THE BAN OF OFF-NET/ON-NET PRICE DISCRIMINATION IN CHILE†

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ABSTRACT

Chilean antitrust authorities banned termination-based price discrimination in mobile calls in 2012. This paper discusses the antitrust process that led to this prohibition and analyzes its merits. We characterize the discriminatory plans that the largest mobile company in Chile—Movistar—offered in 2010, when the legal dispute began, calibrate a competition model for the Chilean market—both for pre- and post-paid customers—and compare the observed price differentials with those which are justifiable on competitive grounds. The main result is that in most plans, efficiency and strategic reasons could explain the observed differential only for large call externality parameter values. We also discuss Competition Court rulings in the context of several other changes that affected the mobile telephony market in Chile and report the evolution of several key market indicators after the ban was introduced.

JEL: D43; L41; L51; L96

I. INTRODUCTION

Unlike any other industry, the telecomm sector in Chile has been under constant scrutiny by the antitrust authorities over the last 15 years. Several contentious and noncontentious cases have had deep effects on the sector's price structure and entry barriers. One of the Chilean Competition Court's (Tribunal de Defensa de la Libre Competencia, TDLC) main decisions in this context was the ban of off-net/on-net price discrimination, which we analyze in detail below.

The TDLC ruling was a secondary outcome of an antitrust suit between two mobile operators. In January 2010, Will S.A., a small local wireless telephony operator, filed a complaint before the TDLC accusing Claro Chile S.A., the third largest company in the industry, of predatory behavior.

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Beyond the details of this particular legal case, what is relevant in terms of competition policy is that, after rejecting Will's complaint against Claro (Ruling 110, 2011), the Competition Court decided to analyze the effects of on-net and off-net price differences in the Chilean telecommunications industry. As a result of this analysis, by 2012, the court determined that the companies could no longer set different rates for on-net and off-net calls and gave them 13 months to adjust the plans they offered (TDLC, Instrucción General N° 2, 2012).[1]

This paper's analysis considers additional theoretical and empirical evidence other than what the Competition Court considered, focusing on whether the discriminatory tariffs could be considered anticompetitive in the short-run and is complementary to the Court's, which recommended banning price discrimination based on dynamic competitive concerns.

Though on-net/off-net price differentials have potential anticompetitive effects, developments in the economic theory of access charges and competition in the telephony market provide more complex policy recommendations. The reason is that not all price differentials between on-net and off-net calls can be associated with anticompetitive practices or a reduction in the intensity of competition among firms in the market. To distinguish between competitive and anticompetitive cases, the potential distortion generated by the regulation (for example, access charges above the marginal cost of call terminations) and the strategic incentives generated by call externalities must be considered.

The theoretical analysis establishes the conditions under which on-net/off-net price discrimination can be considered anticompetitive (Hoernig, 2007, 2010, 2014). One key parameter is the call externality when someone receives a call. Thus, the question about the effects of this type of price differential on competition is an empirical one. For this reason, we perform an empirical analysis using data provided by Movistar, the largest company in the country, at the level of each postpaid contract and its most common pre-paid (linear) tariff.[2,3]

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[1] In addition to enforcing the competition law and punishing unlawful behavior, the TDLC has rule-making authority to issue industry-wide regulations, called "Instrucción General", and also to recommend specific legal or regulatory modifications to the government that would promote competition.

[2] The data provided by Movistar shows that, even though the majority—approximately 70 percent—of their mobile phone users are pre-paid customers paying a linear rate, they account for less than 20 percent of the company's revenues. Hence, both the pre-paid and the post-paid segments are relevant when analyzing potential anticompetitive behaviors. We analyze both segments, though the empirical analysis of the pre-paid segment is, in practice, much simpler since over 90 percent of the pre-paid customers paid the same tariff.

[3] There are two different types of on-net and off-net price differentials in the case of post-paid contracts. In the first, the number of "free" minutes (that is, included in the monthly fee) for calls within and outside the network can differ. In the second, the price of the minutes that exceed those included in the plan may differ depending on the receiving network. Throughout the paper, we refer to the first type as the average tariff differentials and to the second as the

More specifically, we calibrate the theoretical models of competition in linear and nonlinear prices (Hoernig, 2010, 2014) using data from the largest company in the Chilean market at the time the antitrust authorities began their inquiries. Our findings indicate that the observed price differentials can be consistent with short-term competitive incentives, as long as the externality parameter is larger than 0.8 in the case of nonlinear tariffs and 0.67 for linear tariffs.

We also discuss the Competition Court rulings in the context of several other changes that affected the Chilean mobile telephony market. For this, we look at the evolution of several key indicators that point to a more competitive landscape since the ban was introduced. Despite this, it is not possible to disentangle the effect of the ban on price discrimination from the effects of the number portability, access charge reduction, and unbundling regulations that were introduced in the same years.

A. Literature

The policy of banning termination-based price discrimination has been considered and/or implemented in several countries in Latin America (Rojas, 2015), and the anticompetitive concerns of allowing discrimination have been recognized in the literature (Hoernig, 2007; Armstrong and Wright, 2009). However, few papers have attempted to empirically assess the welfare effect of this policy.[4] Rojas (2015) develops a simple model for linear prices and analyzes the short-term welfare effects of the ban in Chile, finding that aggregate effects were negative as a result of an increase in producers' surplus and a larger decline in consumer surplus. Harbord and Hoernig (2015) analyze the welfare effects of reducing mobile termination rates in the United Kindom, and the likely effects of the Orange/T-Mobile merger but do not address the issue of banning off-net/on-net price discrimination. Hoernig (2008) analyzes different regulatory interventions (among them the reduction of access charges and banning on-net/off-net price discrimination) and concludes that, in the short run, all measures that may increase efficiency would reduce consumer surplus. Hoernig et al. (2014) analyze the welfare effect of banning discrimination in the context of calling clubs, finding an ambiguous effect on consumer surplus.

Previously, in Agostini et al. (2017), we consider the theoretical model developed by Hoernig et al. (2014) to analyze termination-based price discrimination. The analysis is restricted to the post-paid segment without considering information on usage, which prevented determining whether marginal or mean tariff discrimination was more relevant and limits the robustness of the

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marginal tariff differentials. Our dataset shows that the second one is the most relevant in the case of Movistar's customers.

[4] Most of the literature have focused on the regulatory question of how optimal termination charges (or access charges) are affected when termination-based price discrimination is allowed (see Agostini et al., 2017, for a review of this literature).

conclusions. The results show that the observed price differentials in the post-paid segment for the three main firms in the market were consistent with strategic interaction among firms, if the externality parameter was between 0.5 and 0.8.

The analysis and results in this paper are complementary in several dimensions and further contribute to understanding the effects of price differentials based on network destination. First, the analysis in this paper includes information on usage, allowing us to distinguish the relevance between marginal tariffs and average tariffs. Second, we use a completely different dataset containing more detailed information about all pre-paid and post-paid plans, including usage, for the largest firm (Movistar) at the time when the antitrust case started in 2010. The data suggest that marginal tariff discrimination is particularly relevant, a conclusion that was not available before. [5] Third, in this paper, we consider the Hoernig (2010) model to analyze the pre-paid segment (linear tariffs), which is calibrated to analyze whether observed on-net/off-net price differentials are consistent with competition. Interestingly, the results show that for externality parameter values over 0.67, the observed price differentials are consistent with competition. This finding is fully consistent with the previous finding in Agostini *et al.* (2017), providing robustness to those results, and it is also consistent with the results for post-paid plans in this paper.

