ANALYSIS OF SERVICE QUALITY STANDARDS FOR DISTRIBUTION FIRMS*

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I. INTRODUCTION

The recent privatization of public utilities in many countries worldwide is changing the pattern by which firms are regulated. Current practices allow for a larger competition together with a broad supply of differentiated services. This article discusses the technical-economical aspects found in the definition of minimum-quality standards for electric energy distribution firms. At present, this is a subject of great importance in the domestic electrical market due to the National Energy Commission's (CNE) interest, who has submitted a Regulation Project of the General Law of Electric Services, 1982 DFL1 (Law Decree No. 1), intended to modify the electric service quality requirements considered minimum to operate a concession. The final goal of this paper is to provide economic policy makers with new background capable of contribut-

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ing to a better understanding of the aspects that must be considered when defining sector policies in Chile as is the specification of minimum-quality standards.

The second part of this paper goes into the current quality standards in Chile and the new authority-proposed quality standards for electrical distribution concessionaire firms. The third part provides a quality standard international comparative analysis for electrical distribution concessionaire firms in Argentina, Bolivia, Chile, France, Peru, Spain and the United States. The comparison focuses on two electric energy features: voltage and outages (in frequency and duration). The comparison of minimum-quality standards among the different countries shows a broad dispersion of requireable standards, but leads to conclude that the new quality standards proposed by the authority are in general within the requirement ranges existing in other countries. Nevertheless, the comparison does not cast light on the technical-economical rationale that justifies the setting of minimum-quality standards.

The fourth part describes the main technical aspects involved in the offering of quality and control programs implemented by electrical firms to monitor service quality. With the purpose of verifying the fulfillment of the electrical distribution service quality standards, firms, in general, have implemented the necessary arrangements to fulfill the law-enforced activities, namely, annual customer surveys and carrying out of service continuity indexes, which also include maintenance programs to monitor service quality on a permanent basis. The discussion makes it possible to conclude that given the interrelationship existing between the investment decisions in each link of the generation - transmission - distribution - consumption chain, it is important to know the points where resources should be allocated to meet, at a minimum cost, all requirements related to service quality. The challenge in the sector's new industrial organization lies in solving this issue with independent firms.

Section five of this document analyzes the economic reasoning capable of justifying the definition of minimum-quality standards. Two beliefs that traditionally have justified the definition of minimum-quality standards are identified. First, when there is the need to remove certain inefficiencies that arise in the presence of asymmetric information respect to what the distribution concessionaire firm is doing. Second, when there is the need to insure that the provision of certain goods amounts to a minimum acceptable qual-
ity when these goods are offered by firms having monopolistic characteristics.

The present day technology questions the validity of the asymmetric information argument due to the possibility of monitoring effectively the quality of the service supplied. In the case of electric service, and even though the service quality can not be ascertained before its consumption, it can be verified *ex-post*, both by the users of the good and third parties. Also questioned is the validity of the monopolistic firm argument because distribution concessionaire firms face a series of incentives as: sales, reputation, segmentation, and threat of other agents, that do not put the choice of the offered service quality beneath the minimum levels desired. Thus, the arguments through which the traditional belief justifies the setting of minimum-quality standards disappear or weaken, which permits to conclude that for electrical distribution concessionaire firms the minimum-quality standards setting is not appropriately justified.

Together with discussing the most recent literature that investigates the need to set minimum-quality standards,¹ the properties that an efficient resource must meet are also characterized. From the previous analysis and where consumers have different electric supply quality requirements, stems an information asymmetry issue, but not with respect to what the distribution concessionaire firm is doing, but with respect to the preferences that individuals have for the different electric supply possible quality varieties. Thus, it follows that the definition of economic efficiency must be one that explicitly embodies the information asymmetries respect to what individuals want.

Given the existing love for diversity among consumers, we have that efficiency in the allocation of resources makes service supply, in general, to be differentiated or allocated with different priorities, which in the end turns out to be more efficient than a solution offering a single variety.² On that respect, the current legislation is not opposed to an electric service supply with different varieties. In particular, the law envisages this possibility as a "supply of special electric service qualities", quality that can be freely requested but not demanded by any concession zone customer. In this sense, concessionaire firms have open the possibility of exploring a differentiated service supply, which together with promoting the development of new technologies, permits consumers to choose, from a full range of services, the service that better meets his needs. However, regulation issues, as transaction costs, information asym-
metries and political and managerial restrictions, suggest the inconvenience of having the Authority in charge of setting all prices of a different-variety menu, and recommend that the Authority chooses only a limited number of the price-quality menu basic varieties to be offered by firms in their concession zones, leaving all the other varieties to be freely agreed upon in the market. Regardless of the above, the main problem lies in defining what price-quality menu elements must be set by the Authority and which must be chosen by the market. The answer to this important question must arise from the analysis of consumer opinion respect to the electric service.

Section six provides information regarding a survey carried out in Chile by ADIMARK on consumer perception respect to electric service quality and their willingness to pay for different qualities. The survey findings show that the most important electric service attributes for the population are supply continuity, both in frequency and duration of outages, voltage and outage time. Consumers evaluate the electric service positively when compared to other public utilities, and furthermore, 89% of the population states their agreement with the service quality currently received and their unwillingness to pay for a higher monthly bill for a higher service quality. The findings support former results which establish that an effective allocation of resources aim at an offer of different varieties and that 11% of the population favors the offering of other service qualities. On that respect, Chamberlin (1985), submits a summary of the different mechanisms with which electric firms have experimented in the United States in search for a method to best match consumer individual needs with the cost of serving these needs, where, among others, a favorable willingness to count with time-of-day tariffs and interruptible services is detected.

Section seven concludes remarking the importance of the findings for the Chilean electrical market. In general terms, it can be concluded that the incentive mechanisms used to establish distribution tariffs can interfere with an appropriate service quality selection by the distribution concessionaire firms, this because the incentive on quality is not always properly separated from the incentive on quantity. Also put forward is the importance that consumer satisfaction has with the service currently offered and how more stringent standards influence electrical tariffs. Finally, it is the ultimate customers who will be subject to a better service but also to higher tariffs.
II. MINIMUM - QUALITY STANDARDS IN CHILE

The current legislation on electric service quality stems from the 1935 operating Regulations and 1982 DFL1. The latter establishes that it is the duty of every public utility concessionaire of any kind whatsoever to maintain the facilities in good shape and in safe conditions for people or things. Additionally, the regulations that control electric system operation define some service quality standards that call for a ±7.5% variation range over the nominal voltage, but fails to specify service continuity requirements in terms of duration or frequency of outages. As to sanctions, the legislation stipulates fines that range from 1 to 50 UTM (Monthly Tax Units) previous complaint of the affected party before the appropriate authority (Superintendency of Electricity and Fuels, SEC, according to its acronym in Spanish), and as long as the authority rules in favor of the claimant. The possibility of a fine for electric service outage, due to a fact imputable to the firm is also considered.

CNE's regulation proposal of the General Law of Electric Services, 1982 DFL1, is intended to modify the electric service quality requirements considered minimum to operate a concession. Among the requirements proposed, the new quality regulations stipulate standards for the variation range over the nominal voltage, at an individual level, pursuant to the voltage level of the respective line; service continuity standards in terms of duration and frequency of outages, also at an individual level, and pursuant to the voltage level of the respective line.

