individuals or businesses) of existing marginal and average tariffs, for on-net and off-net minutes. The distributions correspond to the tariffs during normal hours, which represents approximately 70% of total traffic.

Figure 7: On-Net and Off-Net Marginal Tariff Distribution during Normal Hours

Source: Author's elaboration from data provided by Movistar.

**Figure 8: On-Net and Off-Net Average Tariff Distribution during Normal Hours**

Source: Author's elaboration from data provided by Movistar.

Figures 9 and 10 show the distributions of the differentiation between minutes actually used by individual customers and those included in each Movistar plan, in the case of on-net and off-net calls.[8]

It is observed that, in both estimated distributions, subscribers do not exceed the minutes included in their plans, in general, since the estimated averages are close to zero. In these distributions, it is evident that individual customers end up with a surplus of on-net minutes and very few subscribers exceed the on-net minutes included in their plans. However, there are groups of subscribers that use more off-net minutes than included in their plans, even though they are a minority.
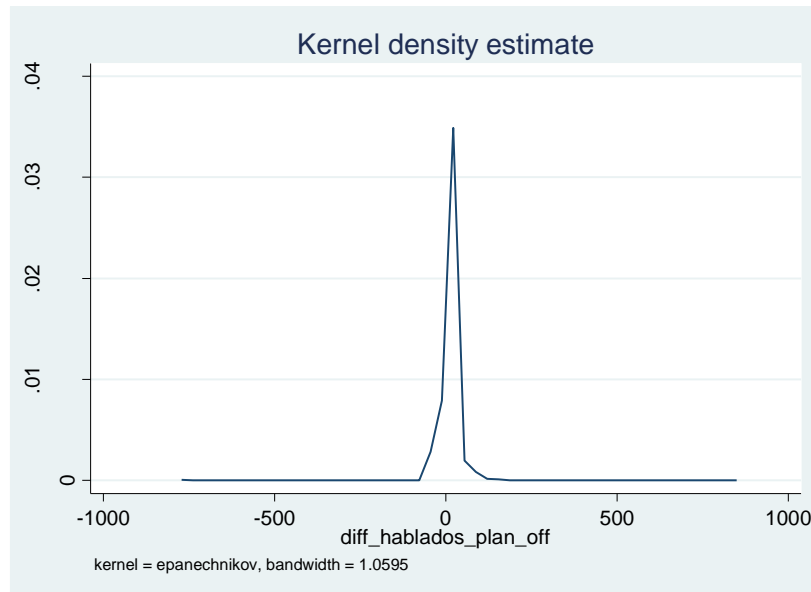
Figure 9. Differentials between On-Net Minutes Actually Used and On-Net Minutes Included in the Plans of Individual Customers
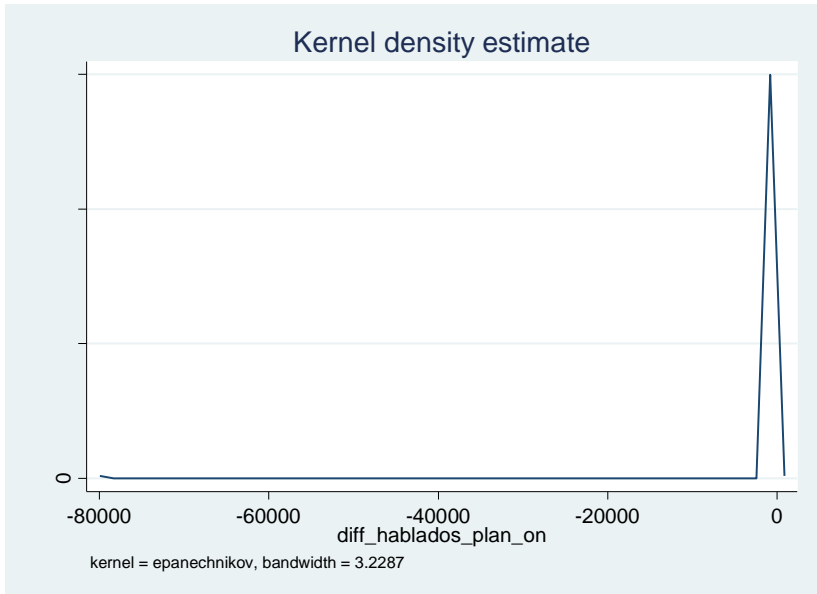
Source: Author's elaboration from data provided by Movistar.

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[8] The estimated distributions should be used to make inferences regarding price differentials beyond the sample. These distributions are calculated with non-parametric distributions using kernel estimates. All estimates are based on monthly data for the period January to May, 2010.

Figure 10. Differentials between Off-Net Minutes Actually Used and Off-Net Minutes Included in the Plans of Individual Customers
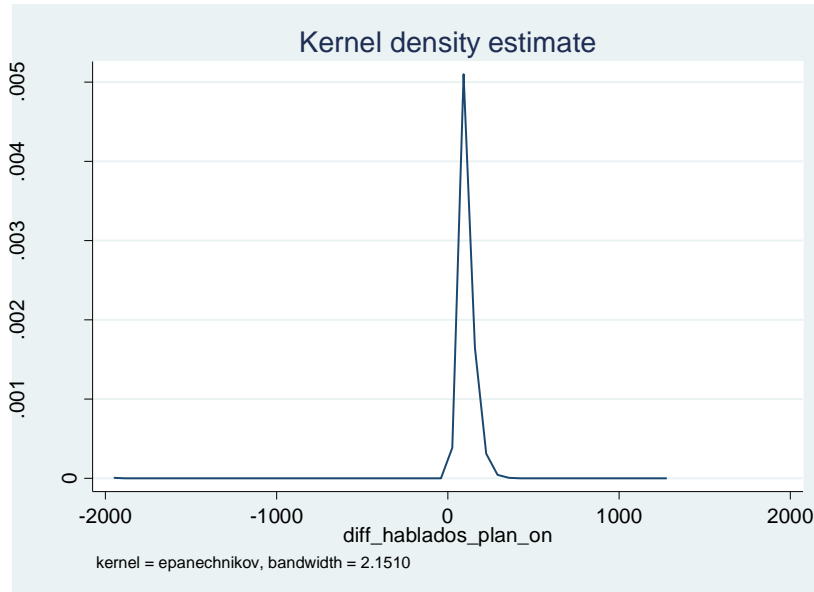

Source: Author's elaboration from data provided by Movistar.

In the case of business customers, the estimated distributions show that they exceed both the on-net and off-net minutes included in their plans, though not by much; that is, there is a clear bias in that trend. This happens more with off-net minutes than with on-net minutes. These differences are illustrated in Figures 11 and 12.

In short, for individual customers, the average differences between the minutes used and those included in their plans correspond to -18.3% in the case of on-net minutes and -21.6% in the case of off-net minutes. For business customers, the average differences are 8.1% in the case of on-net minutes and 9.2% in the case of off-net minutes. In any case, the average tariff is more important than the marginal tariff when choosing a network. Therefore, the following analysis focuses on average tariffs and the Appendix presents the relevant differences in the marginal tariffs.

Figure 11. Differentials between On-Net Minutes Actually Used and On-Net Minutes Included in the Plans of Business Customers

Source: Author's elaboration from data provided by Movistar.

