

June, 2002

**REGULATORY SCHEMES FOR WATER PROVISION IN
THEORY AND PRACTICE**

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Background Document
Second Meeting on Tariff Reform in Urban Water Sector Reform of the NIS
Moscow, Russian Federation, June 2-4, 2002

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Abstract

In this report we first provide a conceptual analysis on the regulatory schemes to be applied on natural monopoly infrastructure provision, with strong reference to water and sanitation services. Second, we also provide two examples of regulatory schemes being currently used in two Latin American countries. We start our analysis addressing the question of why it is necessary to regulate natural monopolies; then, we provide descriptions on pricing criteria that intend to achieve efficiency goals, while water and sanitation services are provided by a local natural monopoly. After revising the conceptual aspects of tariff regulations, in the case of a natural monopoly, we report on the current tariff setting procedures being conducted in Chile and Argentina. The analysis of these cases is intended to provide an example on what are the key aspects involved in the regulatory process: institutions, technical requirements, information demand, and administrative procedures. We also offer a critical assessment on these tariff regimes.

REGULATORY SCHEMES FOR WATER PROVISION IN THEORY AND PRACTICE

Carlos A. Chávez and Miguel A. Quiroga

1. Introduction

Water and sanitation sector provides a good example of a natural monopoly infrastructure operation. Two are the main characteristics of a natural monopoly. First, it does exist because it represents the minimum cost alternative for the provision of a given good or service. This implies that society is better off by allowing the operation of one provider instead of many of them. Second, an unregulated monopoly is usually considered as a potential threat to the society. In effect, as usually conceived, a monopoly has the possibility of exerting market power by charging a tariff that is too high and supplying too low quantity to the customers. These characteristics have as a direct consequence a reduction in social welfare.

The characteristics above imply that natural monopolies are usually good candidates for regulatory process from governmental agencies. Conceptually, natural monopolies' regulations are established to allow the society to enjoy the least cost alternative for the provision of the good or service, while at the same time avoiding the risk of facing social welfare losses by a monopolist's opportunistic behaviour. Although the need for regulation seems to be out of question, it is less clear, even from a conceptual point of view, how regulation should proceed. In practical terms, the absence of a unique way of regulation it is evident when considering the many regulatory alternatives being actually used by different governments in different countries.

The aim of this report is to provide conceptual descriptions on alternative regulatory schemes for the natural monopoly in infrastructure in strong reference to water and sanitation service provision. We also report on actual tariff setting and related procedures conducted by regulatory bodies in two Latin American countries. In this report we provide a conceptual analysis on the regulatory schemes to be applied on natural monopoly infrastructure provision, with strong reference to the water and sanitation services. Then, we also provide accounts on two examples of regulatory schemes being currently used in two Latin American countries.

The layout of this report is as follows. Our analysis starts in section 2 with addressing a question of why it is necessary to regulate natural monopolies; then, we provide descriptions on pricing criteria that intend to achieve efficiency goals, while water and sanitation services are provided by a local natural monopoly.

In section 3 we turn our attention on current tariff setting procedures being conducted in Chile and Argentina. The analysis of these cases is intended to provide an example regarding how current regulatory scheme actually operates, and to shed light on the key aspects involved in the regulatory process; among others: institutional aspects, technical requirements, information demands, and administrative procedures.

Taking together our conceptual review on alternative regulatory schemes for natural monopoly infrastructure, and the actual regulatory practice in two cases of Latin American countries, we proceed in section 4 to assess these regulated tariff systems. In section 5 we present our conclusions.

2. Regulatory Schemes for Natural Monopoly Infrastructure

2.1 Why it is necessary to regulate a natural monopoly?

Companies characterised as local natural monopolies usually provide urban water and sanitation services. Conceptually, a natural monopoly exists whenever it is least costly to provide the good or service by only one firm.¹ The operation of monopolies has been perceived as a potential cause for welfare loss to the society. In effect, monopolies may be able to exert its market power by the way of charging too much and supplying too low quantity of the good or service. As a standard result of that, the society face a welfare deterioration because the value of the reduction in the provision of the good, given by the consumers willingness to pay for it, exceed the cost avoided by not producing it.

The presence of natural local monopolies in urban water and sanitation services provision involves two sources of tension. On one hand, it is better to have one operator supplying the service, because in that way it is possible to exploit cost advantages. On the other hand, the presence of a unique provider is a potential for the exertion of market power. Because of that tension—the need for least cost provision

¹ Put it in another way: A natural monopoly exists when it is more efficient for one firm to serve the market than to have multiple firms serving the market.

and the danger of tariff being set at levels considered too high—, natural monopolies have been usually seen as potential subjects of regulation.