The standards proposed for the variation range over the nominal voltage at an individual level are: ±5% range for high-voltage lines, whose nominal voltage is larger or equal to 154kV; ±6% range for high-voltage lines, whose nominal voltage is smaller than 154kV; ±6% range for medium-voltage lines; and ±7.5% range for low-voltage lines.

Table N° 1 summarizes the continuity standards in terms of a maximum number of accrued outage hours year-round (duration) and a maximum number of outages (frequency) that appear in the regulations proposed. For outages with a duration larger or equal to three minutes, the duration for ultimate customers in low voltage is set in a maximum of 20 hours accrued year-round, with a maximum frequency of 22 outages accrued year-round; the duration for ultimate customers in medium-voltage is set in a maximum of 10 hours accrued year-round, with a maximum frequency
of 14 outages accrued year-round; and in supply points to Public Utility concessionaires the year-round unavailability in hours is equal to the unavailability acceptable in generation plus the unavailability acceptable in transmission. Furthermore, the regulations demand the recording of outage indexes, per transformer and per kVA installed in terms of duration and frequency.

**Table No. 1**

**FREQUENCY AND DURATION OF OUTAGES**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Total Duration</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV</td>
<td>20 hours year round</td>
<td>22 outages year round</td>
</tr>
<tr>
<td>MV</td>
<td>10 hours year round</td>
<td>14 outages year round</td>
</tr>
<tr>
<td>HV at a supply point for distribution utilities</td>
<td>Outage acceptable in transmission and generation</td>
<td></td>
</tr>
<tr>
<td>HV</td>
<td>Defined by the CNE with the calculation of the correction factors for power and energy node prices</td>
<td></td>
</tr>
<tr>
<td>Generation</td>
<td>Defined by the CNE generation expansion plan revised each six months, April and October, of each year</td>
<td></td>
</tr>
</tbody>
</table>

*For outages with a length larger or equal to three minutes.

The Commission establishes a high-voltage service continuity standard to calculate penalization factors. In the case of generation, the acceptable unavailability is given by the generation - transmission indicative development plan proposed by the CNE, that is not compulsory, carried out every six months, on April and October of each year, to calculate transmission node prices. The concern arising in this point is with respect to the consistency existing between the continuity requirements enforced for high voltage and generation versus medium and low voltage.

Sanctions and fines meant for fiscal benefit are stipulated in the case of unfulfillment of the standards. These are enforced with the sole standard unfulfillment verification, i.e. there is no need for third party complaints.
III. INTERNATIONAL COMPARATIVE ANALYSIS OF QUALITY REQUIREMENTS FOR ELECTRICAL DISTRIBUTION FIRMS

Particularly surprising is the definition of quality standards in the electric service that in the present decade regulatory agencies of different countries have included in their respective regulations. The main actors in this story are the concessionaire firms and consumers who must search for standards satisfactory for both parties. First, firms are forced to invest in technology to meet the standards required by the authority, where the pressure to comply with the greater quality requirements enforced by the authority is reflected, in part, in the sanctions considered by the different regulations. When a firm fails to fulfill the quality requirements enforced by the authority, there are sanctions that range from money fines to the discontinuance of its concession. Second, an unsatisfactory service quality may require from consumers large equipment investments to achieve that quality considered satisfactory for their own needs.\textsuperscript{13}

This section will analyze the quality standards enforced by the regulations that control the electrical sector operation in different countries. Only the main quality standard components will be analyzed relative to operating standards in terms of voltage and service continuity, and frequency and duration of outages. The discussion is accompanied with comparative tables that summarize the most significant information on the standards set up in the different countries.

3.1 Voltage

Table No. 2 includes a comparative summary with the main voltage requirements included in the regulations of a sample of Latin American and European countries and the United States.\textsuperscript{14}

In some regions, for instance, the European Economic Community (EEC)\textsuperscript{15} and the United States\textsuperscript{16}, there are recommendations in terms of electric supply quality standards. These recommendations consider, among other features, the interconnection of different electric networks within a large network.

As to voltage variations, the USA’s ANSI standard C84.1-1989 recommends a variation range over the nominal voltage of [-13\%, +6\%]. On the other hand, the EEC has a nominal voltage varia-
### Table No. 2
**VOLTAGE FLUCTUATIONS**
(as % of nominal voltage)

<table>
<thead>
<tr>
<th>Country</th>
<th>LV</th>
<th></th>
<th>MV</th>
<th></th>
<th>HV</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% above</td>
<td>% below</td>
<td>% above</td>
<td>% below</td>
<td>% above</td>
<td>% below</td>
</tr>
<tr>
<td>Argentina (Aerial)</td>
<td>8</td>
<td>-8</td>
<td>8</td>
<td>-8</td>
<td>5</td>
<td>-5</td>
</tr>
<tr>
<td>Argentina (Underground)</td>
<td>5</td>
<td>-5</td>
<td>5</td>
<td>-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argentina (Rural)</td>
<td>10</td>
<td>-10</td>
<td>5</td>
<td>-7.5</td>
<td>5</td>
<td>-7.5</td>
</tr>
<tr>
<td>Bolivia (Normal)</td>
<td>4</td>
<td>-7.5</td>
<td>5</td>
<td>-7.5</td>
<td>5</td>
<td>-10</td>
</tr>
<tr>
<td>Bolivia (Emergency)</td>
<td>7</td>
<td>-10</td>
<td>5</td>
<td>-10</td>
<td>5</td>
<td>-10</td>
</tr>
<tr>
<td>Chile (New Standards, Urban)</td>
<td>7.5</td>
<td>-7.5</td>
<td>6</td>
<td>-6</td>
<td>5'</td>
<td>-5'</td>
</tr>
<tr>
<td>Chile (New Standards, Rural)</td>
<td>15</td>
<td>-15</td>
<td>12</td>
<td>-12</td>
<td>6**</td>
<td>-6**</td>
</tr>
<tr>
<td>Spain</td>
<td>7</td>
<td>-7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S. (120V and 240V)</td>
<td>6</td>
<td>-13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>5</td>
<td>-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EEC</td>
<td>10</td>
<td>-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Chile, New Law, Voltage >= 154kV * * Chile, New Law, Voltage > 154kV ✓ France, year 1996, 225kV ✓ ✓ France, year 1996, 63kV to 90kV


The table provides voltage fluctuation values for different countries, categorized under Low Voltage (LV), Medium Voltage (MV), and High Voltage (HV), with percentages indicating the deviation from nominal voltage. **A significant number of countries, such as Argentina, Bolivia, Chile, and Peru, have adopted voltage stability standards that are valued differently.**

In Latin American countries like Argentina, Bolivia, Chile, and Peru, voltage stability is valued differently, and there is no uniformity of criteria to define maximum allowable variation ranges over the nominal voltage. Nevertheless, differentiated standards exist in terms of the voltage level involved. For instance, Argentina, Bolivia, and Chile specify nominal voltage variation standards for high, medium, and low voltage. On the other hand, Peru sees a difference between primary network (medium voltage) and secondary network (low voltage).