Figure 12. Differentials between Off-Net Minutes Actually Used and Off-Net Minutes Included in the Plans of Business Customers
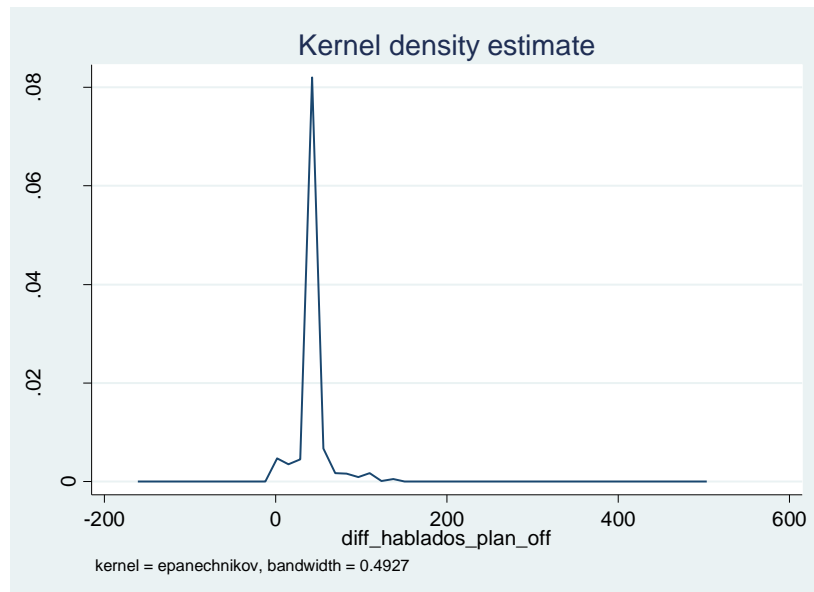
Source: Author's elaboration from data provided by Movistar.

The greatest difficulty in estimating the differentials related with the average tariffs is that these are implied since each plan has a total fixed price that includes a fixed set of on-net and off-net minutes. If the total number of on-net and off-net minutes were identical, the average tariff would also be identical in both cases. However, the plans that differentiate between minutes have more on-net than off-net minutes, reflecting a higher price for off-net minutes.

In order to identify the two average tariffs implicit in a plan, only from the fixed monthly fee, it is necessary to make an assumption regarding the relationship between these two tariffs (the relative price). Since each plan contains a fixed set of minutes for each type of call, a reasonable assumption is to consider that the relative tariffs between on-net and off-net minutes are inversely proportional to the minutes provided in each plan:

$$\frac{Tarifa_{On-net}}{Tarifa_{Off-net}} = \frac{Minutos_{Off-net}}{Minutos_{On-net}}$$

Using this assumption, Figure 13 shows the average tariff differentials between on-net and off-net minutes for all plans existing in May 2010. Furthermore, Figures 14 and 15 illustrates the same differentials but separately for individual and business customers, respectively. The histograms and estimates of the respective distributions are presented in each case.

As is shown in both the actual frequency distribution of the tariff differentials and the estimation of its distribution, the average difference in the average tariffs is between ch$100 and ch$200, when considering all plans. In the case of business plans, there are clearly three humps in the distribution of the differentials around ch$85, ch$100 and ch$115. However, the average tariffs of the largest proportion of plans and subscribers are concentrated around ch$115. In the case of the individual plans, there is a large heterogeneity with higher peaks in the range of ch$20 to ch$60 and ch$100 to ch$170. The greatest density of plans and subscribers are found around ch$160 to ch$170.

Figure 13. Average On-Net and Off-Net Tariff Differentials

(All Plans, weighted by the number of subscribers)
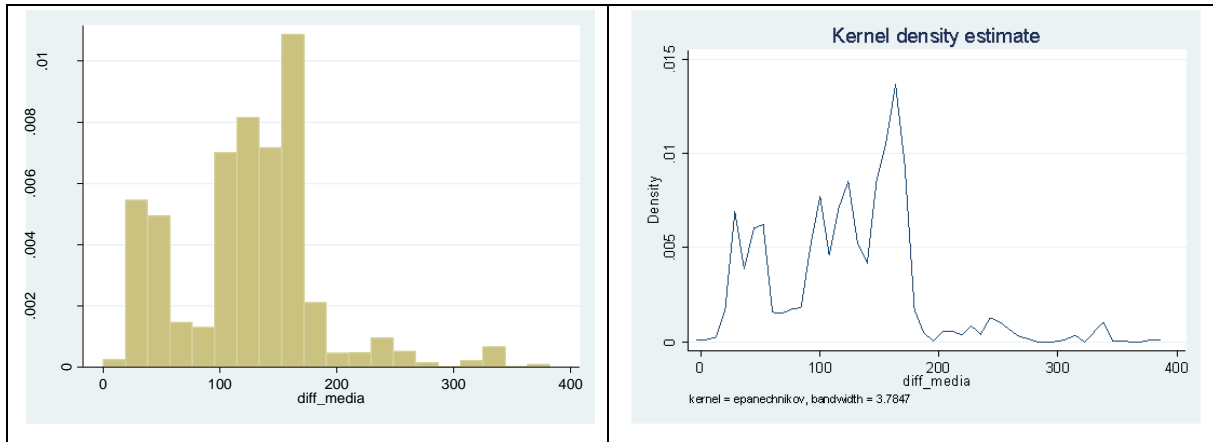

Source: Author's elaboration from data provided by Movistar.

Figure 14. Average On-Net and Off-Net Tariff Differentials

(Businesses, weighted by the number of subscribers)