Section 2 of this paper describes the main issues argued in the *Will v Claro antitrust* case and the noncontentious case that followed. Section 3 discusses the main features of Movistar pre- and post-paid plans, estimating the distribution of fixed charges for the latter, in addition to 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. This model is suitable for the mobile telecommunication market in Chile and 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 a competitive market. In Section 5, we also discuss several other antitrust or regulatory changes that affected the mobile industry in Chile and show how it has evolved over the last 15 years. We present our conclusions in Section 6.

II. THE ANTITRUST CASE AND THE GENERAL INSTRUCTIONS OF THE COMPETITION COURT

In 2010, the wireless residential telephony operator Will accused Claro of anti-competitive conducts through the use of differentiated prices for on-net and off-net calls. More specifically, Will claimed that Claro's price discriminated between its customers and Will's customers and that the on-net prices were

[5] As we discuss below, the calibration exercise is somewhat different as well.

predatory. Will considered that Claro's on-net prices were below cost and, therefore, predatory, because they were lower than the access charges set by the regulator. As a result, Will could not offer its customers a price as low as Claro's prices because it had to pay the access charge to Claro for each call terminated in its network. Will also claimed that the goal of this behavior was to increase Claro's dominant position and creates an artificial barrier to prevent the entry of new competitors.

Claro argued that the pricing policy reflected the fact that customers from other firms had to pay access charges for calls to Claro customers, while calls between Claro customers did not have to pay access charges. In addition, Claro allegedly did not have market power or exercise dominance because it had, on average, a 17.5 percent market share during the period of the alleged anticompetitive behavior. In its analysis of the case, the Competition Court defined the relevant market as "public telephony" in Chile, where operators of fixed and mobile telephony compete by offering "access and use."

Thus, the Court considered that even though Claro and Will customers used Claro's network when calls terminated in its network, the two differed in terms of the revenue they generated for Claro and also with respect to the resources and infrastructure used. For that reason, price discrimination could not be considered anticompetitive in this case.

With respect to the predatory pricing allegations, the Court determined that there was no evidence of on-net calls that were being priced below cost. Furthermore, it would have been very difficult for Claro to recover the losses incurred due to predatory pricing given its relatively low market share and the fact that there were two larger firms in the market. For all these reasons, the Competition Court dismissed the case and found Claro not guilty of anticompetitive behavior.

The Court opened a formal noncontentious procedure to analyze the effect of on-net/off-net pricing policies in the market as a result of the *Will v Claro case*. Its main objective was to determine whether there was merit to issue an industry-wide regulation (Instrucción General) to be applied in the market to promote competition and/or prevent anticompetitive behavior.

The Court analyzed the level of on-net and off-net prices both for pre-paid and post-paid contracts,[6] finding large price differentials in both segments. In the pre-paid segment, around 75 percent of customers faced discriminatory tariffs and generated around 88 percent of pre-paid traffic. The observed off-net price was, on average, 3.3 times higher than the on-net price. In additional, the observed average price differential was 3.4 times the regulated access charge.[7] This last figure is relevant to the analysis, as the Court considered

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[6] In 2012, pre-paid customers represented around 70 percent of all clients. In terms of revenue, however, the relative importance of the two market segments is reversed.

[7] See Table 4 in TDLC (2012) for detailed figures. This table also shows that the price differentials were approximately 33 percent larger for the two largest companies.

that only price differentials consistent with cost differentials were reasonable. Therefore, the access charge should be considered a cap on price differentials.

In the case of post-paid contracts, the analysis is more complex. Post-paid contracts can implement price discrimination in two different dimensions: by including a different number of on-net and off-net "free minutes" (that is, minutes that are included in the monthly fixed fee), and/or by setting different per-minute prices for those minutes in excess of the free ones (one or the other may be relevant, depending on the subscribers' actual level of use versus the free minutes included). The Court's descriptive analysis shows that both types of discrimination are prevalent, and it is particularly strong for the two largest companies in the dimension of "free" minutes.

When looking at the evolution of on-net and off-net price differentials, the Court noticed that they remained quite stable between 2008 and 2011, despite the fact access charges were cut by 28 percent in 2009. The on-net/off-net price discrimination clearly has the effect of discouraging calls to customers of other companies. In fact, while on-net minutes grew 259 percent between 2007 and 2011, off-net minutes were stagnant.

The Court also considered that the difference between on-net and off-net prices could increase the dominant position of larger firms, reducing the degree of competition among them, and could also pose an entry barrier for new firms, as they would face difficulties attracting customers.[8] Though the Court mentioned the existence of a positive externality that could lead to a higher off-net price than the on-net one, it argued that large firms could still potentially use that differential to create switching costs and prevent the entry of new competitors.

The Court concluded that, with the goal of protecting competition and given the potentially exclusionary effects of the on-net/off-net price differential, differential should not exist. Consistent with this line of reasoning, in 2012, the Court issued an industry-wide rule establishing the reduction of the price differential between on-net and off-net calls to a maximum equal to the regulated access charge until 2013. Starting in 2014, no firms could offer plans with differentiated prices for on-net and off-net minutes.

III. EMPIRICAL ANALYSIS OF MOVISTAR PLANS

There were 2,550,546 Movistar mobile telephone customers with postpaid contracts in May 2010, distributed in 3,687 different plans (2,342 for

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[8] This conclusion is consistent with a previous opinion expressed by the same Competition Court in 2009, when local telephony in Chile was liberalized. At that time, the Competition Court was not wholly convinced that the on-net/off-net price differentials were consistent with competition. The Court argued the following in its sentence: "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 further." (Judgment 2, 2009, p. 59).

Table 1. Classification of plans depending on the type of on-net/off-net price discrimination

	Individual customers		Firms	
	% minutes	**% mobiles**	**% minutes**	**% mobiles**
% only marginal tariff discrimination	47.7	48.4	13.2	14.0
% only average tariff discrimination	0.9	0.8	0.0	0.0
% both	31.6	18.9	0.0	0.1
% none	19.8	31.9	86.8	85.9

Source: Authors' calculations.

individuals and 1,345 for small- or medium-size enterprises).[9] The vast majority of plans had few customers: 89 percent of the plans had fewer than 692 customers, which is the average number of customers per plan. On the contrary, just 16 percent of customers subscribed to just five plans. This skewed distribution highlights the need for weighting by the number of subscribers (or by traffic) to have a meaningful description in terms of off-net/on-net price differentials.[10]

An important aspect to consider when analyzing the difference between on-net and off-net tariffs is whether marginal tariffs (that is, the price charged for the calls exceeding the minutes included in the plan) or the average tariffs (the implicit tariffs in the minutes included in the plan) are the most relevant for consumers. If the vast majority of customers generally use only the minutes included in their plans and do not routinely exceed them—or it is a small amount when they do, then the relevant differential to analyze is the one on the average tariffs implicit in the plan. However, if customers consistently exceed the minutes in their plans, then the relevant differential corresponds to the marginal tariffs. One of the advantages of the dataset we use for the empirical analysis is that it allows analyzing these issues in detail.

Table 1 presents information on how ubiquitous the two types of price discrimination are (we weight by traffic and number of mobiles). As can be seen in Table 1, the on-net/off-net price discrimination is far more common for individual plans than for businesses plans (68 vs. 14 percent) and the marginal price discrimination is more pervasive than average price discrimination, as there is a relevant fraction of plans that discriminate only in marginal prices (first row) and very few plans that discriminate only on average tariffs (second row).

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[9] Many of the 3,687 plans differ only in "name" as coded by Movistar. The number of different plans is less than a thousand.

[10] Pre-paid tariffs were much simpler for Movistar. As reported by the Court, the three largest pre-paid plans (which had around 90 percent of the total pre-paid customers) had identical tariffs: $Ch264 for off-net calls and $Ch66 for on-net calls.