Argentine enforces different requirement levels for the same
voltage levels (Medium and Low Voltage), but distinguishes between aerial networks and underground networks. Furthermore, it sees 2 stages of application of the standards. The first is transitional, it only enforces metering requirements at a global level, where after 36 months of network operation, it moves to a second rated stage that features more stringent standards, which must also be fulfilled at an individual level. Finally, Argentina defines less stringent standards for rural sectors.

Bolivia also considers two stages, transitional and rated. In the first, as in Argentina, the metering requirement is at a global level, to move thereafter to a second stage where, unlike Argentina, global level metering is maintained for low voltage, and individual level requirements are added for medium and high voltage. Likewise, the Bolivian regulations establish differentiated standards for special contingent situations that may affect the normal electric network operation in every one of its voltage levels. There is a distinction between a normal operating condition and an adverse operating condition, with more stringent nominal voltage variation requirements in the first.

Peru establishes nominal voltage variation standards differentiating between primary and secondary networks, and among sectors or typical distribution areas. There are three typical distribution areas, which are defined in terms of population density, average demand, etc. Considering the standards defined, the regulations also call for, as of the metering carried out, the construction of voltage level indexes or indicators that are later used to manage and evaluate the concessionaire firm’s performance.

Lastly, variation standards over the nominal voltage in Argentina, Bolivia, Chile and Peru, must be met for set time frames.

In the case of Chile, a five-year transitional stage is added, before the rated condition. The regulations proposed establish that in both stages the metering requirements must be met at an individual level in low, medium and high voltage.21

3.2 Continuity

International electric service continuity standards acknowledge two components in service outages: duration and frequency. Table N° 3 includes a comparative summary with the main continuity requirements included in the regulations of a sample of Latin American and European countries.
<table>
<thead>
<tr>
<th>Country</th>
<th>HV T. Length (hours per year)</th>
<th>HV Frequency</th>
<th>MV T. Length (hours per year)</th>
<th>MV Frequency</th>
<th>LV T. Length (hours per year)</th>
<th>LV Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>12</td>
<td>6</td>
<td>24</td>
<td>8</td>
<td>120</td>
<td>12</td>
</tr>
<tr>
<td>Bolivia (Normal)</td>
<td>12</td>
<td>6</td>
<td>28</td>
<td>14</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Chile (New Bylaw)</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>20</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Spain</td>
<td>6</td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>France (year 1996)</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>Peru</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>24</td>
<td>6</td>
</tr>
</tbody>
</table>


Regulations in Argentina, Bolivia, Chile, France and Peru, enforce service continuity requirements in terms of duration and frequency, and Spain only considers duration standards. All of them consider differentiated standards for the different voltage levels, standards which differ among the different countries. We can say though, that some of these countries, and differently, include certain differentiation in the frequency and duration requirements in terms of the application, transitional or rated stages, and population density or energy demanded. For instance, Argentina, Bolivia and Peru have transitional or rated stages. Also, Argentina establishes, in the transitional stage, outage indexes that depend on the fault origin, whether it is external or internal to the network; and in the rated stage it carries out an individual metering. Argentina, furthermore, has different requirements depending on the energy demanded at the concession zone. Bolivia has requirements that vary in terms of the number of users existing in the concession zone, being frequency and duration requirements more substantial during the rated condition and in more populated zones. Peru has a scheme similar to Argentina’s.

Spain and France, define differentiated standards in terms of voltage level, and also with respect to the number of customers existing in the concession zone.

In general, all countries consider sanctions to concessionaire firms
due to their unfulfillment of the required quality standards. These sanctions range from money fines to the discontinuance of the concession. Also, in countries like Argentina, Bolivia, Spain and England, fines paid by concessionaire firms can be meant to the benefit of the affected customers.

A series of conclusions, which must be beared in mind when defining minimum-quality standards, has arisen from the comparative analysis performed. Among these is the fact that different countries value differently or have different costs when offering a same service quality. The existing lack of uniformity does not help to define a standard, and only shows the complexity of the issue.

IV. QUALITY IN THE GENERATION-TRANSMISSION-DISTRIBUTION-CONSUMPTION CHAIN

4.1 Technical Factors that Characterize Service Quality

Electric service quality is a broad concept that actually characterizes several electrical variables, like voltage (magnitude and waveform), current, frequency, availability (safety, continuity, service resetting), reliability, etc., and where each is conditioned by technical, economic, environmental and geographical factors, in a complex and non linear interaction typical of interconnected electric systems.

Electric service quality can be analyzed from different perspectives: consumers, quality requirements on the electric equipment's side, or generation - transmission - distribution chain. The consumer perspective has been imputed the most importance because he, as the last link in the generation - transmission - distribution chain, is mainly affected by any supply problem in voltage or continuity that impairs the normal operation of its equipment. The electric equipment at the consumer level, together with the growing technological sophistication, is sensitive to quality variations in the electric supply. Many load level devices include microprocessor-based controls and power electronics elements, sensitive to different types of disturbances. Adding up to the above is the importance that ultimate customers give to service quality. On the other hand, the emphasis on the global effectiveness of power systems has resulted in a continuous growth in the application of elements such as, for instance, motor speed controllers and shunt capacitors
to correct power factor and reduce losses. This leads to a day to day larger level of harmonic pollution, with impacts not only at the ultimate customer level, but also on transmission and distribution systems.

Lastly, many electronic equipment, computers for instance, are interconnected in networks, which means that processes are more integrated and, therefore, the failure of any component is far more important.

A second perspective is that of the manufacturer of equipment sensitive to electric supply disturbances, which is interested in knowing the levels and frequency of the electric disturbances to specify reasonable tolerances in the equipment design and construction stages.

It is also important to emphasize that electric utilities involved in the generation - transmission - distribution - consumption chain only have, each of them, partial control over the service quality attributes of the electric power supplied to the ultimate customer. The final service quality is the addition of the physical effects that join together progressively in such chain and where the effect of each stage can not necessarily be detached. For instance, as to voltage regulation, the problem is not readily detachable, since the investments made in any sector of the chain impact on the downstream installations, which means important economies when focusing the system planning with an integrated design criterion, so as to globally optimize the investments. Figure N° 1 shows the technical requirements involved in each stage of the chain in terms of maximum acceptable variations, pursuant to the current requirements and those recently proposed in Chile as to the system’s own nominal voltage.

FIGURE N° 1
VOLTAGE REGULATION REQUIREMENTS
From the analysis of the standards proposed by the authority it is inferred that the net range for voltage fluctuations, and depending on the interconnection of the lower voltage lines with respect to the higher voltage lines, is:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Proposed Standards</th>
<th>Maximum range for voltage fluctuation (Favorable case)</th>
<th>Minimum range for voltage fluctuation (Untoward case)</th>
</tr>
</thead>
<tbody>
<tr>
<td>154kV ≤ HV</td>
<td>± 5%</td>
<td>± 5%</td>
<td>± 5%</td>
</tr>
<tr>
<td>23kV &lt; HV &lt; 154kV</td>
<td>± 6%</td>
<td>± 11%</td>
<td>± 1%</td>
</tr>
<tr>
<td>400V &lt; MV &lt; 23kV</td>
<td>± 6%</td>
<td>± 12%</td>
<td>± 0%</td>
</tr>
<tr>
<td>LV ≤ 400V</td>
<td>± 7.5%</td>
<td>± 13.5%</td>
<td>± 1.5%</td>
</tr>
</tbody>
</table>


As to continuity, responsibility separation is easier in the measure that each stage events or disturbances can be made independent although, strictly, this is not altogether true, since disturbances can be produced in one stage and detached in another. Figure N° 2 shows a typical power system, where continuity requirements expressed in the new standard proposed in the country are observed.