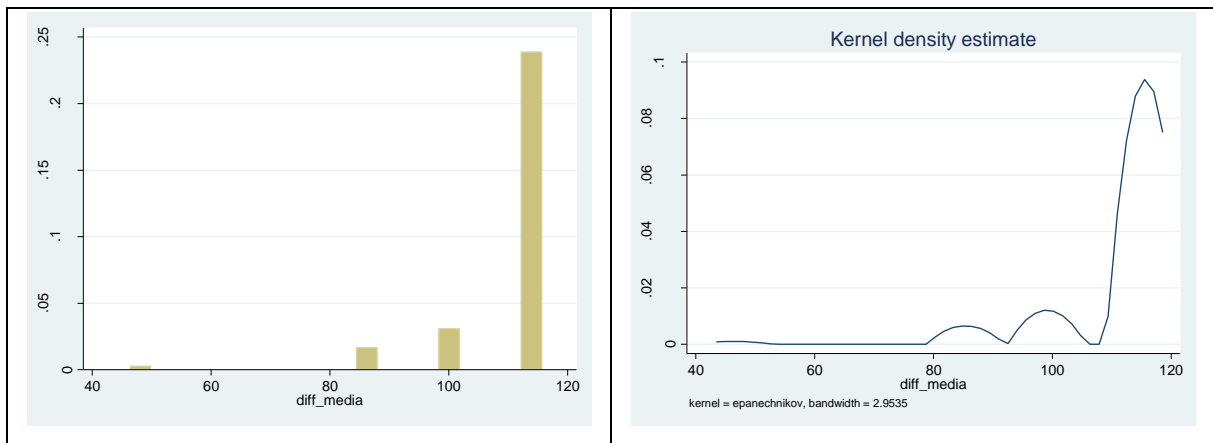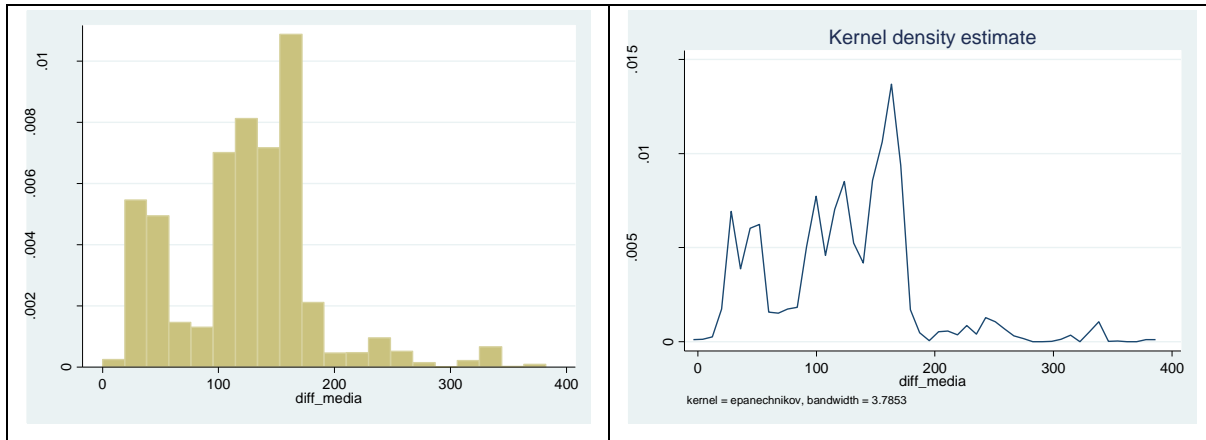Source: Author's elaboration from data provided by Movistar.

Figure 15. Average On-Net and Off-Net Tariff Differentials

(Individuals, weighted by the number of subscribers)

Source: Author's elaboration from data provided by Movistar.

To conclude this section, it is possible to note that the difference between the tariff charged for on-net and off-net calls affects a small percentage of subscribers, approximately 5.4% of the postpaid customers.[9] Considering the total number of customers with postpaid contracts that face on-net and off-net price differentials, the average on-net average price is ch$11 while that for off-net calls is ch$130. The on-net and off-net price differential ranges between ch$85 and ch$115 for the average tariffs in business plans. The same differential in 80% of plans ranges between ch$114 to ch$132 in the plans of businesses and from ch$38 to ch$170 in the plans of individuals.

It should be noted that the average tariffs correspond to prices that are inversely proportional to the costs stated in each plan instead of to the costs effectively used by the subscribers. Hence, the estimated values correspond to an upper limit of the real average tariffs implicit in each plan. However, these ranges are not too different from those of the marginal tariffs[10], so these values can be considered as a reference even for customers who routinely use a few more minutes than those included in their plans. These ranges were contrasted with those that are calibrated, using a theoretical model, for the case of Chile, in the next section.

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[9] This percentage corresponds to subscribers with postpaid contracts, who face an average tariff differential, which is the relevant differential when choosing a network. As shown in Table 1, this percentage is higher, 19%, considering the marginal tariffs.

[10] In this case, the tariffs range from $50 to $100 for businesses (and from $110 to $200 for individuals).

4. ECONOMIC ANALYSIS

Of the models that assess strategic interaction in telecommunication networks, the Hoernig (2010, 2014) model has the advantage of being the most general since it does not limit the application to two competing networks nor does it require that the size of the networks be the same. To the best of our knowledge, all the other literature has one or both restrictions, which limits its use in practice.[11] Therefore, the empirical comparisons are performed using the Hoernig (2010, 2014) model, particularly the equation:

$$p_{ij} - p_{ii} = \underbrace{\left(\frac{c_{ij}}{1 - \frac{\gamma \alpha_i}{(1-\alpha_i)}} - c_{ij} \right)}_{A} + \underbrace{\left(a_j - c_{t,i} \right)}_{B} + \underbrace{\left(c_{ii} - \frac{c_{ii}}{1+\gamma} \right)}_{C} \qquad (*)$$

where $p_{i,j}$ is the price of calls originated within the network i and terminated on the network j; $p_{i,i}$ is the price of calls originated within the network i and terminated on the same network; c_{ii} is the marginal cost to the firm i of an on-net call; c_{ij} is that of an off-net call to the firm i; a_j is the per minute regulated access charge that firm i must pay to firm j for terminating its calls on the rival's network; $c_{t,i}$ is the cost per minute of calls terminating on its own network; α_i is the market share of the network i; and γ is the call externality (individuals obtain a proportion γ, between zero and one, o the her utility for each call received).

The simulation exercise that follows is based on the following assumptions:

1. The average access charge per minute is equal to ch$69.1, which is the result of the weighted average of the current access charges that include VAT. The weights used are 0.72 for regular hours, 0.2 for reduced-rate hours and 0.08 for night-time hours; they were calculated based on the information on off-net calls to mobile networks of Movistar customers (except those with prepaid contracts) during the month of November 2010.

2. The market share of Movistar is 42%.

3. The actual cost of call termination is less than or equal to the regulated access charge set by the authority. Since there is no information on the cost of call termination, we assume that it is least equal to the one reported by Movistar to the regulator in the 2009 access charge setting process (ch$46.39 per minute in average). The calculations

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[11] See a summary of this literature on Agostini, Lazcano, Saavedra, and Willington (2016).

are checked for robustness, allowing variations in the cost by also using those cost of call termination reported by the other two mobile firms in the same regulatory process (Entel: ch$26.58 and Claro: ch$13.62 in average). It should be note that the significant differences in the reported costs of the three companies are due to the incentives that exist for larger companies to induce the regulator to set higher access charges; thus, hindering the growth of rivals. Therefore, we may trust more on the cost of call termination reported by Claro, the smallest firm of these three mobile companies, that on the one reported by the other two companies.

4. Since the parameter value of the externality γ is unknown, the calculations of the externality are checked for robustness using values between 0 and 1. It should be noted that a reasonable interval for this parameter may be between 0.5 and 0.8.[12] The relevant values of the table would, therefore, be those reported in bold.

According to the previous assumptions, Table 4 shows the values of the price differential arising from the competitive equilibrium for a company with a market share of 42% for the various values of γ (in the different rows) and of the cost of terminating calls (in the different columns).

This price differentials, which is summarized in equation (*), can be explained by three conceptually different elements. The most obvious is related to the difference that may exist for a given company between its cost of terminating a call on its own network and the cost of terminating a call on another company network. The latter value is given by the "access charge" and is regulated. An imperfect regulation, in which the access charge is set above marginal cost, partly explains the observed price differential. This element corresponds to the second part of equation (*), B.