2.2 Price regulation in the context of natural monopoly: using the “marginal cost Principle”

The conceptual analysis of monopoly regulation focused in principle on the problem of pricing the good or service provision. From the economic point of view, and for the specific case of water and sanitation service provision, the assumed objective of price regulation is to achieve efficiency of the water supply and use of water and sanitation. Of course, pricing water and sanitation services under efficiency goals it is likely to have impacts on other areas of interests. For example, the possibilities to rise revenue for companies operation, and even distributional impacts.

Considering that the regulatory goal is to achieve economic efficiency, economics suggests that price should be set equal to the marginal cost of production. Roughly, the very basic conceptual idea behind this principle is that marginal cost represents the cost to the society of producing an additional unit of a good or service, therefore, it represents the amount of resources that society should allocate to the production of that good or service. Pricing the provision of the good or service at its marginal costs, the producer and consumers arrange their production and consumption decisions according to its true cost. Therefore, a desirable result is achieved.

2.3 Problems using “marginal cost principle”

Although having a lot of appealing from efficiency grounds, using the “marginal cost principle” to price water and sanitation service provision may have a limited scope. Different reasons explain the limitations of this alternative. First, choosing price that equals marginal cost may not allow meeting revenue requirement to guarantee operation of the provider. Second, in cases in which it is possible to anticipate divergences between short run marginal cost and long-run marginal costs it is not clear to which one the price should be tied. Third, considering that, at least in the short-run, capacity of operation is fixed, and in some cases demand vary over time (for example, by season) then the “marginal cost principle” does not have a straightforward way of implementation. We now turn to discuss briefly some of these issues.

i) Marginal cost principle and lack of revenue

Pricing the provision of water and sanitation services under the marginal cost principle may involve a trade-off between efficiency and rising enough revenue. That is likely in the presence of a firm that is characterised by decreasing average costs.² In such a situation marginal costs of production are expected to be lower than average costs, then pricing at marginal costs although achieving efficiency, will not allow to the operator to rise enough revenue to cover total costs. One of the alternatives to deal with this problem is to use a two-part tariff, also called non-linear or non-uniform pricing.

Two part tariff in the case of water and sanitation service provision would consist on a lump-sum connection charge, say F , plus a per-unit charge set equals to marginal cost, p . That is, the tariff faced by a consumer is given by, $T = F + pq$; where q represent the quantity provided.³ In this case, it is worth noting that this pricing scheme involve price discrimination in the sense that the effective per-unit price, the average price T / q is decreasing in q ; that is to say that the average tariff is decreasing. Two-part tariff allows achieving both, efficiency and revenue; however, they seems to not provide appropriate incentives for water conservation.

Finally, although not intended to reconcile revenue and efficiency goals for the case of decreasing average costs, another alternative to deal with the possibility of not rising enough revenue, it is just to set price equals to average cost. In such a case, price will be set too high with respect to efficient level, and provision will be too low. The impact on efficiency will depend, among others aspects, on the extent of the divergence between average and marginal costs.

ii) Short-run vs. long-run marginal costs

Economic analysis of production and cost usually distinguish between short-run and long-run. The short-run is defined as the time horizon within at least one factor of production is fixed, while the long-run is the period of time to what all factors of

² Decreasing average cost in this case might be the result of economics of scale in the operation; roughly speaking, given capacity fixed, the average cost of providing the service to an additional consumer is lower than the average cost of doing that to the previous one.

³ Another alternative to reconcile efficiency and revenue goals is to use what has been called "Ramsey pricing". Roughly, this pricing strategy consist in defining a per-unit price tied to marginal cost, but adjusted for different consumers (or groups of them) according to the demand elasticity in such a way that those whose demand is more inelastic face a higher price. Although its design is theoretically correct, it seems that in practical settings two-part tariff approach is more widely used.

production are able to vary. In water and sanitation provision, it is possible to think the short-run as the period of time during which capacity of production is fixed, while in the long-run that capacity would vary.