Given the interrelationships mentioned above, it is important to ask ourselves who finally provides the service quality, who has in the end the responsibility of delivering a "good" supply. Before
the ultimate customer, the responsible is the distribution firm, but strictly, the responsibility is shared by all the actors participating in the generation - transmission - subtransmission - distribution - consumption chain. It was already mentioned that the different service quality regulations set forth worldwide assign different responsibilities to the participants in the chain.

Due to the interrelationship existing among the investment decisions in each link of the chain, it is important to know which is(are) the point(s) where resources must be allocated to, at a minimum cost, meet all the requirements related with service quality. Nevertheless, and before assigning responsibilities, the feasibility that the different actors involved in the generation - transmission - subtransmission - distribution - consumption chain bargain and agree upon each party's responsibility with respect to service quality must be investigated. As to the latter, and among the advantages that a vertically integrated firm can contribute to the generation - transmission - subtransmission - distribution activities, are the low costs of carrying out a planning that permits the effective location of the investments required to meet the service quality demanded by ultimate customers. Thus, the challenge in the sector's new industrial organization lies in solving this problem with independent firms.

4.2 Service Quality Control

Electric supply quality verification in distribution is established in the Chilean law. On that respect, the electric service law (1982 DFL1) defines as distribution firm electric supply normal quality standards, those maximum variation limits over the values defined for voltage, frequency, availability and others.24 With the purpose of verifying the fulfillment of these electric distribution service quality standards, the law defines control programs that must be conducted by SEC. The service quality control program is intended to identify service quality shortfalls and establish a ranking of distribution concessionaire firms. The main program defined breakdowns in three actions:

- Customer complaints received by SEC.
- Annual customer-targeted surveys.
- Service continuity index (carried by concessionaire firms).

The regulations being studied (proposed on December 1995) define more specifically the service continuity indexes that distri-
bution concessionaire firms must record. The service continuity indexes proposed, whose metering is annual, include:

- Outage average frequency and standard deviation.
- Outage average duration and standard deviation.
- Total outage time and average deviation.

In general, distribution firms, besides accomplishing the activities demanded in SEC's control program, as the implementation of an annual customer survey and carrying of service continuity indexes, have service quality control programs which are divided in three parts:

1. Preventive maintenance, where fault statistics are carried to anticipate events that may cause service outage. This is made through scheduled periodical inspections, which include the repair and replacement of damaged elements.

2. Corrective maintenance. Corresponds to a fault repair, whether provisionally or definitely. To carry out the corrective maintenance, firms usually rely on telephone service lines that receive all customer calls. When a fault or outage occurs and the user notifies the occurrence to the company before it can be detected in the preventive maintenance periodical inspections, the telephone service department will be in charge of notifying the fault to the technical team.

3. Specific maintenance. An appropriate maintenance schedule will establish when the system elements must be replaced. Element behavior verification is made through a technical-financial evaluation that establishes whether the element operates at its full capacity or not, which can lead to its replacement or repair.

To verify the fulfillment of the electric distribution service quality standards, firms in general have implemented the necessary procedures to complete the activities required by the law, as is the making of annual customer surveys and carrying of service continuity indexes where, furthermore, they have maintenance programs to continuously monitor service quality.

V. ECONOMIC REASONS TO SET MINIMUM-QUALITY STANDARDS

In general, the common opinion acknowledges two economic reasons that justify the setting of minimum-quality standards:

1. Quality and asymmetric information. Pursuant to Akerlof (1970),
the presence of information asymmetries between suppliers and users, where suppliers have more information than users with regard to the quality of the good, can result in an inefficient situation characterized by an inappropriate exchange level.

2. Quality and monopoly. It can arise from the need of insuring that the provision of certain goods fulfills a minimum quality when these are offered by a firm having certain monopolistic characteristics. In Latin America, this belief is originated when observing the poor performance historically shown by most government enterprises; mainly in what is connected with the quality or quantity of services offered by firms that have been mainly protected from the private sector’s free competition.

Nevertheless, the literature that has recently analyzed this issue of minimum-quality standards is not conclusive in its findings. Standing out on that subject are the works of Leland (1979), Chambers and Weiss (1992), Sheshinski (1976), Besanko, Donnenfeld and White (1987) and Fraser (1994).

When asymmetries do occur between parties, Leland, following Akerlof’s ideas, states that the definition of minimum-quality standards may lead to improve social welfare. This because the setting of minimum-quality standards can prevent a situation where poor-quality goods crowd-out good-quality goods. The dilemma in Leland’s world, where there are several firms, is to monitor what the producers have done, resulting in that the society can be better off if the range of possible actions for them is cut short, reducing thus the probability of consumers having a negative consequence due to the acquisition of poor-quality goods.

Chambers and Weiss also consider a scenario featuring several firms where each produces a freely chosen quantity of a variety specified by pre-existing technological conditions within them. Chambers and Weiss’ scenario is alternative to Leland’s, where the problem is not any more to monitor what the producers have done, but to know the type of producer in the sense of whether he produces good or poor-quality goods. Given that the quality of the goods offered by the different producers can not be ascertained through a simple inspection, it is inferred that the only signal available for producers to validate the quality produced is given by the volume produced of that variety. Chamber and Weiss prove that abiding by the truthful revelation principle, producers offering higher-quality goods must produce a smaller number of units than the producers of lower-quality goods. With this, we have
that the definition of minimum-quality standards excludes the production of certain lower-quality varieties, which would oppose the socially optimum solution that requires the fulfillment of a positive production of all varieties.

Unlike Leland and Weiss, Sheshinski considers the situation of a non discriminating monopolist that must freely choose both the quantity and quality of a variety he pretends to offer in the market. Sheshinski proves that it is not true that the quality offered by a monopoly is necessarily beneath the socially optimum quality. In this case, we have that the enforcement of minimum-quality standards can put us even further from the social optimum. Sheshinski proves that quality regulation is ambiguous in the sense that the regulator, starting from the monopoly solution, must seek a quality increase when quality and quantity are substitutive and the impact of quality increases on the monopoly's marginal revenues is bigger than the impact that this increase has on the marginal cost; must seek a quality decrease when quality and quantity are substitutive and the impact of quality increases on the monopoly's marginal revenues is smaller than the impact that this increase has on the marginal cost; and there is no clear recommendation with respect to what must be done when quality and quantity are complements. Sheshinski also proves that a price cap regulation carries the additional effect, in general, of reducing the quality offered. This occurs basically because the monopolist will try to protect his profits.