The other two elements are related to the existence of call externalities. On one hand, the company, in a regulatory context of *calling party pays*, has an incentive to charge an on-net price below its cost, so that the total number of calls made by the customer is socially efficient. In other words, the company internalizes the externality. The incentive to set this price exists because it is possible to "recover" the loss for each call by charging the fixed tariff. It is important to highlight that this is not the case of predation with short-term losses that will be recovered in the future. It is simply a two-part tariff where the variable charge is set to maximize the utility of the subscribers and with the fixed

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[12] Harbord and Hoernig (2010) prepared a welfare analysis using the Hoernig (2010) model simulating different access charges and parameters of the demand function. In page 8, they refer to the externality parameter: "*The parameter measuring the strength of call externalities (β) is varied between five levels, from zero (i.e. no call externalities) to the maximal value of 1 (i.e. the receiving party receives the same utility as the sending party). Arguably, a value of at least 0.5 is realistic, even if we allow for some internalization of call externalities between individuals in stable calling relationships with one another.*" Moreover, in a recent study for Ecuador, Rojas (2015) estimate a call externality in 0,67.

charges it is possible to recover the "losses" and/or extract the consumer surplus. This element corresponds to the third part of equation (*), C.

Table 4. On-Net and Off-Net Price Differentials

Predicted by equation (*), $\alpha = 0.42$ and $a = $ ch\$69,1 per minute

Call Externality	Cost of Call Origination and Termination ($c_{ti} = c_{oi}$), in ch\$		
	45,4	26,6	13,6
0	24	43	55
0,1	41	55	64
0,2	58	68	74
0,3	76	81	85
0,4	96	97	97
0,5	**119**	**115**	**112**
0,6	**146**	**136**	**129**
0,7	**179**	**163**	**152**
0,8	**222**	**198**	**181**
0,9	281	247	223
1	370	320	286

Source: Author's calculations.

The last element is related to the existence of call externalities and the price of off-net calls. Since the company is unable to charge a fixed tariff to non-subscribers, there is no longer an incentive to charge an off-net price below the costs described in the previous paragraph (since it is unable to recover said loss). Hence, the off-net price should not be less than the access charge plus the cost of call origination. Furthermore, as subscribers of different networks consider not only the price of originating a call but also the number of calls they expect to receive in its subscription decision (logically, total calls received depend both on the on-net price of the chosen network and on the off-net price of other networks), each firm has an incentive to charge off-net prices above the perceived cost (access charge plus the cost of call origination), and thus reduce the rival network's attractiveness. A larger off-net price, *ceteris paribus*, increases the number of subscribers. This element corresponds to the first part of equation (*), A.

Clearly, the first two elements that explain the price differential respond to efficiency reasons that have nothing to do with anti-competitive behaviors (such as predation or any type). The third element is clearly more controversial: the incentive to increase the price of off-net calls to make the rival networks less attractive.

Is this anti-competitive? In terms of the equation (*), there are no arguments related to predation or to a strategy that seeks to prevent entry. It is a static model in which companies face the above-mentioned incentives that lead to this type of pricing policies.

Are the resulting prices efficient? The price of on-net calls is efficient while the price of off-net calls is clearly not. Price efficiency would require that the prices of both types of calls be the same and equal to the price of on-net calls in equilibrium. This value is lower than the marginal cost of calls; hence, it would be absurd to suggest that companies, who are profit-maximizing, freely set these prices.

A different (though certainly related) question that one may ask (and that the regulatory authorities should themselves ask) is: What is the optimal regulation? This can be stated more narrowly or more broadly. In the context of the *calling party pays* system, with access charges that are set using a long-term costs and pricing freedom criteria, is it desirable to have regulation that prevents on-net and off-net discrimination? In the context of the *calling party pays* system and pricing freedom, is it desirable to set access charges based on costs? Or is it better to have a scheme with access charges equal to zero or a bill and keep scheme? Or, even more general, is it optimal to have the *calling party pays* scheme?

The answers to these questions clearly exceed the scope of this work. We are interested in responding whether in the current regulatory context, the observed on-net price and off-net price differential is justified by reasons other than anti-competitive practices.

The model that supported equation (*) is static and, therefore it is not possible to perform a full analysis of predation. However, Hoernig (2007) does a simple extension of the model to partially address the issue of predation. This author is concerned about the prices in a context in which one of the companies aims to reduce the profits of the rival company (the model is developed for two networks, but their intuition is certainly general). More precisely, while a company behaves in equilibrium (Nash) maximizing its profits given the behavior of the other company, the latter company maximizes its profits given the behavior of the other company and also given an additional restriction: that in equilibrium the profits of the rival company do not exceed a certain value.

In other words, the model addresses the first stage of what would be a predation argument, without actually analyzing the feasibility of recovering any losses incurred (or, more generally, the optimality of predatory behavior in the long term). The results obtained by Hoernig (2007) are intuitive: to reduce the profits of the rival company, the "predatory" company increases the price of its off-net calls –this increase is more severe the greater is the reduction of profits that violates the other company–, while maintaining the efficient level of the price of on-net calls. Therefore, an on-net and off-net price differential, beyond that indicated in equation (*), is obtained.

Therefore, according to the above-mentioned arguments, it is possible to construct ranges or thresholds for price differentials, explained by efficiency reasons (parts B and C of equation (*)) or by reasons arising from the strategic interaction of the regulatory framework in which the companies operate (part A of equation (*)). Price differentials that exceed the sum of the previous elements should

worry competition authorities. According to Hoernig (2007), a possible explanation could be anti-competitive behavior such as predation.

Table 5 shows a decomposition of the price differentials predicted by equation (*), for different values of the externality that are between 0.5 and 0.8 (in the different rows) and for different values of the cost of terminating calls (in the different columns).

Table 5. Decomposition of the On-Net and Off-Net Price Differentials

Predicted by equation (*), α = 0,42 and a = ch$ 69,1 per minute

γ:	C_{oi}:	45,39			C_{oi}:	26,58			C_{oi}:	13,62		
	A	B	C	Δp	A	B	C	Δp	A	B	C	Δp
0,5	65	24	30	**119**	54	43	18	**115**	47	55	9	**112**
0,6	88	24	34	**146**	74	43	20	**136**	64	55	10	**129**
0,7	118	24	37	**179**	98	43	22	**163**	85	55	11	**152**
0,8	158	24	40	**222**	132	43	24	**198**	114	55	12	**181**

Source: Author's calculations.

For example, if the externality was equal to 0.6 and the actual cost of terminating calls is ch$26.58, then the following thresholds of price differentials could be defined:

- **Differential less than or equal to ch$63 is explained by efficiency reasons**: ch$43 for the difference between access charges and the costs of terminating calls (B) and ch$20 for reduction of the price-net to users with plans offset by the fixed charge of such plans, which occurs because of the call externalities (C).

- **Differential in prices between ch$63 and ch$136 is explained by efficiency and strategic interaction reasons among companies**: the previous two elements (B + C) plus the increase of the off-net price due to strategic interaction, caused by the call externalities (A).

- **Differential in prices above ch$143 should be regarded with suspicion by the competition authorities.**

These values are only examples since there is no evidence to state that the externality is 0.6 nor that the cost of terminating a call is around ch$26.58.

However, from Table 5 it is apparent that the sum of the second and third parts of equation (*) do not actually vary too much depending on the externality values and the relationship between the access charge and the cost of terminating calls. This sum is between ch$54 (the lowest call of termination and call externalities) and ch$67 (the highest call of termination and call externalities).

There is a large variation in the component associated with the difference between the off-net price and the cost of an off-net call (which is equal to the sum of the price of terminating a call and the cost of originating a call, a value that is generally believed to be identical to the cost of terminating a call). This value goes from ch$47 to ch$158 with the call externality being the major determinant of such variation.