Figure 1 complements the above table by showing the distribution of on-net and off-net marginal prices for individual and corporate plans separately. The distributions are based only on plans that discriminate in the marginal tariff (that is, those corresponding to rows 1 and 3 in Table 1) and are weighted by the total number of subscribers.[11] Important differences are found between the on-net and off-net marginal tariffs. In the case of the individual plans, the average (median) marginal tariffs are Ch$73 (66) and Ch$196 (186) for on-net and off-net calls, while for corporate plans, these figures are Ch$60 (42) and Ch$121 (126).[12] To have a sense of what these values mean, consider that the access charge was set to Ch$66 in the 2009 regulatory process.[13,14]

Though marginal price discrimination is prevalent and quite significant, we must also analyze whether customers regularly exceed their "free" number of minutes included in their plans to assess its empirical relevance. Otherwise, marginal tariffs would be irrelevant.

To address this issue, we have administrative data with information on the average number of minutes originated by customer for each plan. The data show that on average, customers exceeded their "free" on-net minutes in 43.7 percent of the total number of individual plans that discriminate. This figure is 59.2 percent for off-net "free minutes." Moreover, the figures are 70 and 73.7 percent when weighted by number of mobiles phones. In the case of corporate customers, the numbers are even higher. Figure 2 provides histograms for the average number of exceeded on-net and off-net minutes for individuals and corporate plans.

One can conclude from the preceding analysis that the marginal on-net/off-net price differential is not only prevalent among mobile plans but also that

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[11] We focus mainly on marginal price discrimination although we also report average price discrimination. The case of discrimination on average prices is not straightforward to address. Plans include a different number of "free" on-net and off-net minutes, but it is not obvious how to put a per-minute price on each one for two reasons. First, the fixed charge covers not only the cost of those free minutes but also other fixed costs (for example, billing, etc.), and we lack information to impute a fraction of the total fixed charge to the free minutes. Second, even if we knew the share of fixed costs corresponding to the "free" minutes, we would need to allocate a fraction of that cost to off-net calls and the remaining to on-net calls to obtain per-minute prices. But again, this allocation would be arbitrary and the price differential will be directly determined by this decision. In Appendix A, we show average mean prices under two simplifying assumptions: associating the whole fixed charge to the "free" minutes and assuming that half of it covers on-net calls and the other half all off-net calls (see Figure A.1).

[12] The reported values do not vary significantly if we weight by traffic rather than subscribers. All figures are based on normal-hour tariffs, which represent more than 70 percent of the traffic.

[13] Access charges are set every 5 years, following an administrative procedure that tries to approach the marginal cost of terminating a mobile call in the network of an economically efficient hypothetical firm that starts from scratch, considering the available technologies and the Chilean market characteristics.

[14] The exchange rate in May 2010 was 533 Chilean pesos per U.S. dollar.
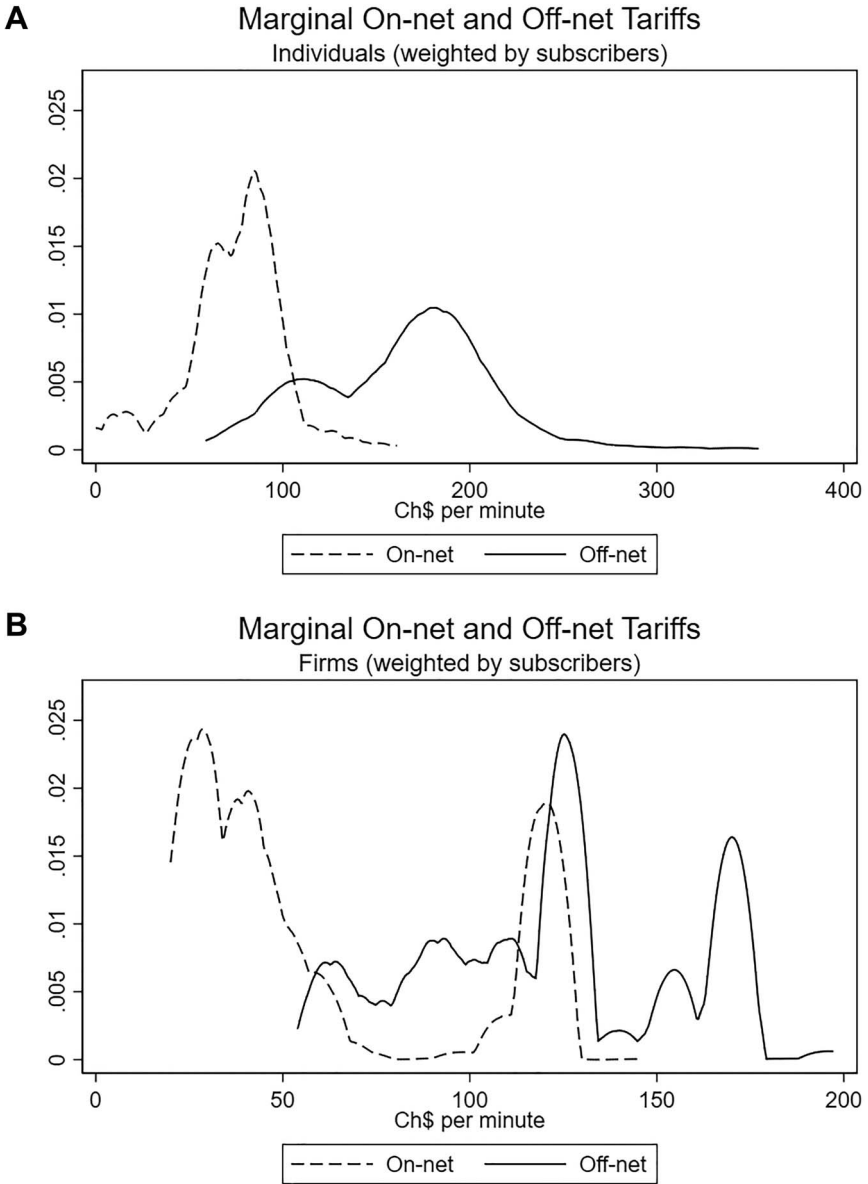
A

B

Figure 1. On-net and off-net marginal tariff distribution (individuals and firms). *Source*: Authors' calculations.

the difference between marginal tariffs is the empirically relevant one, since a significant share of customers exceeds the minutes included in their plans.

We conclude this section showing the distribution of off-net/on-net price differentials for firms and individual customers in Figure 3. For individual
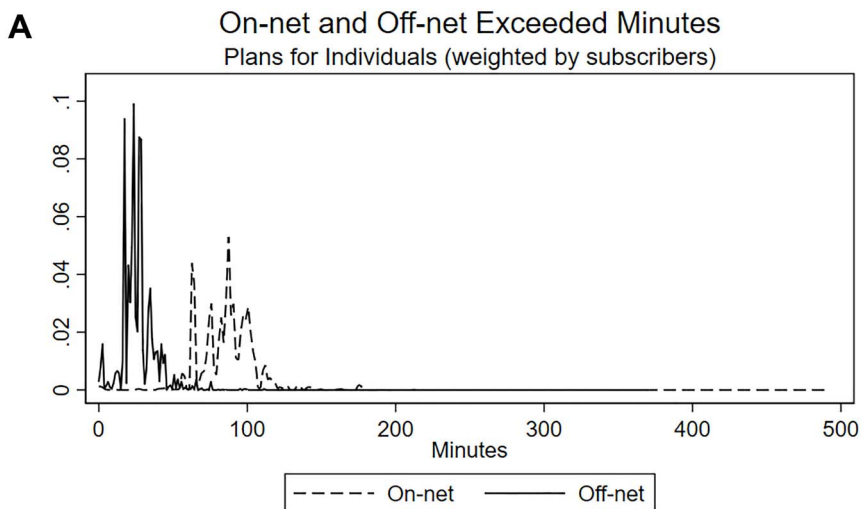
A