Besanko, Donnenfeld and White study the case of a discriminating monopolist who has the option of offering baskets of goods with different qualities to consumers that value differently the quality of the goods offered. Each consumer only buys one unit of a certain variety. The monopolist does not know the individual preferences, but does know how these are distributed throughout the population. The monopolist is attracted to produce different varieties that permit him to segment the market between those willing to pay more and those who only value quality marginally.26

Besanko and others acknowledge that the monopolist, when trying to discriminate, offering different quality varieties to different population groups, generates two distortions with respect to the socially optimum allocation: some consumers are induced to buy qualities that are below the optimum, and others are in fact excluded from the market. In this case, quality reduction may be
used as a mechanism to segment the market. Also, Besanko and others analyze the impact that minimum-quality standard definition or maximum price enforcement have on welfare. The results are that the enforcement of a minimum-quality standard always reduces quality deterioration, but it results in the exclusion of certain consumers from the market with respect to the non regulated situation. On the other hand, the enforcement of a maximum price reduces quality deterioration for consumers having a low willingness to pay for quality, but increases the distortion for those consumers having a high willingness to pay for quality.

Finally, Fraser considers two alternative tariff setting schemes for a non discriminating monopolist who freely chooses the quantity and quality of the varied offered. The first tariff setting scheme studied by Fraser is a maximum or ceiling price mechanism (RPI-X). Sharing Sheshinski's opinion, Fraser finds that maximum price determination causes the firm to reduce the quality offered because it will try to protect its profits. The second tariff setting scheme considered by Fraser is a ceiling price mechanism that rewards pursuant to the quality offered. Fraser finds that this ceiling price mechanism can achieve increases in the quality offered because it introduces a mechanism that permits the firm to exploit the price-quality positive relationship. Fraser does not analyze the welfare effects due to the definition of minimum-quality standards. However, and given the model similarity, we can extend Sheshinski's results to Fraser's model, and infer that the effects of enforcing minimum-quality standards are ambiguous.

Based on the findings of these studies it turns out that the enforcement of minimum-quality standards has an impact on the population's welfare level conditioned by the underlying economic model structure. Furthermore, and notwithstanding the National Energy Commission's concern respect to the electric service quality, it is inferred from these studies and Raineri (1996) that firms usually face at least four factors that condition their incentive structure and makes them consider the quality of the goods and/or services they offer:

1. Sales Incentive. If consumers can examine beforehand the quality of the service offered, then the firm will have a sales incentive to promote a specified quality.
2. Reputation Incentive. If the quality of the good sold can only be verified by its use through consumption experience, the firm will have a reputation incentive to certify the quality offered.
### TABLE N° 5
MINIMUM-QUALITY STANDARDS RECOMMENDATION

<table>
<thead>
<tr>
<th>Author</th>
<th>Type of environment</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leland (1979)</td>
<td>Many firms</td>
<td>+</td>
</tr>
<tr>
<td>Chambers y Weiss (1992)</td>
<td>Many firms</td>
<td>-</td>
</tr>
<tr>
<td>Sheshinski (1978)</td>
<td>non-discriminating monopoly</td>
<td>ambiguous</td>
</tr>
<tr>
<td>Besanko, Donnenfeld y White (1987)</td>
<td>discriminating monopoly</td>
<td>ambiguous</td>
</tr>
<tr>
<td>Fraser (1994)</td>
<td>non-discriminating monopoly</td>
<td>ambiguous</td>
</tr>
</tbody>
</table>


3. Segmentation. Quality selection can be used as a mechanism to segment the market.

4. Threat of the Regulator Agency or other agents interested in entering the market when the firm fails to comply with the quality standards considered appropriate. In this case, the authority counts with different economic policy instruments to incentive or punish the firm in function of the quality offered. Instruments like the use of tariffs linked to the fulfillment of certain quality standards, market de-regulation giving way to a larger competition, and enforcement of penalties, as fines, license or concession cancellation, and suspensions. On the other hand, the market always presents a threat where new producers can enter, compete and offer a higher-quality service capable of reducing the current and/or future sales of the established firms.

Considering these factors and how they affect the firms' incentive structures, it can be asserted that the arguments on which the common belief leans on to define minimum-quality standards disappear or weaken. In the case of the electric service, and although service quality can not be verified before its consumption, it can indeed be verified ex-post, both by ultimate customers and third parties.²⁸

5.1 Efficient Characterization in the Resources Allocation

Harris and Townsend (1981), Myerson (1981), and Dasgupta, Hammond and Maskin (1979) put forward that in environments with asymmetric or private information, the definition of economic
efficiency must be one that explicitly considers the existing information restrictions. In the case of an electric distribution system, these information asymmetries may appear in at least two fronts. First, the information asymmetry could rise respect to the quality of the service offered by the distribution firm. Second, the information asymmetry may appear with regard to consumer preferences for different service qualities.

When we think about a probable information asymmetry with respect to the quality of the service offered by the distribution firm, we have that this can be easily solved with the implementation of a control program that permanently verifies such quality, because it can be monitored on a continuous basis by a third party.\textsuperscript{29} A second factor that helps to solve the disinformation issue with respect to service quality is the permanent exchange relationship existing between the ultimate customers and the distribution firm.\textsuperscript{30} This long-term relationship results in the distribution firm being constantly concerned about the effects that a poor-quality service can have on its reputation and subsequent deterioration of its future profits. The quality control program and the long-term relationship that exists between consumers and distribution firm are mechanisms that strongly contribute to the vanishing or likely vanishing of the information problems with respect to the quality of the service offered. Thus, the problems that may arise from the electric service quality, explained by a possible information asymmetry as concerns what the distribution firm is doing, are solved through considerations of reputation and prompt quality verification.

The information asymmetry problem that exists with regard to consumer preferences for different service qualities is more complex. In this case, practically there is no way of knowing consumer preferences for different qualities, except by observing explicitly their behavior when faced with different-quality electric supply alternatives. Consumption or consumption intention surveys are an indirect mechanism that permits the collection of some information regarding the preferences of individuals for different qualities. However, though these provide valuable information that permits to know better the individual preferences, the problem with these is that they not necessarily respond to an action, but rather to an intention. The information asymmetry with respect to the preference of individuals is an issue that must be solved permitting consumers to clearly express their taste for baskets that combine different electric service qualities and quantities. In this, and follow-
ing Harris and Townsend (1981), Myerson (1981), and Dasgupta, Hammond and Maskin (1979), we have that the social optimum definition must be one that explicitly considers the self-selection and participation restrictions of the individuals.

When there are information asymmetry problems with respect to consumer preferences for different-quality varieties, the problem that an Equalitarian Social Planner solves as the first best alternative, must incorporate self-selection and participation restrictions. Thus, we have that the problem faced by the Social Planner, when he includes the self-selection restrictions, is the choice of baskets of different-quality goods for each type of agent so as to maximize the consumer plus producer surpluses sum. When deciding what baskets to produce, the Social Planner must choose those baskets that are attractive for individuals. Attractive in the sense that they are interested in participating and that, at the same time, of all the baskets offered, their preferred basket is that one explicitly designed for them, i.e. "customized". In other words, that the allocation meets the participation and self-selection restrictions. Thus, it can be concluded that within the economically feasible, the social optimum leads to design a menu of different varieties. Menu where it is perfectly possible that certain individuals are excluded from consuming any variety whatsoever.