Adding both effects, the critical value for the price differential that is not justified by efficiency or strategic interaction reasons between the companies is between ch$112 and ch$222 (if the assumption that the call externality is between 0.5 and 0.8 is valid).

After comparing these values with the results presented in the previous section in which the price differentials in the Movistar plans were analyzed, it is apparent that, in the case of business customers, most of these differentials are below ch$132. Thus, no plan threatens competition if the call externality is at least 0,6, but near 80% could be anticompetitive if the call externality is 0,5 or less (see Figure 14). The reason is that 82% of plans for business customers have a price differential between ch$114 and ch$132.

In the case of individual customers, Table 6 shows the distribution of plans by on-net and off-net price differentials. Based upon Table 5 above, if the call externality is at least 0,7, no more than 10% of discriminatory plans for individuals customer may be anticompetitive (dark area of Table 6). This percentage is even lower if the cost of call termination is the highest in the three considered in Table 6. However, if the call externality is 0,6, there are at least 31% percent of these discriminatory plans that may be considered anticompetitive (grey area in Table 6). Finally, if the call externality is the lowest possible according to our assumptions, 0,5, we can assure that only 45% of discriminatory plans offered to individual customers have on-net and off-net price differentials that can be explained by efficiency or strategic reasons. In such a case, 55% of the discriminatory plans should be considered as anticompetitive (in bold in Table 6).

In summary, since the threshold for price differential ranges from ch$112 to ch$222 and actual price differentials for individual customers has an important dispersion, where 80% of these plans are between ch$20 and ch$152, the conclusion whether Movistar is offering discriminatory plans for either efficiency and strategic reasons or for predatory practices depends upon the call externality parameter. On the one hand, if this parameter is equal or lower than 0,5, we can say that most plans are anticompetitive. On the other hand, if the call externality parameter is equal or above 0,7, most plans are competitive.

Table 6. Distribution of the On-Net and Off-Net Price Differentials

Interval (ch$ per minute)			Density Function	Cumulative Function
0	-	18	0,00	0,00
19	-	37	0,10	0,11
38	-	56	0,10	0,21
57	-	75	0,03	0,24
76	-	94	0,03	0,26
95	-	113	0,13	0,40
114	**-**	**132**	**0,16**	**0,55**
133	-	151	0,14	0,69
152	-	170	0,21	0,90
171	-	189	0,03	0,93
190	-	208	0,01	0,94
209	-	227	0,01	0,95
228	-	246	0,02	0,97
247	-	265	0,01	0,98
266	-	284	0,00	0,98
285	-	303	0,00	0,98
304	-	322	0,00	0,99
323	-	341	0,01	1,00
342	-	360	0,00	1,00
361	-	379	0,00	1,00
380	-	398	0,00	1,00

Source: Authors' calculations based on Figure 15.

5. CONCLUSIONS

This paper analyzes the economic rationality of the on-net and off-net price differentiation that the telecommunication companies incorporate in their plans. The literature (Hoernig 2010, 2014) predicts that if the companies charge two-part tariffs to its customers –which is quite normal in postpaid plans–, then price differentials between on-net and off-net calls are perfectly consistent with companies that maximize their profits. The arguments are threefold: i) it may be more expensive to provide the service when a call is placed to another network, particularly in the case of an access charge set above the cost of terminating a call by the regulator; ii) due to strategic interaction among rival companies, it is possible to charge below cost for on-net calls since it is recovered with the fixed charge to customers, and above cost for off-net calls; and iii) due to predatory strategies or strategies that seek to prevent the growth of small rival companies.

The first two arguments are not anti-competitive. The conclusion would be different if the question was about the efficiency of the differentiated pricing between on-net and off-net calls, resulting from those two arguments. Indeed, efficient resource allocation would require that the price of both types of calls be the same and equal to the equilibrium price of on-net calls. But this issue must be placed in the context of a challenge to the current regulation (*calling party pays* system with access charges that are set using long-term costs and pricing freedom criteria), or go beyond and resolve it within the comprehensiveness that would imply reviewing the regulation of this industry in Chile: Should the *calling party pays* system be maintained or should access charges be set based on costs? Since approaching the efficiency problem goes beyond our objective, this study focused on analyzing whether differentiated pricing between on-net and off-net calls are legal or not from a competition perspective, keeping as given the current regulation in the telecommunications sector in Chile.

In accordance with this objective, we analyzed the existing Movistar plans as at May 2010. It was found that only 6.5% of the customers with postpaid contracts subscribed to plans that differentiate between on-net and off-net minutes. It was found that the average on-net price is ch$11 and the average off-net price is ch$130, with the differences in 80% of plans ranging from ch$114 to ch$132 in the plans of businesses and from ch$38 to ch$170 in the plans of individuals.

This paper concludes with a calibration of the proposed theoretical model, checking for robustness by using different cost parameters and call externalities. For the parameter of the costs of terminating a call we choose the three alternatives estimated by the three major companies during the 2009-2014 regulatory process, all of them being lower than the finally regulated access charge for this period. For the parameter of the call externality we take four values from 0,5 to 0,8, considered the most reasonable ones by the literature. The critical value for the price differential that is not justified by

efficiency or strategic interaction reasons among companies is highly sensitive to the call externality parameter but not on the cost parameter. Hence, the threshold on the price differential ranges from ch$112 to ch$119 if the cost externality is 0,5; ch$129 to ch$146 if it is 0,6; ch$152 to ch$179 if it is 0,7; and ch$181 to ch$222 if it is 0,8. Consequently, from the plans with on-net and off-net price differentials observed for Movistar in May 2010, either for business and individual customers, most of them could be fully explained by efficiency (costs) and strategic interaction reasons among competitors if the externality cost is at least 0,7. On the contrary, if this parameter is 0,5, the lowest possible according to our assumptions, around half of this Movistar plans could be anticompetitive.

However, this result is not completely robust. By using price differential in discriminatory plans for Movistar, Entel and Claro, the three companies that operate the market, Agostini, Lazcano, Saavedra, and Willington (2016) find that between 40% and 67% are above the thresholds, for the call externality of 0.7 and 0.8. Such result is consistent with the one that we show in the appendix, in which we use marginal prices instead of average prices of each plan. Why the difference? Since our other work uses market data, all prices are not weighted by subscribers, which is the case in this paper.

Contrary to our analysis, which provides a policy recommendation in order to analyze whether each offered on-net and off-net plan is anticompetitive, the Competition Court determined in 2012 that the companies could no longer set different tariffs for on-net and off-net calls. The rationale for this court's decision is based on a cost-benefit analysis: the risk of anticompetitive practices is clear and a case by case analysis would require determine the value of the call externality, a key parameter in the model that had never being estimated before the Competition Court made its decision.

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APPENDIX. Differences in Marginal Tariffs in Movistar Plans

In the case of the differences in marginal tariffs between on-net and off-net minutes, contrary to the case of average tariffs, no additional assumption is required to find these estimates since each plan has an explicit price for every minute that exceeds the included minutes.

The histograms (Figures A1 to A6), followed by the kernel nonparametric estimates for the tariff differentials between on-net and off-net minutes for the existing plans in 2010 (Figures A7 to A12) are shown below. As in the previous analysis, both individual plans and business plans are considered; and the analysis is done separately by normal and low demand hours.