It is clear that considering long-run as the relevant period of time, efficiency calls for choosing price that equals long-run marginal costs, that is marginal costs of operation plus marginal costs of expanding capacity of production. In the short-run; however, economic efficiency from a fixed capacity calls for setting prices equals to the short-run marginal costs, and therefore, such pricing strategy would allow to recover part of the operational costs, without any consideration on future capacity expansion. To that regard, some have argued that if it is possible to anticipate the need of replacement or expansion of infrastructure in the future, then the correct price strategy will be to choose price equals to long-run marginal cost to provide right signals for investment decision.

iii) Marginal costs pricing when demand changes over time

Demand varying over time, say for example by seasons, seems to be a particular feature in water and sanitation service provision in some regions and countries. For example, demand is expected to be high in summer season, and lower in winter season. Demand for hot water is expected to be high during winter season and low during summer season.

In those cases it is suggested that, on efficiency grounds, price should be set at levels that equals short-run marginal costs, and decide on the desirability of plant size expansion by comparing long-run marginal cost (i.e. including operation costs as well as cost of expanding capacity) to willingness-to-pay during high season demand. If demand in high season is greater than long-run marginal cost, it will be a welfare improvement by expanding capacity. However, what should be avoided in a situation, as it described is to charge a uniform price above short run marginal cost and bellows long-run marginal cost. In such a situation two types of inefficiencies result. On one hand, because price is greater than short run marginal cost, in low season too low consumption level is achieved, and the plant is under-utilised. On the other hand, pricing lower than long-run marginal cost implies a welfare loss if capacity is expanded because at that price the level of consumption has a value lower than the cost of providing it.

2.4 Regulatory Systems

In general, there are two types of approach to deal with the problem posed by the existence of natural monopolies. First, the regulatory agency approaches. Second the operation of a public enterprise that is self-regulated. The first approach is characterised by the presence of a regulatory agency, which have as its duty to design regulatory schemes for natural monopoly operation, and the enforcement for compliance of such regulatory regime. Under the second general approach, there is a state owned company that operate as a public enterprise which ideally should allow the provision at least cost without the exertion of market power. In this second approach, because of political pressures and financial constraints, self-regulated public companies are expected to provide water and sanitation service at too low tariff levels, without possibilities of rising enough revenue to fund their operational costs, and facing serious restrictions to develop investment intended to either improve supply coverage or the quality of the provision. Because of that, and considering the aim of this report, we focus on the first approach to deal with natural monopoly problems; that is the existence of a regulatory agency.

Considering the regulatory agency approach, there are different specific forms of regulations. We consider here cost-of-service (cost +), price-cap, yardstick competition, and franchise. A hybrid of these alternative systems can be also considered as alternative regulatory regimes. We turn now our attention to the examination of these regulatory schemes.

a) Cost of service (Cost +)

This type of regulation is explicitly intended to allow the operator to cover the costs of providing the service. Among others, the costs that should be included are costs of operation, costs of capital, depreciation of installations, and capital expenditure for renewal and provision capacity expansion.

Although relatively simple for every party involved; that is, regulator, provider, and general public, the main problem with this type of regulatory scheme is originated by the presence of asymmetric information between the regulator and the operator. This type of problem exists because the regulated firm privately holds valuable information from the regulator. That is to say that an operator being regulated by a cost of service regulation, it is likely to have incentives to overstate its costs, over/under invest in supplying capacity, and eventually, cross subsidy among its consumers.

b) Price-Cap

This type of regulation consists in establishing a ceiling on the price to be charged on consumers. The main feature of this regulatory approach is that it put incentives on the operators to control costs. As the regulated operator knows the maximum price that it is able to charge, the saving on costs during the term of the price-cap becomes part of the rate or return to the operator.⁴

The regulatory approach although inducing to cost control of the operator, which is desirable from a social perspective, might also produce some negative effects. In principle, if regulation focus exclusively on upper limit of the price, the operator might respond by cutting cost on items that affect the quality of the service, or simple reducing investment in the development of infrastructure. In addition, price-cap regulation does not avoid the asymmetric information problem present in cost of service (cost +) type of regulation. In effect, to establish the cap on price, regulator would still need to know some information about actual operation of the provider, its related costs, and investment needs. To that extent, the regulated provider might respond strategically by providing information intended to mislead the regulatory authority.

c) Yardstick Competition

Pricing water and sanitation service provision will require that the regulator be able to obtain information on present and perhaps future costs of operation, actual and future demand, and the alike. As we have argued for the case of cost of service (cost +) and price cap regulatory schemes, asymmetric information problems seems to be a potential problem for the regulatory process. Yardstick competition regulatory system provide an alternative to the regulators to be able to obtain information needed for the regulatory process avoiding, at least partially, the problem posed by the incentives to the regulated provider to provide information intended to take advantage on the information asymmetries.

The regulation scheme based upon yardstick competition consist on setting prices by using data that have been compared to those provided by “similar” providers.