The decentralization of this kind of solution, where a different-variety menu is offered, may face some practical problems when implemented. Among those most frequently mentioned in the literature, and that arise when attempting to implement a first best alternative in a decentralized manner, is the problem of the economies of scale connected with the production of the different varieties. If indeed there are economies of scale connected with the production of the different varieties, the first best alternative implementation through the market can be privately unprofitable, requiring a subsidy so that those firms in charge of providing the electric service can finance their current operation and infrastructure investments. Nevertheless, the idea of a subsidy may not be politically viable. Furthermore, there is the problem that the authorities will be coping with a perverse incentive that drives them to reduce the subsidy, and thus, give up past investments. In this case, and to overcome the potential problems that the implementation of the first best alternative could have, it is advisable to search for a second best alternative, which includes the warranty that the firm is capable of covering all its costs.31
A second best alternative solution is one where the Social Planner chooses a menu of price-quality varieties so as to maximize the consumer plus producer surpluses sum subject to the same previous participation and self-selection restrictions, but also adding a non negativity restriction of the profits. The price-quality menu is one which specifies the unit price and the fixed charge of each variety, so that under these prices the baskets offered meet the restrictions of participation, self-selection and non negativity of the firm’s profits.

The characterization of the solution proposed herein is one that is strictly bound to the literature that analyzes mechanisms of allocation of resources where the service is offered with different priorities. Here, the electric service interruptibility is one of the features that must be considered to define service quality. The offer of service by priority for the electric sector and other industries is discussed, among others, by Wilson (1989, 1992, 1993), Chao and Wilson (1987), Marchand (1974), Tschihart and Jen (1979), Harris and Raviv (1981), and Chao, Oren, Smith and Wilson (1988), who set forth broadly based arguments on the advantages of using in the electrical sector a priority service mechanism over other mechanisms of resource allocation, e.g., fixed price or spot price mechanisms.

The main feature of a resource allocation mechanism known as priority service is that it rations the available supply pursuant to contracts that specify the priority with which the different consumptions are met, where service priority is freely chosen by each consumer. In this manner, faced with demand increases that surpass the available capacity or reductions in the available capacity, the service rationing is carried out interrupting the service for those users (or for those uses) contracted under a low priority. Only after the service has been cut to those users that have entered into a low priority contract, the service is rationed to those users that contracted a superior quality.

In a priority service scheme, the variety existing in the menu of priorities offered is restricted by the technology, where the technology and the cost connected with every technological solution establishes the degree of enlargement generated in consumer preferences.

Electric service quality is a broad concept that takes into account different attributes, as continuity and voltage. However, the existing literature on mechanisms of effective allocation of resources
has focused primarily on aspects related to the electric service continuity. Regardless of the literature’s bias, which has favored the service continuity issue, its findings can be easily reinterpreted to consider the analysis of a broader quality concept for the services offered by electric distribution concessionaire firms.

From the previous analysis, and after reviewing some problems that spring up with the implementation of the first best alternative, rises as an option the implementation of a second best alternative. The solution given by the second best alternative is one where the authority regulates the price-quality menu offered by the firm. Notwithstanding, just like in the first best alternative, the second best alternative also presents difficulties that question its effectiveness. These difficulties, that also show up in the implementation of the first best alternative, are problems that involve the practice of the regulatory agency functions. On that matter, we can assert that the regulatory agency faces three important limitations that interfere with the exercise of its functions and prevent the implementation of the chosen mechanism of resources allocation, regardless if this is a first or second best alternative. These limitations are:

- information restrictions;
- transaction costs;
- political and administrative restrictions.

Thus, it is possible to say that as a whole, the information problems, transaction costs and political and administrative restrictions, constraint the scope of the regulation, imposing a substantial work and pressure burden, with a considerable use of resources, on the regulator agencies and regulated firms. In this case, the second best alternative solution is one where the authority regulates the price-quality menu offered by the firm. If this is compared with the mechanism currently used in Chile, where by tariff option the authority only chooses some few varieties of the menu, we find that the choice of the menu with all its details certainly involves a larger degree of complexity and use of resources that must be borne by the authority and the regulated firms. The question to be answered then is, to what degree the larger costs connected with the choice by the authority of the price-quality menu compensate the social benefits that this alternative would afford? The answer is not obvious, but there clearly is an optimum combination. However, a recommendation is that the authority must de-regulate those market segments where competition is feasible, searching for simple tariff mechanisms or formulae for those segments where it is not. Part of
this already is being applied in Chile, where the current legislation that regulates the electrical sector distinguishes between generation, transmission and distribution activities. In particular, the characteristics assumed as typical of each of these activities suggest a competitive development for the generation segment, which does not seem to be the case for transmission and distribution.

If we go deeper into the previous paragraph reasoning, the distribution segment must answer the following: what price-quality menu elements, if any, must be set by the authority, and what elements must be left to the market? This necessarily takes us to discuss what services within the electric supply are basic services and which are not, and where those services considered basic would be subject to pricing, and in certain measure could be demandable in all the concession zone.\textsuperscript{33} In this case, the authority would choose a small number of varieties within the menu of possible alternatives.

Both the legislation that regulates the electrical sector and the one regulating the telecommunications sector include in a certain measure a distinction between basic services and the so called complementary services, where the tariffs of the latter are set freely by public service concessionaire firms. For instance, we have that local telephone concessionaire firms offer, besides the basic telephone service, a series of complementary services that have tariffs freely set by the market.

Now, if we think about the burden imposed on regulatory agencies and firms due to the need of defining prices for each of these non essential services, we have that it would be increased significantly. It is important to emphasize, as stems from the analysis made by Train (1991, chap. 9),\textsuperscript{34} that the adding of new varieties into a price-quality menu already in force, necessarily improves the consumers’ situation. This because in the case that the new variety available is inconvenient for a consumer, he may remain as he was in the original situation maintaining the same consumption pattern. Unlike what occurs with the consumers, where the introduction of a new variety will always improve their welfare, the creation of a new variety that complements an already existing price-quality menu could have for the firm a negative impact on its profits. This happens if the individuals that initially consumed varieties that contribute significantly to the firm’s profits substitute their consumption with the new variety offered with a consumption pattern that contributes in less to the firm’s profits.

Different incentive schemes are more or less successful in mak-
ing the firm use the resources in a more efficient manner, together with the subsequent achievement of an appropriate quality level. In this sense, it is socially advisable that the regulatory agency separates the incentive problems connected with cost reduction from those connected with quality supply using two instruments: a sales incentive that leads to a cost reduction, and a quality incentive that rewards the firm in function of the quality offered.

The major issue still unsettled that society must solve lies in the definition of what services are considered basic. What must be the service quality level to satisfy a basic electric supply service throughout the concession zone? Should there be a single basic service, or should there be different categories of basic services that consider the typical characteristics of each subzone of the concession zone? The answers to these questions must necessarily take into account the consumers' opinion.

VI. PREFERENCES AND SERVICE QUALITY IN CHILE

The current legislation is not opposed to an electric service supply with different varieties. In particular, Article 79 of the 1982 DFL1 takes this possibility into account as a "supply of electric service special qualities", quality that can be freely requested but not demanded by any concession zone customer. In this sense, concessionaire firms have an open possibility to explore an offer of differentiated services, which together with promoting the development of new technologies would permit consumers to choose, from a wide range of services, the service that better fits his needs.