Important differences are found in the on-net and off-net marginal tariffs. In the case of the business plans, the tariff differentials are concentrated around ch$50 and ch$100, in both normal and low demand hours. In the case of the individual plans, the tariff differentials are concentrated from ch$110 to ch$190 in normal hours, and from ch$120 to ch$200 during low demand hours.

By using Table 5, it is easy to see that a high percentage of discriminatory plans that Movistar offered to individual customers have no explanation on efficiency and strategic interaction reasons. To show that, let us take the marginal price differentials at normal hours, whose probability functions are summarized in Table A1. We observe that if the call externality parameter is 0,5, then 39% of Movistar's discriminatory plans for individual customers are anticompetitive. This percentage falls only to 20% when the call externality parameter ranges from 0,6 to 0,8. The reasons to finding is that 15% of these plans have price differentials between ch$185 to ch$200, greater than most thresholds shown in Table 5. This result holds for low demand hours.

In the case of business customers, most results remains. That is, there is no anticompetitive discriminatory price differentiation for most call externality parameters.

Table A1. Distribution of the On-Net and Off-Net Price Differentials

(individual customers, marginal price differentials, Normal demand hours)

| Interval (ch$ per minute)			Density Function	Cumulative Function
9	-	24	0,00	0,00
25	-	40	0,02	0,03
41	-	56	0,02	0,06
57	-	72	0,01	0,08
73	-	88	0,07	0,19
89	-	104	0,11	0,35
105	-	120	0,18	0,61
121	-	136	0,10	0,77
137	-	152	0,02	0,80
153	-	168	0,01	0,82
169	-	184	0,00	0,82
185	-	200	0,10	0,97
201	-	216	0,00	0,97
217	-	232	0,00	0,97
233	-	248	0,00	0,97
249	-	264	0,00	0,97
265	-	281	0,00	0,98
281	-	296	0,02	1,00
297	-	312	0,00	1,00

Source: Authors' calculations based on Figure A2.

Figure A1. On-Net and Off-Net Marginal Tariff Differential Distribution

(All Plans – Normal Hours, weighted by the number of subscribers)
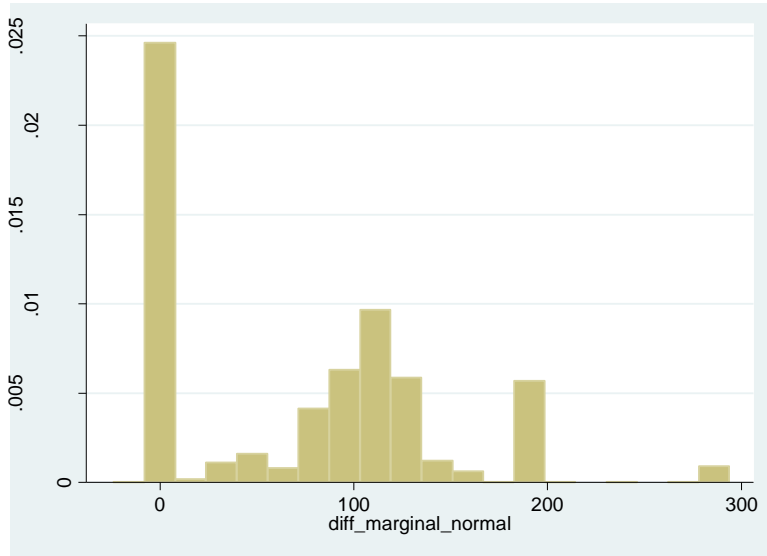
Source: Author's calculations.

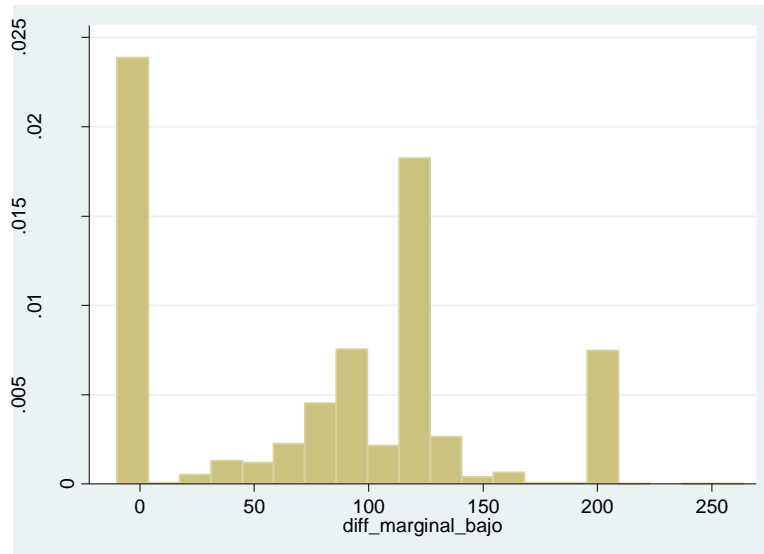**Figure A2. On-Net and Off-Net Marginal Tariff Differential Distribution**

(Business Customers – Normal Hours, weighted by the number of subscribers)
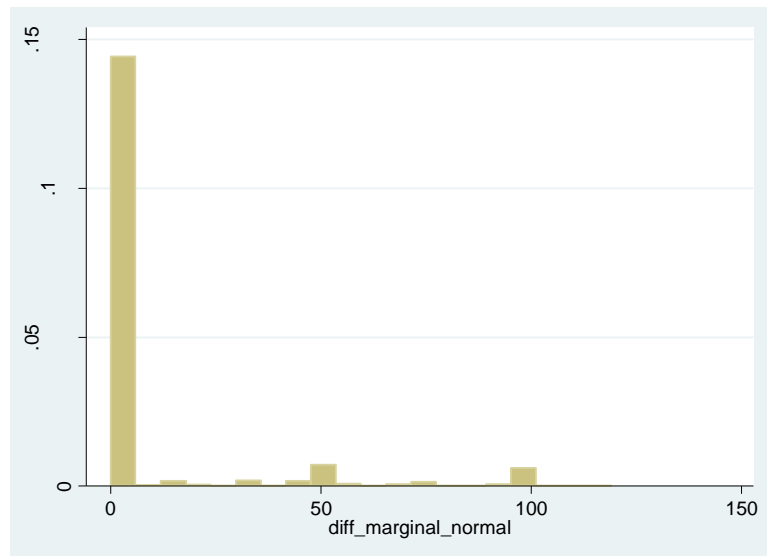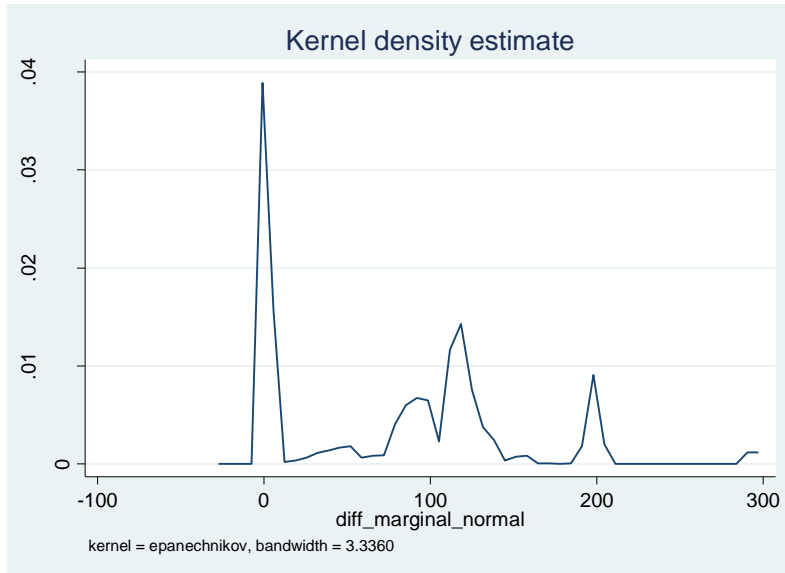

Source: Author's calculations.