On-net and Off-net Exceeded Minutes
Plans for Individuals (weighted by subscribers)

Only plans that discriminate on marginal tariffs and whose customers on averge exceed its free minutes.
70.8% for on-net calls and 74.4% for off-net calls
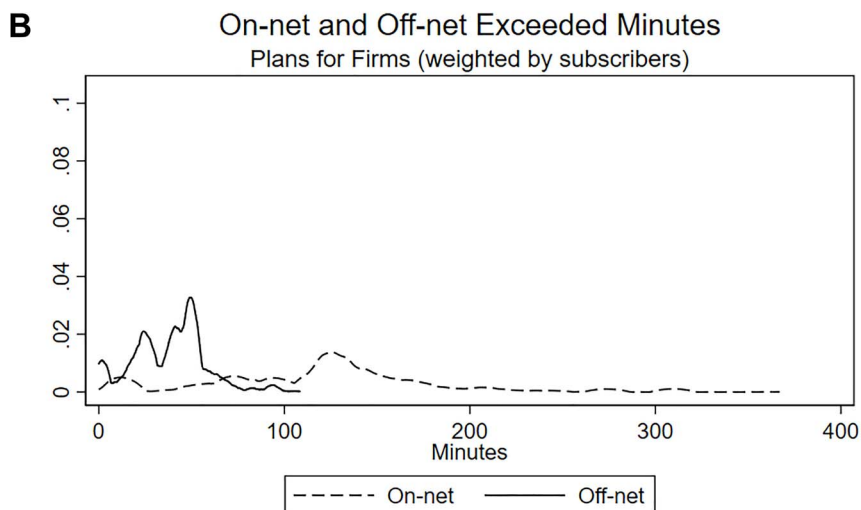
B

On-net and Off-net Exceeded Minutes
Plans for Firms (weighted by subscribers)

Only plans that discriminate on marginal tariffs and whose customers on averge exceed its free minutes.
74.3% for on-net calls and 74.3% for off-net calls

Figure 2. On-net and off-net minutes in excess of "free" minutes (individuals and firms).
Source: Authors' calculations.

plans, the average (median) price differential is Ch$122 (115), and for business plans, it is Ch$61 (50).[15]

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[15] In Figure A.2 in the Appendix, we show a similar graph for the distribution of average price differentials under the assumptions discussed in footnote 6.
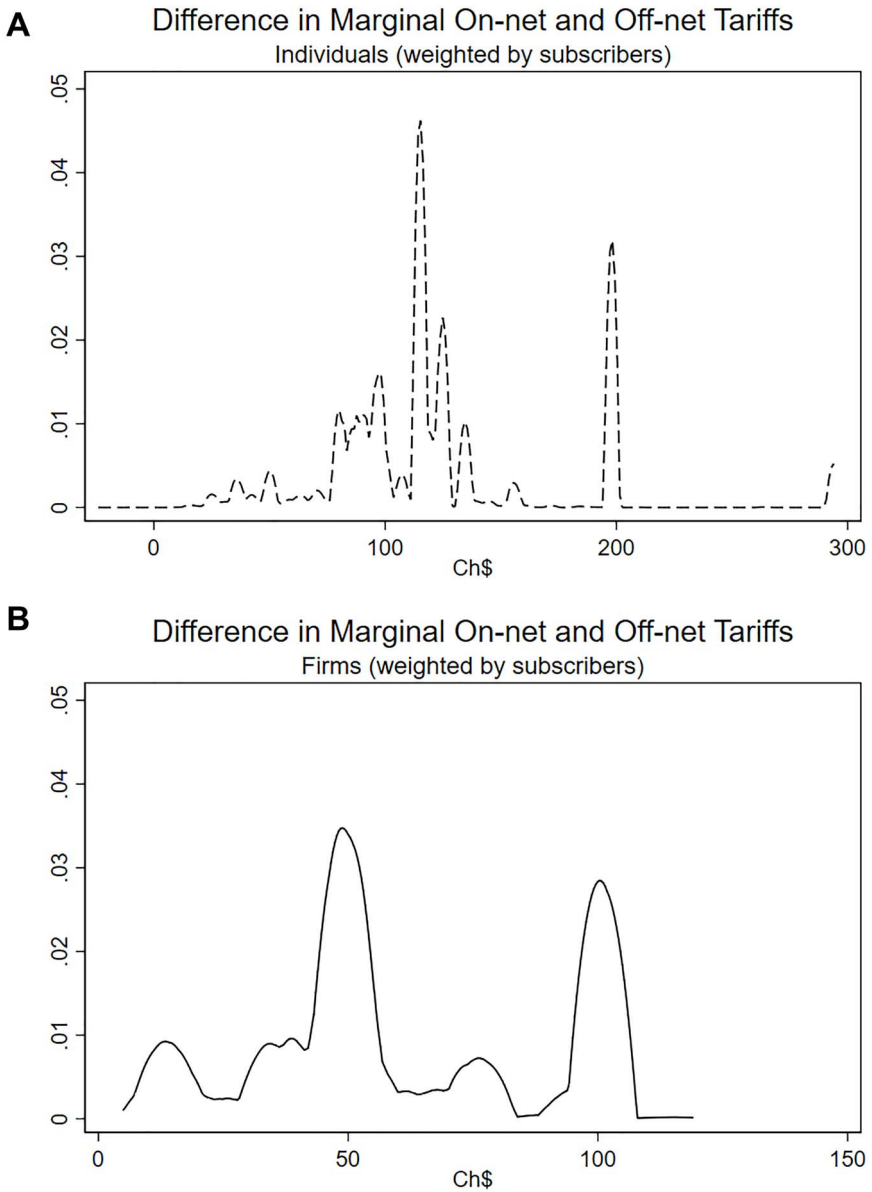
A

Difference in Marginal On-net and Off-net Tariffs
Individuals (weighted by subscribers)

B

Difference in Marginal On-net and Off-net Tariffs
Firms (weighted by subscribers)

Figure 3. Distribution of off-net/on-net price differences (individuals and firms).
Source: Authors' calculations.

After presenting the economic model, we analyze whether the existing price differentials can be considered anticompetitive or whether they can be explained by strategic interaction and regulatory considerations.

IV. ECONOMIC ANALYSIS

A. Nonlinear Tariffs

The literature describes several models for assessing strategic interaction in telecommunication networks. Among them, the model used in Hoernig *et al.* (2014)—which extends the model of Berger (2005) and Jeon *et al.* (2004)—has the advantage that it does neither limit the application to two competing networks nor does it require that the size of the networks be symmetric.

The model is one of differentiated firms *a-la* Hotelling where, given the access charge, firms simultaneously choose nonlinear tariffs—which include a fixed charge and per-minute prices for on-net and off-net calls—and consumers then choose which network to subscribe to. A key factor of the model is that it considers the possibility that customers obtain utility not only from the calls they originate but also from the ones received. This is captured by an externality parameter, which is assumed to have a value between zero and one.

The key result of the Hoernig *et al.* (2014) model for our purposes is the following equation that characterizes the off-net/on-net equilibrium price differential:

$$p_{ij} - p_{ii} = \left(a_j - c_{t,i}\right) + \left(c_{ii} - \frac{c_{ii}}{1+\gamma}\right) + \left(\frac{c_{ij}}{1 - \frac{\gamma\alpha_i}{(1-\alpha_i)}} - c_{ij}\right) \quad (1)$$

where p_{ij} is the price of calls originated within the network i and terminated on the network j; p_{ii} 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 the marginal cost of an off-net call to the firm j; 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 (for each call received, individuals obtain a proportion γ, between zero and one, of what they get for each call originated).