Between December 1995 and January 1996, the market research firm ADIMARK carried out a survey on "Quality Perception of the Electricity Product". The study universe was formed by all households located in Santiago, Valparaíso, Viña del Mar, Concepción/Talcahuano, Temuco, and La Serena/Coquimbo. Among the goals pursued by the study, specially important was the obtaining of indicators on the perception that users have on the electricity product quality; and their attitudes and preferences regarding the annoyances and willingness to pay for service quality improvements. Specifically evaluated, among others, was the importance given by the public to different attributes connected with the electric service quality, as: outage number, outage duration and voltage stability. Furthermore, the study inquired about the average monthly billing per house-
hold, and the sensitivity they have with respect to prices charged. For instance, in hypothetical scenarios of quality improvement or worsening in important service attributes, it investigates household heads' tolerance in dealing with price increases or reductions.

In general terms and comparing electricity with other services like water, gas and telephone, individuals qualified the electric service positively with respect to the price they pay for it (62% of the sample gave grades of 6 and 7, on a 1 to 7 scale).36

In the presence of the question about the degree of annoyance that in relative terms causes the outage frequency, outage duration and voltage and lighting problems, it was found that the outage duration is the source of the most annoyance, followed by the outage frequency and, lastly, by voltage and lighting problems.

Once known the appreciation of the surveyed with respect to the quality they perceive in each of the already mentioned three attributes of the electric service, their willingness to pay for a higher-quality is investigated. On that respect, 89% of the surveyed state their unwillingness to contract a higher-quality service. Thus, assuming that the new quality standards would have a positive impact on the distribution tariffs, it can be concluded that the new legislation proposed by the authority opposes the consumers' free choice of service quality, and could have, therefore, a negative effect on the welfare level of the population. As to this same question, only 11% of the surveyed would be willing to contract a higher-quality service paying a higher price. Next, the surveyed are also exposed to the reverse hypothetical situation, i.e., that the firm reduces the quality below the service quality offered. In this case, and before the option of choosing between a reduction in the monthly bill value or demanding the immediate restitution of the quality offered, 97% of the surveyed choose the latter. Only a small fraction, 3% of the surveyed, would accept a lower-quality service at a lower price.

The following are the main conclusions extracted from the study:

1. The electric service attributes that appear as most important to the population, and in order of preference, are:
   - Continuity (duration and frequency).
   - Voltage.
   - Outage time-of-day.
2. Electric distribution firm qualification in their different attributes is favorable.
3. Among those willing to pay more for a higher-quality service, a
larger percentage of the segments with the lowest and highest monthly billing would be willing to accept a monthly bill increase due to service quality improvement. The monthly bill increase percentage goes from 9% for those who pay more, to 30% for those who pay less (these percentages must be analyzed carefully because the differences in the monthly bills between those who pay more and those who pay less can easily surpass a 1:5 ratio).

Nevertheless, the larger part of the population is in agreement with the service received, and state their unwillingness to accept a higher (or lower) monthly bill for having a better (or worse) electric service quality.

4. For the different monthly billing brackets it was concluded that a non negligible fraction of the population recommends the distribution firm to introduce differentiated tariffs depending on the electricity consumption time-of-day. It is important to point out, as discussed by Chamberlin (1985), that the time-of-day tariffs, more than shifting consumption outside peak demand hours, must stimulate consumption outside the peak hours.

On that respect, it can be mentioned that in residential level studies, Mackie-Mason (1990) and Train (1991) discuss the conditions under which a time-of-day tariff mechanism, implemented on the basis of a voluntary participation and complementary to the current flat rate mechanism for the energy, give a solution that is Pareto Superior to the existing situation. In general, they find that the implementation of a time-of-day tariff mechanism complementary to the existing flat rates can provide a solution to improve firm profits without the need of incurring in a higher price for those consumers that do not choose the time-of-day tariff alternative. Also, Chi-Keung Woo et al. (1995) discuss a similar situation but applied to industrial consumers, where there is always a solution found with time-of-day tariffs complementary to the existing ones that is Pareto Superior to the solution without time-of-day tariffs.

The favorable disposition that exists in the population for counting with other service qualities suggests the need of inquiring about the different types of services offered elsewhere. On that respect, Chamberlin (1985) introduces a summary on the different mechanisms with which 158 electric firms have experimented in the United States, searching for the best way of matching consumers' individual needs with the cost of meeting those needs.37 For residen-
tial, commercial, industrial, and other customers, Table N° 6 summarizes the mechanisms and number of firms that adopted them:

<table>
<thead>
<tr>
<th>Rate</th>
<th>Residential</th>
<th>Commercial</th>
<th>Industrial</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of Day</td>
<td>74</td>
<td>74</td>
<td>81</td>
<td>16</td>
</tr>
<tr>
<td>Interruptible/Curtailable</td>
<td>9</td>
<td>44</td>
<td>77</td>
<td>14</td>
</tr>
<tr>
<td>Industrial Incentive</td>
<td>1</td>
<td>4</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Inverted Block</td>
<td>25</td>
<td>4</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Special Purpose Incentive</td>
<td>33</td>
<td>18</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Residential Demand</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vintage</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Demand Subscription</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Partial Requirement</td>
<td>6</td>
<td>17</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Coincident Use</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Low Income Residential</td>
<td>14</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: Chamberlin (1985).

The table above reveals the existence of a broad spectrum of instruments tested by electrical firms to improve their results and also lead to a more rational use of the electric energy. Highlighting among these is the time-of-day tariff, which is offered to all sorts of customers; on a voluntary basis to residential customers and in a somewhat mandatory manner to large customers. Somehow, time-of-day tariffs try to replicate the spot prices registered by the system. For the effects of service quality, also important are those mechanisms that promote an interruptible or curtailable service, being these effective to sell energy without necessarily compromising a larger capacity.

It must be emphasized that when designing new varieties that complement an existing price-quality menu there is a need to consider both the impact that the new varieties will have on consumer welfare and firm profits.
VII. CONCLUSIONS: DISTRIBUTION TARIFF SETTING IN CHILE AND SERVICE QUALITY

The existing regulation mechanism in Chile is one where distribution tariffs are established based on the optimization of an actual firm that gives origin to a model firm, against which all distribution concessionaire firms are put to compete. The mechanism has proven effective in reducing costs and in conveying this greater efficiency to consumers of what is a simple mechanism where total distribution costs are reimbursed. If the tariffs set by the authority fail to recognize properly the quality offered, we may have that the firm, when facing an incentive to reduce costs, has in hand a perverse incentive to reduce the quality offered, because it will try to protect its profits. The current tariff setting scheme in Chile is one that intends to solve, with the same instrument -the maximum set tariff- two problems: those of quantity and quality. Thus, and following Fraser, we have that a tariff-setting mechanism that acknowledges the quality offered as part and parcel of the set tariff may achieve quality increases given that it introduces an incentive that permits the firm to exploit the price-quality positive relationship.

The distribution firms' exposure to fines for offering an unsatisfactory service quality does not solve the issue of separating the incentive scheme with respect to quantity and quality. When the set tariffs underestimate the cost of quality, we will have that the substantial fines will only make the distribution firm offer a quality that is the minimum possible demanded. For instance, and thinking about the setting of a permitted voltage level fluctuation band, we will have that to protect its profits, the firm will tend to stay close to the band floor.