Figure A3. On-Net and Off-Net Marginal Tariff Differential Distribution

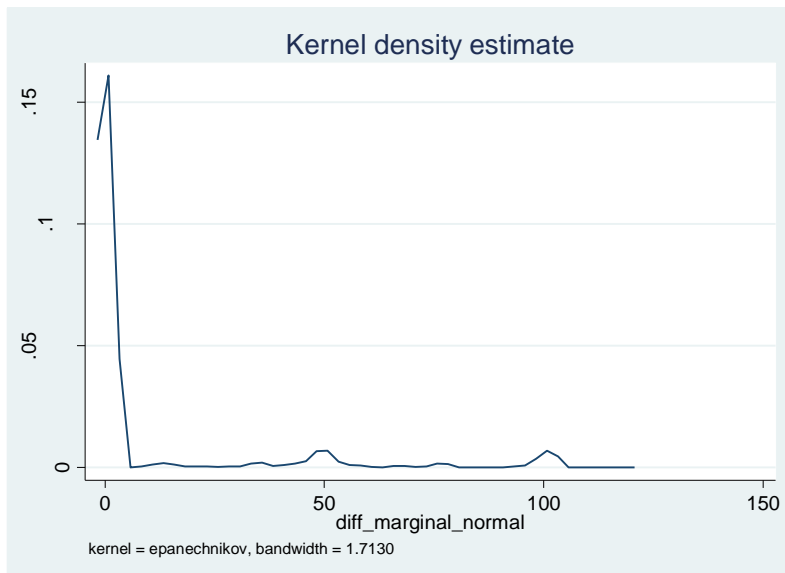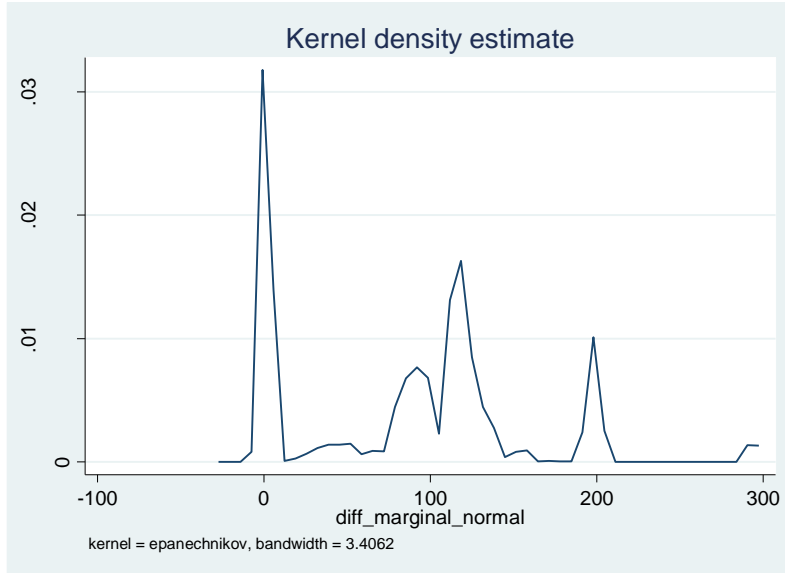(Individual Customers – Normal Hours, weighted by the number of subscribers)
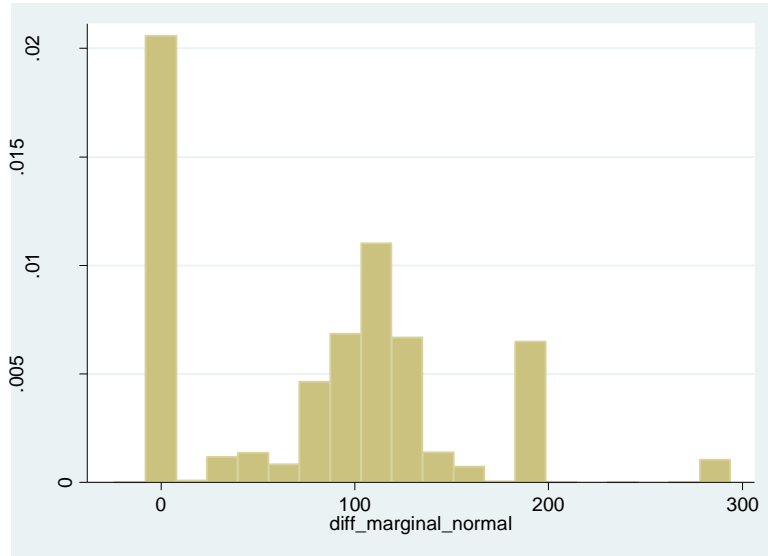
Source: Author's calculations.

Figure A4. On-Net and Off-Net Marginal Tariff Differential Distribution

(All Plans – Low Demand Hours, weighted by the number of subscribers)
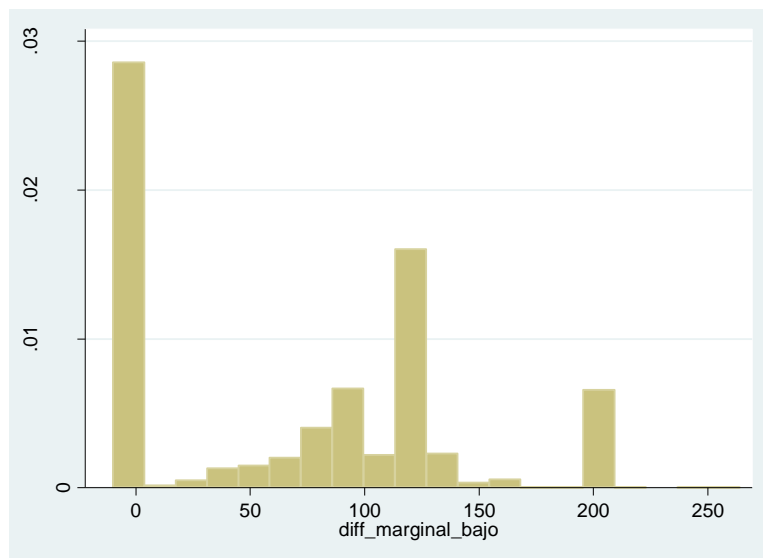
Source: Author's calculations.