The price difference, summarized in equation (1), can be explained by three conceptually different elements. The most obvious one is related to the difference that may exist for a given firm between the cost of terminating a call on its own network and the cost of terminating it on another network. The latter value is given by the access charge and is set by the regulator. A cost-based regulation, in which the access charge is set close to the average cost and above the marginal cost, partly explains the observed price differential. This element corresponds to the first term of equation (1), A.

The other two elements are related to the existence of call externalities; they are zero if the externality is zero. In a regulatory context of calling party pays and with two-part tariffs, a firm has the incentive to charge an on-net price that is below its cost so that the total number of on-net calls made by the customer is

socially efficient. There is an incentive to set this price because it is possible to "recover" the loss for each call by charging a higher fixed tariff. It is important to highlight that this is not a 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 market share and the fixed charge is used to recover the "losses" and/or extract the consumer surplus. This element corresponds to the second term of equation (1), B.

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 subscribers of other companies, there is no incentive to charge an off-net price below costs as described before. Hence, the off-net price should not be less than the access charge plus the cost of call origination. Furthermore, as customers of different networks consider not only the price of originating a call but also the number of calls they expect to receive in their subscription decision—which 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 to reduce the rival network's attractiveness. A larger off-net price, *ceteris paribus*, increases the number of own customers. This element corresponds to the third part of equation (1), C.

Clearly, the first two elements that explain the price differential correspond to efficiency reasons that are unrelated to any potentially anticompetitive behavior (such as predation, for example). The third element is clearly more controversial: the incentive to increase the price of off-net calls is to make rival networks less attractive to consumers.

Is this anticompetitive? In terms of equation (1), there are certainly no arguments related to predation or to a strategy seeking to prevent market entry. It is a static model, with no threat of potential entry, in which companies face the abovementioned incentives that lead to this type of pricing policies. However, it is still true that the reason for raising off-net prices is to hurt rivals and the incentive is larger for larger networks. Moreover, discrimination may be challenged on efficiency grounds. 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 ($c_{ii}/(1 + \gamma)$). This value, however, is lower than the marginal cost of calls; hence, it would be absurd to expect profit-maximizing companies to set these prices.

Next, we perform a calibration exercise to determine how the observed off-net/on-net price differentials compare to equation (1). For this, we consider an access charge of Ch\$66 (the weighted average access charge per minute[16],

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[16] 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 off-net calls of Movistar post-paid customers during the month of November 2010.

a 44 percent market share for Movistar, and we assume that the cost of initiating a call is equal to the termination cost.

The two main obvious calibration challenges are that the externality parameter is unknown and that we cannot observe the cost of originating and terminating calls. Regarding the latter, the access charge can be considered an upper bound of the true cost; therefore, we perform sensitivity analyses around this value.

In terms of the externality, its theoretical value should be between zero and one. In the literature, a few authors have attempted to further restrict this range. Harbord and Hoernig (2015) simulate a welfare analysis considering different access charges and parameters of the demand function. They refer to the externality parameter as: "The parameter measuring the strength of call externalities 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." Rojas (2015) follows Harbord and Hoernig (2015) and considers a call externality of 0.5 in his simulations. Rojas (2017), on the other hand, estimates the value of the call externality empirically based on an experiment in Ecuador, finding mean values of 0.67 and 0.41 for on-net and off-net calls, respectively.[17] Moreover, he finds that the call externalities are larger for pre-paid customers (0.79 and 0.45 for on-net and off-net calls, respectively) than for post-paid clients (0.27 and 0.29). For their part, Hurkens and López (2012) consider values in the [0, 0.8] range in their simulations but argue that values in [0.1, 0.3] range seem more plausible. Moreover, when they calibrate the externality value—given the observed off-net/on-net price difference—they find a value of 0.07.

To determine the reasonable values of γ, we consider the on-net price equation $p_{ii} = c_{ii}/(1+\gamma)$. Interestingly, this equation is valid in the competitive setting of Harbord and Hoernig (2015), but also if a firm is attempting to predate other firms (Hoernig, 2007). Therefore, γ can be directly obtained from the previous equation if we observe the on-net price and the termination cost. In our simulations, we use the average on-net marginal price (Ch\$72) and consider a range of call termination costs between Ch\$36 and Ch\$66 (that is, the regulated access charge).

Table 2 shows the results of the simulation. Given fixed (and observed) values for the on-net price (Ch\$72), the access charge (Ch\$66), and Movistar's market share (44 percent), we consider different values for the call termination cost and use $p_{ii} = c_{ii}/(1+\gamma)$ and equation (1) to infer the call externality value, the off-net/on-net price differential, and the maximum value of off-net call that could be explained by the model.

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[17] Note that Harbord and Hoernig's model considers a unique value for the call externality.

Table 2. Calibration results (predicted by equation (1), $\alpha = 0.44$)

On-net price	Access charge	Call termination cost	Call externality	Off-net/on-net price differential				Off-net max price
				A	B	C	Total	
72	66	66	0.83	0	30	126	156	228
72	66	61	0.69	5	25	74	104	176
72	66	56	0.56	10	20	44	74	146
72	66	51	0.42	15	15	25	55	127
72	66	46	0.28	20	10	13	43	115
72	66	41	0.14	25	5	5	35	107
72	66	36	0.00	30	0	0	30	102

Source: Authors' calculations.

Is it possible to argue the existence of potentially anticompetitive behavior from Table 2? Though the model that supports equation (1) is static and, therefore, it is not possible to perform a full dynamic analysis of predation, Hoernig (2007) extends his model to partially address this issue. He considers the Nash equilibrium of a game where one firm is self-constrained to keep the profits of the other firm below a certain value (logically, lower than in the unconstrained equilibrium). He finds that the optimal way to reduce a rival's profit is by increasing the off-net price, reducing the fixed fee, and keeping the on-net price at the efficient level (see Remark 7 in Hoernig, 2007). The off-net/on-net price differential is therefore increased.

In other words, the model addresses the first stage of what would be a predation model, without analyzing the feasibility of recovering any losses incurred later on (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 a rival firm, the predatory firm increases the price of its off-net calls—this increase is more severe the greater the desired reduction of profits inflicted on the other company is—while maintaining the efficient level of the price of on-net calls. Therefore, an on-net/off-net price differential beyond what is indicated in equation (1) is obtained.

In sum, one can argue that price differentials are justifiable by efficiency reasons (parts A and B of equation (1)) and by the strategic interaction among firms (part C of equation (1)). Price differentials that exceed the sum of the previous elements should worry antitrust authorities. According to Hoernig (2007), a possible explanation could be an anticompetitive behavior like predation.

When we look at Movistar plans, the median difference between marginal prices is Ch$115 for individual plans and Ch$50 for business plans (when considering only the plans that discriminate in marginal tariffs), as can be seen in Figure 3. When comparing these values with Table 2, it is safe to say that the level of price discrimination for corporate plans can be explained by competition for reasonable values of the externality parameter (for example,

values above 0.50). In the case of individual plans, only values close to 0.8 would justify the price differential on competitive grounds.

B. Linear Tariffs

Models of competition in linear prices that explicitly consider the role of call externality are scant. Berger (2004) focuses on the optimal regulation of access charges and their role as a potentially collusive mechanism. The model consists of two symmetric networks and its graphical analysis shows that off-net calls will be priced above on-net calls in equilibrium when access charges are set at marginal costs or when firms agree on an access charge. Moreover, the price differential increases as access charges do.