The authority, when considering changes in the existing quality standards, must evaluate what is the degree of satisfaction consumers have with respect to the service currently offered and how more stringent standards will affect electric tariffs. Finally, ultimate customers will be the ones affected with a better service but also with higher tariffs.

ADIMARK's findings point out that, in connection with the value of the monthly bill, there is enough satisfaction among consumers with the service they receive, where 62% of the sample evaluates the electric service with grades 6 and 7. On the other hand, the large majority opposes a monthly bill increase in exchange for a higher-quality electric service; and also opposes a monthly bill re-
duction for a lower-quality electric service. Only 11% of the sample expresses, in exchange for a higher monthly bill, an interest in counting with a higher-quality electric service, and 89% of the sample opposes the contracting of a higher-quality electric service in exchange for a higher price and, also, state being in agreement with the quality they currently receive in connection with the value of their monthly bill.

As to the evidence submitted, we have that if the authority's goal is to increase the population's welfare level, a proposal that enforces in a general manner more stringent quality standards, and that necessarily has as a counterpart an increase in consumers' final tariffs, could create an opposite effect, i.e., have a negative effect on the population's welfare level. Both ADIMARK's survey and the studies developed in the United States, point out the favorable consumer willingness to experiment with different alternatives of electric supply. Thus, distribution firms must search for expeditious mechanisms capable of meeting the demands of that 11% of the population interested in contracting an electric service with a quality that surpasses that currently supplied. Again, the issue is about identifying those that are willing to pay more for a higher-quality service.

The current legislation is not opposed to an electric service supply with different varieties, which leaves open the possibility for distribution firms to explore new businesses that contribute positively to their revenues and also to the welfare of ultimate customers. Among the alternatives that appear as reasonable to develop are the time-of-day tariffs offered to all classes of customers. Time-of-day tariffs, more than a mechanism in search of driving consumption out of peak hours, is a mechanism that pursues consumption increase outside the peak hours. Also important for the effects of service quality are those mechanisms that promote an interruptible or curtailable service, being these effective to sell energy without necessarily compromising a larger capacity. The variety of instruments applied by electric firms in the United States (see Chamberlin, 1985) has been focused on promoting the rational use of energy, and at the same time improve the earnings of their own firms. Nevertheless, these instruments have mainly considered aspects connected with service availability both in peak and non peak hours. It is perfectly possible to design more complete instruments that include other attributes considered in a wide-ranging definition of what electric service quality actually is.
NOTES

4. Service continuity requirements only appear for emergency systems. Emergency systems are defined as the set of electric installations and equipment made available to provide electric energy to those parts of a facility whose operation is essential to protect life or private property and for safety reasons, when the facility's normal power supply is interrupted (NCH Standard Elec. 4/34).
5. Title I, Art. 3o, N° 17.
6. See Title I, Article 3º, N° 29 of the regulations. The verification of the cases where the lack of quality or continuity are due to acts of God or force majeure corresponds to SEC, as is established by the regulations in Title I, Article 3rd, N°11. Also, subparagraph N°12 establishes that SEC must “warn, fine and even provisionally administrate the service at the expense of the concessionaire, if the quality of an energy distribution public service is extremely unsatisfactory.”
7. Besides the greater requirements established for electrical concessions in urban areas, the authority has proposed other requirements for electrical concessions in rural areas.
8. Extracted from the Regulation Project of the General Law of Electric Services, December 1995, Title VI, Chap. 2, Art. 173. The value of the voltage level considered shall correspond to the statistical value of the voltage measured pursuant to the corresponding standard, during 95% of the time of any week of the year or of any seven consecutive days of metering and recording.
9. See Regulation Project of the General Law of Electric Services, December 1995, Title VI, Chap. 2, Art. 175. These standards are defined over untimely system faults, and are independent for the different voltage levels. Additionally to these faults, service continuity can be affected by the normal fulfillment of the system’s maintenance and expansion programs.
13. J.M. Clemmensen (1993), quoted by Sebastián Ríos M. (1993), mentions the importance of the electric service quality for the industrial and service sectors, where during 1987, and only in the United States, it demanded USD$ 25.6 billion in the industrial sector and USD$ 13.3 billion in the service sector.
For the United States and the European Economic Community, the requirements correspond to a recommendation.

CENELEC.

United States, Recommendation: ANSI.

Republic of Argentina, Utilities Quality Standards and Sanctions.

Ministry of Capitalization of the Republic of Bolivia, Regulations on Distribution Quality.


Except for the first year during transition where service quality requirements are minor.


To calculate the maximum and minimum fluctuations over the nominal voltage it was assumed that variations in the voltage levels with respect to the nominal voltage level are copied when going from higher to lower voltage systems.

1982 DFL1, Art. 79. Maximum variation values permitted for voltage, frequency, availability and others, correspond to the normal quality standards of distribution utilities operating in systems which generation installed capacity exceeds 1,500 kW. In the case of systems with generation installed capacity falling short of the previous figure, supply quality is defined by common consent between the concessionaire and the respective Municipality.

Chambers and Weiss take this result from Cooper (1984), who analyzes the general structure of self-selection models and proves that for an environment as that of Chambers and Weiss, the self-selection restriction requires that producers offering higher quality goods produce a smaller number of units than the producers of lower quality goods.

Nevertheless, the presence of fixed and/or sunk costs associated to the production of each variety is opposed to the development of a large number of varieties. This because with fixed and/or sunk costs, the diversification does not permit the taking advantage of the economies of scale that result from mass production.

In the case of electric distribution, and assuming that distribution rates are adjusted pursuant to the investments made in the sector, it could be expected that the enforcement of more demanding service quality standards would achieve an increase in defaulters and/or energy stealing.

In general, at the residential level, the users of the good may verify only the main attributes of the supply quality as, for instance, continuity and some voltage fluctuations. Nevertheless, they could perfectly well count with special electronic devices to monitor accurately a wide variety of electric service attributes. On the other hand, a third party, as a quality certification organization can, with the appropriate instruments, effectively verify the electric supply quality.
For instance, it can be an independent entity that certifies what is the quality of the service offered.

In general, consumers have different sensitivities with respect to the quality of the main attributes that affect the electric service, as is the case of continuity and voltage. They clearly perceive outage frequency and duration problems. Nevertheless, they may have a lower sensitivity with regard to voltage level variations.


See Jean-Jacquess Laffont and Jean Tirole (1993).

The definition of these basic services clearly must be one that considers special conditions of the concession zone, where a particular service exception is applicable, given the peculiarities of each subzone, for instance, a distinction between rural and urban.

Although Train (1991, chap. 9) considers only the addition of new tariff options to an already existing price menu, his analysis can be extended problem-free to include new varieties on an already current price-quality menu.

It must be emphasized that together with ADIMARK’s staff, the authors of this article had an important involvement in the design of the questionnaire applied in such survey.

For gas, water, and telephone, the population percentages that evaluate with grades 6 and 7 in connection with the price they pay for the service are 60%, 59%, and 52%, respectively.

The 158 firms are divided in 123 private and 35 public firms.

See Rudnick and Raineri’s article in this volume.


The setting of a maximum price will have a negative effect on the quality offered if this maximum price is below the price that the firm would have charged to offer a superior quality.

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