⁴ Because tariff formulas are modified according to given tariff terms, each provider has incentives to obtain efficiency gains that might be funded through cost savings obtained within that period.

In the case in which no “similar” operator exists, yardstick competition may also involve defining a “model firm” providing water and sanitation services in the same system in which the actual firm operates. The “model firm” would consist of and hypothetical operator, different from the real provider, that is assumed to provide water and sanitation service to the same present and future customers where the actual provider is operating. Although closely related, a “model firm” approach is different from yardstick competition. The main difference is that to construct the “model firm” regulator would actually need to obtain some information from the actual operator. Those running the design of a “model firm” face the same information problems as the regulatory authority.⁵

The basic idea behind yardstick competition is to avoid the asymmetric information problem, considering in the regulation the type of operation that is desired by the regulatory authority.

d) Franchise regulation

The regulatory schemes discussed above must deal with the problem of pricing water and sanitation service provision. As we have seen, all of them, to a different extent, face the potential problem of asymmetric information. One of the alternatives to the previously discussed regulatory regimes is to define a franchise regulation. At the very simplest level, this type of regulation consist of a set of potential providers bidding for the lowest price of water and sanitation services provision subject to a restrictions on quality of provision as well as other related to performance. To put it simple, under this regulatory system operators compete for the right to provide the service. Where service have some specific attributes defined by the regulatory authority.

The franchise regulation depart from the three systems discussed before in that it does not require to display efforts obtaining data on costs and demand neither in actual firms, or hypothetical firm. However, the systems present also some problems. In principle, even considering that the operator is neither the owner of the infrastructure nor develop investment to improve or expand operation capacity, by the end of each bidding period, contracts should be renegotiated. In that context, problems on capital maintenance may be relevant. Additional problems might be present in case that the

⁵ As we discuss in section 3, the regulatory scheme in use in Chile is based upon the construction of a “model firm”. An assessment of the Chilean regulatory scheme is provided in section 4.

operator develops investment programs. In this case, capital investment is specific to the are of provision, and entry-exit is not flexible.

The regulatory system that we have discussed seems to involve very different opportunities and risks for private operators. Table 1 shows a summary of advantages and disadvantages for the four regulatory schemes previously discussed from the point of view of a private operator

Table 1
Advantages and Disadvantages for Private Investors from Different Regulatory Systems

Regulatory System	Advantage	Disadvantage
Cost of Service (Cost +)	The possibility of using in its own benefits the information asymmetries between provider and regulator, and also between provider and consumers.	The provider might be under the discretion of the regulatory authority. This aspect may be more relevant in countries characterised by weak institutions.
		Rate of return allowed by the regulator not being good enough to the operator, or the risk that the rate of return may be modified into the future.
Price-Cap	The possibility of exploiting information asymmetries between regulatory authority and the provider to induce the setting of too high tariffs.	Tariff level might not be enough for the provider to cover costs, including opportunity cost of capital.
		The company may suffer from regulatory authority discretion.
Yardstick Competition	In case that regulatory system implementation requires obtaining information from the provider, it may display opportunistic behaviour providing information to mislead the regulator.	The company might eventually face a reduction in the incentives because the units respect to which is going to be compared are actually facing different conditions.
Franchise Regulation	If quality of the contracted provision is difficult to monitor, the provider may be able to reduce quality to increase profit.	Upon expiration of the franchise contract, the capital investment is transferred to the contractor government. Valuing investment, among other issues, could be difficult to implement.

	<p>The company is likely to consider the tariff bid at which won the concession can be renegotiated into the future. This sort of advantage is reduced as concessions are allocated for shorter periods and new bidding process are performed.</p>	<p>If the contracts are incomplete and economic and general condition changes over time, then the initial agreement may not be desirable in the future generating uncertainty.</p>
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The regulatory regimes discussed above are to some extent general characterisation of regulatory scheme possibilities to be applied to urban water providers. It should be recognised, however, that combinations of those systems could also and actually are being used by regulators in real practice. To learn about actual implementation of these systems in practice, we turn now in the next section to report on tariff setting regulations and procedures conducted by regulatory agencies in Argentina and Chile. These countries offer cases of study of two very different approaches of regulation of urban water and sanitation service provision. While in the Argentinean case –the Buenos Aires Water Concession–the regulatory approach in use from early nineties has been primarily based on a franchise operation system, regulation of urban water provision in Chile have been based, since the end of the eighties, on a system that combine yardstick competition with a price-cap regulatory regime.