For his part, Hoernig (2007) considers a model with two (ex-ante) asymmetric networks. The results show that off-net Lerner indexes for both firms will be larger than the corresponding on-net indexes if the access charge is set at or above the call termination cost. Moreover, if firms have similar costs and set a similar on-net price, the larger firm will choose a larger off-net/on-net price differential. The intuition is similar to the nonlinear case: by raising off-net prices (from the price level that would be set if the externality were zero), a firm improves its competitive position by making the rival network less attractive, as its customers would receive fewer calls. The incentive is stronger for the larger network, as its own customers would care less about the level of off-net prices. The paper also considers the case of a "limited-predation" equilibrium.[18] To achieve its goal of reducing the small networks' profits, the larger network increases the off-net/on-net price differential compared with the one in an equilibrium without predation.

Hoernig (2010) extends some of the previous results to the case of multiple asymmetric networks. In particular, the theoretical results confirm that larger networks will choose larger off-net/on-net price differentials (as long as the call externality is strictly positive). It also shows that, given a firm's own market share and on-net price, the (uniform) off-net price does not depend on the number or size of the other networks and depends only on the average termination cost. In particular, the price differential is as follows:

$$p_{ij} - p_{ii} = \frac{c_{ij}}{\frac{\gamma(\varphi-1)}{(1+\gamma\varphi)(1-\alpha_i)} + \frac{c_{ii}}{p_{ii}} \frac{(1+\gamma\varphi)^{-1}-\alpha_i}{1-\alpha_i}} - p_{ii}, \qquad (2)$$

where φ is the price elasticity of demand. The previous expression is obtained assuming that the off-net price of the firm is unique and that the access charge is the same for all networks (two assumptions that are consistent with the facts in the Chilean market).

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[18] That is, an equilibrium where the large firm chooses prices such that, in equilibrium, the other firm earns lower profits than in the standard Nash equilibrium of the game.

Table 3. Calibration results (predicted by equation (2), $\alpha = 0.44$)

Off-net Price	On-net price	Access charge	Call termination cost	Call externality	Off-net/on-net price differential		
					$\varphi = 1.5$	$\varphi = 2$	$\varphi = 2.5$
264	66	66	66	0.83	315	339	359
264	66	66	61	0.69	**205**	217	227
264	66	66	60	0.67	**190**	**200**	**209**
264	66	66	59	0.64	176	185	**193**
264	66	66	53	0.47	113	118	122
264	66	66	47	0.31	73	76	78
264	66	66	41	0.14	45	46	47
264	66	66	36	0.00	28	28	28

Source: Authors' calculations.

Though we cannot obtain expressions for on-net and off-net prices in terms of the parameters of the model, we still can take equation (2) to the data. Following the literature (Hoernig, 2009), we assume a value of $\varphi = 2$ and then consider some sensitivity analysis. We consider values of the call externality between 0 and 0.83 (and their corresponding call termination cost) for consistency with the previous calibration exercise with nonlinear prices, implicitly assuming that the parameter is identical for on-net and off-net calls.

Table 3 presents the results of the exercise for the actual pre-paid prices that Movistar had in 2010 (see footnote 10). The first two columns report the observed prices; the third column shows the regulated access charge; columns 4 and 5 correspond to the pairs call termination costs and call externalities, respectively, which are consistent with one another (given the on-net price); and the last three columns show the calibrated price differential for different elasticity values (φ). Values in bold correspond to price differentials close to the observed one. As expected, larger externality values can justify larger price differentials on purely competitive grounds. On the other hand, the impact of the demand elasticity parameter on the price differential is very small for low externality values and increases for larger ones.

Hoernig's (2007) limited-predation analysis is not extended to the multiple asymmetric networks in Hoernig (2010), but its intuition carries through. A firm willing to reduce its current profits to reduce competitors' profits would set off-net/on-net price differentials that are larger than those reported in Table 3 (for a given externality level). In the case of Movistar, the observed price differential of Ch\$198 is consistent with a call externality parameter of 0.67 (assuming a price elasticity demand of 2). Therefore, only if the externality is below 0.67, could it be argued that the Movistar's price differential is consistent with Hoernig's limited-predation model.

V. INDUSTRY EVOLUTION

In this section, we describe the context of the mobile communications industry in Chile when the off-net/on-net case was decided by the Court and its
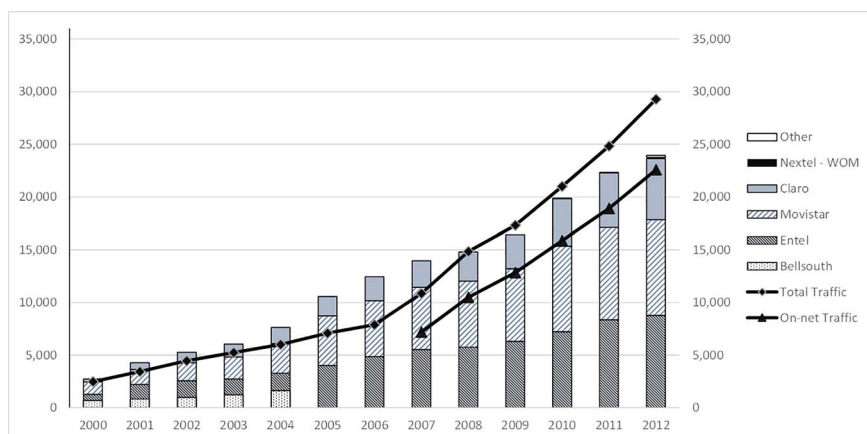
Figure 4. Mobile customers by firm (in thousands) and traffic originated in mobile networks (in millions of minutes)—2000/2012.
Source: Authors' calculations based on SUBTEL statistics.

subsequent evolution, briefly discussing several other instances in which the Competition Court and/or the sectoral regulator intervened in the market to promote competition.

Chile switched from a Receiving Party Pays to a Calling Party Pays system in 1999, triggering a period of rapid growth in mobile subscriptions and overall traffic. Figure 4, which summarizes the evolution of the mobile industry before the Court ruling, shows the subscription rate for the period 2000–2012, which increased persistently and reached an average of more than one mobile phone per inhabitant in 2010. In 2000, this was an incipient industry with two large firms—Entel and Movistar—and two smaller participants, Bellsouth and Claro. As of 2005, when the Competition Court cleared Movistar's acquisition of Bellsouth, the industry structure consisted of two large firms with market shares of around 40 percent each and a smaller one with approximately 20 percent. Figure 4 also shows that the percentage of on-net traffic also grew persistently through 2012, accounting for 76 percent of total mobile-to-mobile traffic.[19]

The mobile industry has been under the scrutiny of competition authorities since the creation of the new Competition Court in 2004. The TDLC's first rulings included the approval of two acquisitions in the telecom sector. The first involved the two main cable TV operators (VTR bought Metropolis Intercom) and the second was Telefónica's (that is, Movistar) acquisition of the mobile operator Bellsouth in 2005. At the time, Bellsouth had a market share of 17.8 percent and Movistar 30.7 percent. Interestingly, the Court imposed

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[19] Note that, given the market shares, if the traffic were balanced, on-net calls should represent less than 40 percent of total traffic.

two main mitigation measures to clear the acquisition. First, Movistar had to sell off a share of the radio spectrum concession it had within 18 months. Second, it forbade the newly merged firm from selling plans with on-net/off-net discrimination until the spectrum was reallocated.[20]

On top of the mitigation measures, the Court ordered the sectoral regulator (SUBTEL) to implement measures to reduce switching costs, banning the practice of selling phones that only operated in a single network and eliminating entry barriers by forcing network mobile operators (NMOs) to make public wholesale offers that would facilitate the entry of virtual mobile operators (VMOs). In fact, several VMOs had attempted to enter the market but faced different obstacles that have been partially removed in the last decade.