Figure A5. On-Net and Off-Net Marginal Tariff Differential Distribution

(Business Customers – Low Demand Hours, weighted by the number of subscribers)
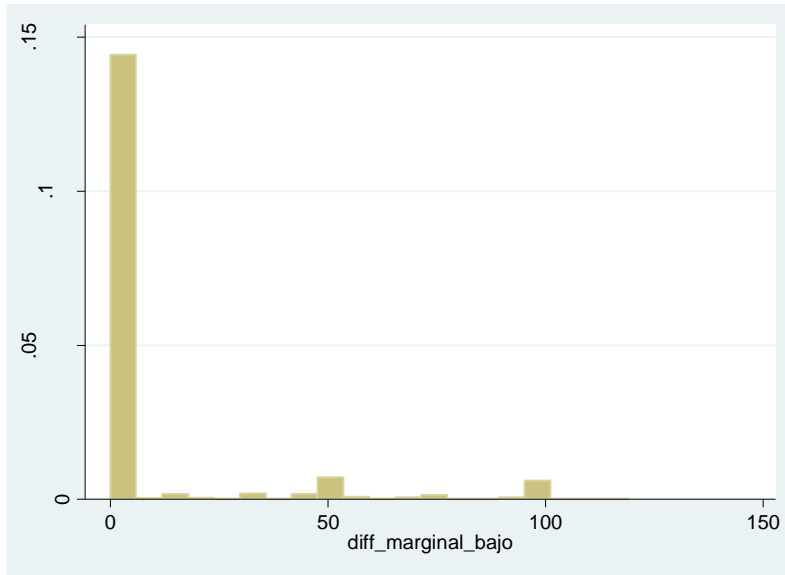
Source: Author's calculations.

Figure A6. On-Net and Off-Net Marginal Tariff Differential Distribution

(Individual Customers – Low Demand Hours, weighted by the number of subscribers)

Source: Author's calculations.

Figure A7. Estimations of the Marginal Tariff Differential Distribution

(All Plans – Normal Hours, weighted by the number of subscribers)

Source: Author's calculations.

Figure A8. Estimations of the Marginal Tariff Differential Distribution

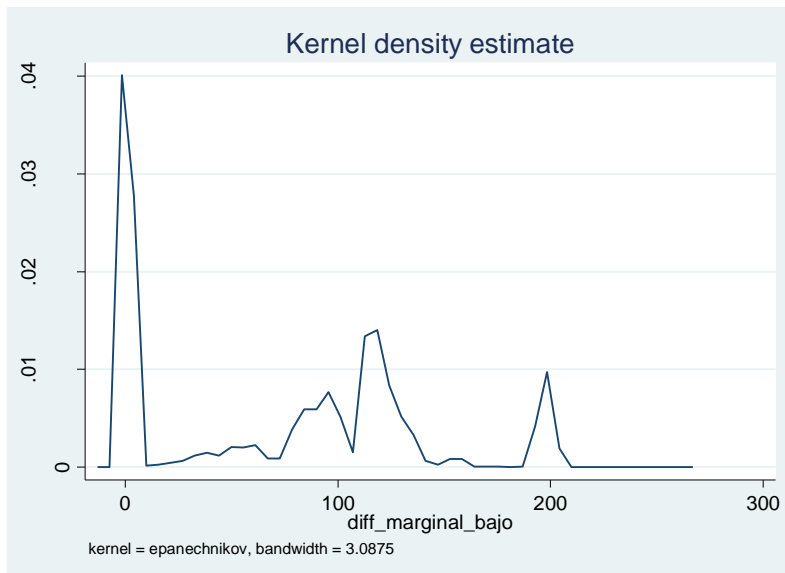(Business Customers – Normal Hours, weighted by the number of subscribers)

Source: Author's calculations.

Figure A9. Estimations of the Marginal Tariff Differential Distribution

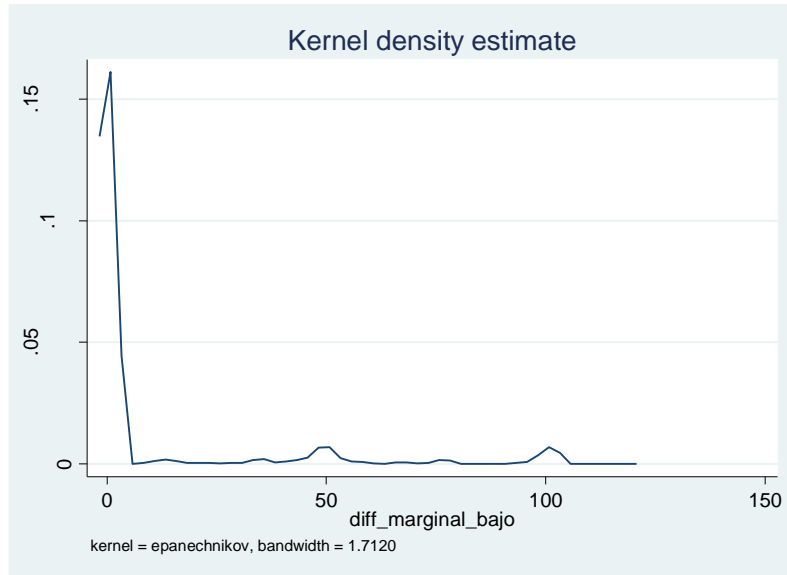(Individual Customers – Normal Hours, weighted by the number of subscribers)

Source: Author's calculations.

Figure A10. Estimations of the Marginal Tariff Differential Distribution

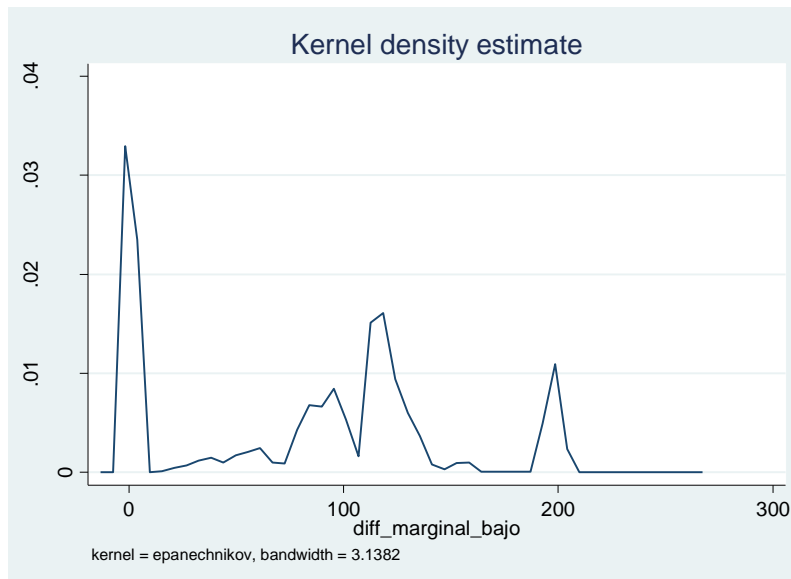(All Plans – Low Demand Hours, weighted by the number of subscribers)

Source: Author's calculations.

Figure A11. Estimations of the Marginal Tariff Differential Distribution

(Business Customers – Low Demand Hours, weighted by the number of subscribers)

Source: Author's calculations.

Figure A12. Estimations of the Marginal Tariff Differential Distribution

(Individual Customers – Low Demand Hours, weighted by the number of subscribers)

Source: Author's calculations.