In 2007, the national antitrust prosecutor filed a lawsuit against the three NMOs. The NMOs allegedly hindered the entry of VMOs by presenting several administrative motions and complaints before the sectoral regulatory authority with the sole purpose of delaying the entry of new competitors. At the same time, they systematically refused to sell network access or wholesale final consumer plans. Though the TDLC initially ruled in favor of the NMOs, the Supreme Court overturned it and eventually, in March 2013, the NMOs were forced to make public, economically reasonable, and nondiscriminatory unbundling offers that would allow the entry of VMOs. Relevant entry of VMOs had already occurred in 2011 and gathered pace by 2014 and 2015.

In 2010, while the antitrust Court was studying the case on exclusionary practices by NMOs, a law allowing the portability of fixed and mobile numbers was enacted. Number portability started in 2012 with close to 0.8 million switches in the first year and peaked at 4.4 million changes in 2017. Figure 5 shows the evolution of mobile portability rates since it started, distinguishing whether the switching client was originally a pre- or post-paid customer. The switching rate increased steadily for both types of customers, from rates below 5 percent in the first year to over 15 percent in the last two years.

Interestingly, Figure 5 also shows that customers began to switch from pre-paid plans to post-paid contracts around the time that number portability began. It shows that both types of plans were steadily growing until 2012 (albeit prepaid plans at a faster pace than postpaid ones). After 2012, the number of subscribers of pre-paid plans started to decline while post-paid subscribers continued to grow, reaching almost the same number by the end of 2018. When the aggregate numbers are considered, one can see that consumers have switched from pre-paid to post-paid by almost one to one, as the total number of mobile customers has not changed significantly since 2012.[21]

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[20] Eventually, the spectrum was allocated to Nextel and VTR. The first one partially rolled out its own network and was acquired by WOM in 2015, which rapidly expanded its customer base by signing agreements with NMOs to enhance its network.

[21] Switching from pre-paid to post-paid contracts is related to the lower costs and better capabilities of mobile phones, which triggered an increased demand for data traffic. Available
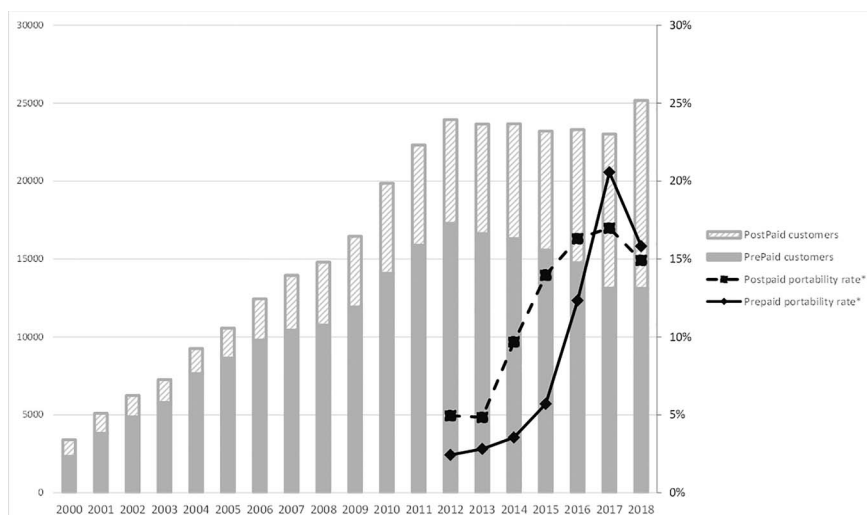
Figure 5. Portability rate (in percentage) and customers in pre-paid and post-paid plans (in thousands) * portability rates for pre- and post-paid clients correspond to their type of contract before switching companies.
Source: Authors' calculations based on SUBTEL statistics and portabilidadnumerica.cl.

Figure 6 provides the details of firms' churn rates because of number portability. WOM has clearly been the most successful. Since number portability began, it has received more switching customers than Entel and almost as many as Movistar. Net of leaving customers, it gained nearly 2 million customers with an aggressive marketing campaign and low prices. The second net winner was the MVO Virgin, with just 0.5 million. Movistar and Entel, the two largest NMOs, have been the main donors of customers (especially Entel, which has lost 2.5 million customers), while the third NMO (Claro) had a high churn rate but in net terms maintained a relatively constant number of customers.

Along with number portability, the Supreme Court's sanction of NMOs for exclusionary practices, the drastic lowering of regulated access charges

SUBTEL statistics indicate that traffic per user increased 74 percent between 2017 and 2018, while in the last 5 years, the number of minutes per user grew by an annual average of 3.3 percent. Despite these trends, average prices have fallen. It is not possible to obtain systematic information about prices, but based on press releases, it is possible to conclude that between 2013 and 2018, the average revenue per user of the three NMOs fell by close to 25 percent (in real terms). (See http://www.economiaynegocios.cl/noticias/noticias.asp?id=118527 and https://www.biobiochile.cl/noticias/economia/negocios-y-empresas/2018/08/10/entel-movistar-y-claro-registran-caida-en-sus-ingresos-promedio-por-cliente.shtml).
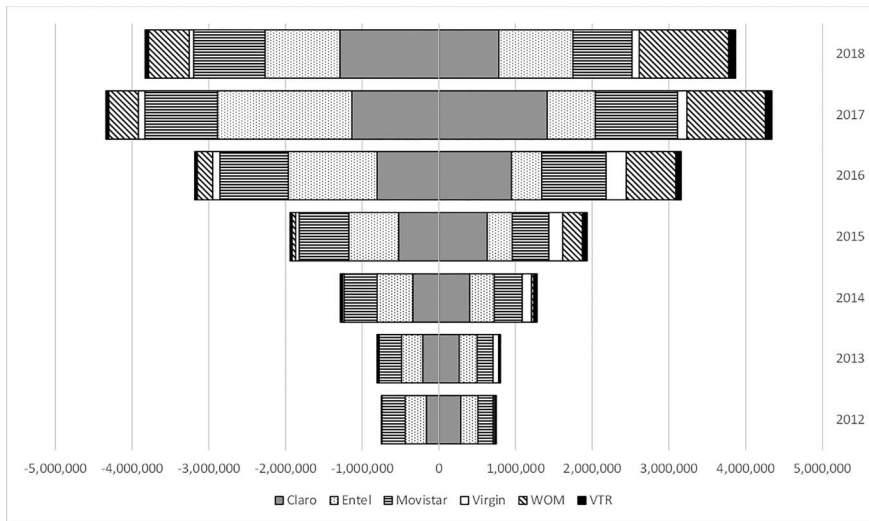
Figure 6. Ported customers by firm and year—2012/2018.
Source: Authors' calculations based on portabilidadnumerica.cl.

and the ban on on-net/off-net price discrimination are all factors that have contributed decisively to a more competitive mobile telephony landscape in Chile.

Figure 7 portrays a very different image from Figure 2. It shows how the two largest firms (Entel and Movistar) lost customers during the period 2012–2018 and a new relevant actor emerged in 2014. It also shows that off-net traffic increased steadily over the last four years, while on-net traffic started to fall right after the full ban on price discrimination entered into force in 2014.

Logically, this trend is not explained exclusively by the ban. As consumers started to switch to new entrants with number portability, what were previously on-net calls likely became off-net minutes. But logically, the ban on price discrimination was a key factor for the success of number portability; the two policies clearly complement each other.

The mobile industry has changed significantly over the last 10 years. Some of these changes are just the result of technological improvements as mobile phones have become cheaper and also capable of performing more and better tasks over time. In fact, the technological change, together with better software and apps for mobile telephony, has make data traffic more relevant than voice minutes.

In the case of Chile, there have also been regulatory and antitrust decisions that contributed to significant changes in the industry. The ban of off-net/on-net price discrimination, the introduction of portability, and the significant reduction in access charges have increased competition and allowed the
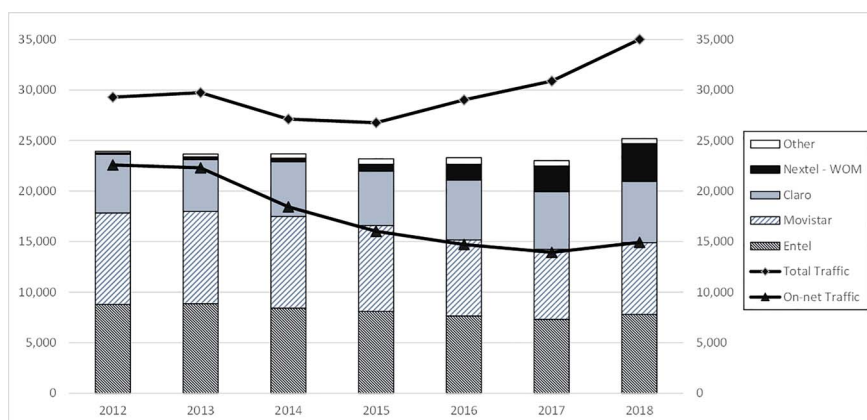
Figure 7. Mobile customers by firm (in thousands) and traffic originated in mobile networks (in millions of minutes)—2012/2018.
Source: Authors' calculations based on SUBTEL statistics.

entry of new firms. However, most of the changes occur at the same time, making it impossible to evaluate or even distinguish the effect of each one on competition, prices, and entry.

VI. DISCUSSION AND CONCLUSIONS

This paper analyzes the economic rationality of the on-net and off-net price differentiation that telecommunication companies used to include in their plans, but which the Chilean antitrust Court banned.

The literature shows that when firms charge customers two-part tariffs— which was standard practice in post-paid plans, price differentials between on-net and off-net calls could be perfectly consistent with companies simply maximizing their current ("static") profits. Hence, the existence these price differentials in the plans that telecom firms offer is not necessarily related to anticompetitive behavior to deter market entry or preying on competitors, though they could potentially have these effects too.

The distinction between competitive and anticompetitive effects depends on the access charge set by the regulator and, more critically, on the magnitude of the call externality. Obviously, the latter is not observable but should be considered in any antitrust analysis.

The Competition Court ruling reasoned that off-net/on-net price discrimination can have anticompetitive effects and banned it for this reason. In particular, it argued that the price differential could increase the dominant position of large firms, reducing the degree of competition in the market, and that it could also pose an entry barrier for new competitors, as it would be hard for them to attract a relevant number of customers.

Though the Court notes that the existence of the positive externality on received calls can partially explain the off-net/on-net price differential, it rules that discriminatory practices should be banned to protect competition and prevent the potential exclusionary effects of the on-net/off-net price difference.

In a sense, the Court takes the stance of prioritizing competition as a legal good to be protected beyond potentially relevant efficiency considerations. This is at odds with standard antitrust reasoning, since efficiency considerations are often weighed against anticompetitive risks when deciding whether to forbid a conduct that may reduce competition. Furthermore, a decision based only on considering potential anticompetitive effects is less justified in this case as the literature that has assessed the welfare effects of banning termination-based price discrimination is inconclusive.

It seems then that the rationale for the court's decision is based on a cost–benefit analysis: the risk of anticompetitive practices is clear, but considering the potential benefits requires a thorough analysis to determine the call externality value, a key parameter in the theoretical model used in this paper that had never been estimated before the Competition Court made its decision.

Therefore, we consider which externality values are consistent with the observed price differentials and a competitive (static) equilibrium. The results show that if the true externality value was below 0.8 in the case of post-paid contracts or 0.67 in the case of linear tariffs, then the observed price differentials would not be fully justified on equilibrium considerations.

A full analysis of welfare effects is beyond the scope of this paper. Such an analysis would require a dynamic model that captures not only the short-term consequences that can be approximated with the model used here, but also the long-term effects. Moreover, as the literature has extensively analyzed, the optimality of banning price discrimination may likely depend on the level of access charges.

In the particular context of Chile, assessing the long-term effects of the prohibition against discrimination would be particularly challenging, since several other regulatory policies and antitrust decisions also affected the market at the time of the off-net/on-net price discrimination ban: in particular, access charges were sharply reduced, NMOs were forced to make wholesale offers to potential VMO entrants, and number portability was introduced. All these policies had deep impact on the mobile industry in Chile and isolating the effect of each one is empirically very challenging, if not impossible.

VI. **APPENDIX.**

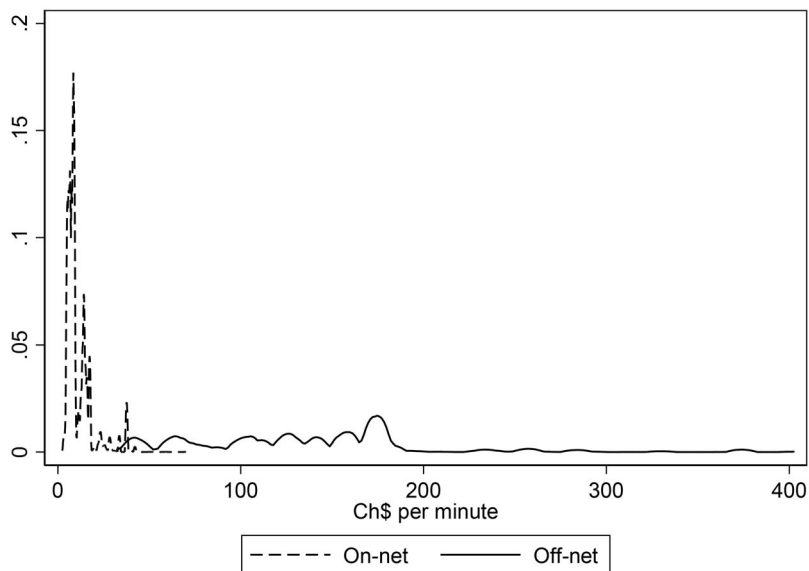Distributions of on-net and off-net average prices.

Figure A.1. Average on-net and off-net tariffs (individuals—weighted by number of subscribers).
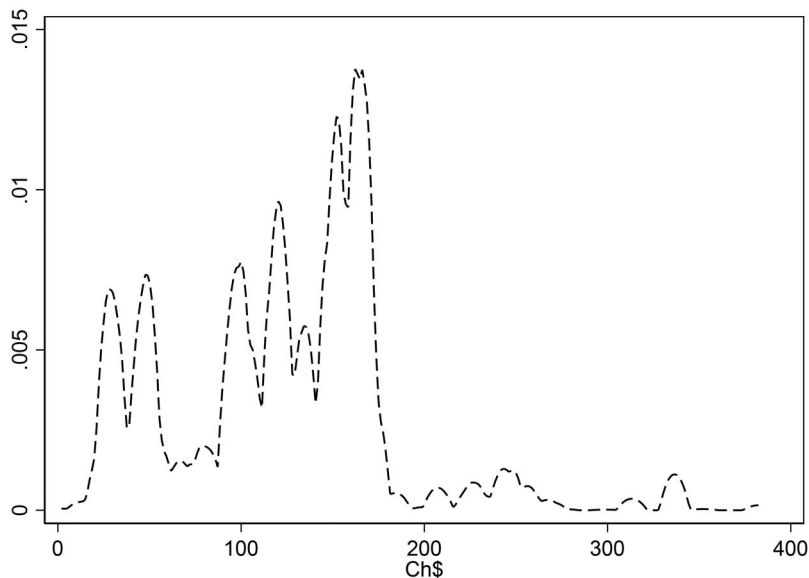*Source*: Authors' calculations.

Figure A.2. Difference in average on-net and off-net tariffs (individuals—weighted by number of subscribers).
Source: Authors' calculations.

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