3. Tariff Regulatory Schemes for Water Provision in Practice

3.1 Tariff System for water provision in Chile

a) The Chilean water and sanitation sector

Provision of water and sanitation services in Chile is under the responsibility of several utility companies, each of them being operated as a local natural monopoly. Ownership of the providers is heterogeneous. In some cases providers are private. In many others, utility companies are state-owned. Mixed ownership is also present and seems to be a norm. Despite the heterogeneity in ownership structure, since the introduction of the legal and institutional reforms of 1988/1989, utility companies whose principal owner is the state are organised and must operate under a structure that is similar to the private companies.

The new institutional design of the sector was introduced in 1988. It considered the allocation of a franchise to each company to authorise its operation. The concession is transferable, indefinite, and is allocated for each of the stages in which the productive process involved in water and sanitation provision can be divided: water production, water distribution, water collection, and water treatment and disposal. Taking into consideration only the urban areas of the country, and data from the state regulatory agency, by the year 2000 there were 44 utility companies in operation distributed among the 13 political-administrative regions into which the country is divided.

According to the current regulatory design, utilities holding a franchise are under control of a state regulatory agency called Superintendencia de Servicios Sanitarios (SISS). The SISS is the regulatory institution for the national water and sanitation service sector. The SISS was created by law as an autonomous, decentralised governmental agency, which depends on the President through the Ministry of Public Works. The SISS was created as a part of the process of legal, economic, and institutional transformation of the water and sanitation services sector started at the end of the 1980s. The SISS is responsible by law for the controlling the sector. The agency has normative responsibilities, including enforcement and compliance with norms relative to water and sanitation services provision. Furthermore, the SISS has a relevant role in the determination of the tariff formulas to be applied to consumers.⁶

b) Tariff regulatory system in Chile

One of the main features of the current regulatory regime for the Chilean water and sanitation sector is the regulated tariff scheme. Tariff regulations are intended to introduce appropriate incentives to the development of the sector as well as economic incentives for consumers. The Law of Tariffs, D.F.L, introduced the current tariff

⁶ Specifically, the SISS has among its duties: i) studying, proposing, and enforcing compliance of technical norms relative to the design, construction, and exploitation of sanitation services; ii) monitoring and enforcing of norms relative to tariff per services provided by utility companies operating in the sector; iii) application of the franchise regime, including allocation, exploitation, tranferences, and expiration of the franchise; iv) defining norms and executing control over industrial effluents; and v) applying penalties and other types of sanctions to violators of the existing regulations in the sector.

system in 1988. No 70/1988. The associated operative rules were promulgated in 1990 under Supreme Decree (D.S.) No 453.

Tariff regulatory scheme in Chile is intended to achieve the following objectives. First, tariffs formulas are designed to signal private investors that government was committed to no expropriate their return-on-capital through underpricing, while at the same time reducing the chance of monopoly rents. Second, tariffs are intended to introduce appropriate incentives for water sector development. Third, tariff are expected to provide incentives to induce the operator to minimise long-run average costs. Fourth, tariff are also intended to allow efficiency gains to be transferred to consumers by either reducing tariff levels or increasing the quality of the provision. Finally, fifth, tariff design that reflect the true cost of provision, are also intended to provide an incentive to consumers for water conservation.

The legal structure that supports the Chilean water and sanitation tariff system was structured under the following principles: i) dynamic efficiency, ii) economic efficiency, iii) intelligibility, iv) equity, and v) self-financing [SISS, Internet site]. [For a discussion of these principles see Chávez and Quiroga (2002)].

c) Administrative procedures for tariff determination.

The determination of tariff –the tariff process- is implemented under a set of administrative steps that are clearly identified in the legislation. The specific procedures to be applied in the process are intended to make the implementation of the regulation a transparent process. For that reason, for the process of the tariff setting, Chile's legislation settle down the steps and the timing, the instances of coordination between the SISS and the company for which tariff formulas are being estimated, and the schemes for resolving eventual discrepancies [see Figure 1].

Three are the main steps considered in the process of tariff determination in the case of Chile. In the first step, the terms of references upon which tariff studies should be conducted are elaborated. In the second step, the company and the regulatory agency agree on the new tariff formulas. In the third and final step, the Ministry of Economics formally defines the new tariff formulas.

The purpose of elaborating term of references to conduct the tariff studies is to allow both parties (regulator and provider) in developing the tariff studies independently, while still using a common framework to conduct the studies. In this way it is expected to reduce the range of discrepancies on the results, and facilitate

comparisons among the studies. Twelve months before the expiration of current tariff application, the regulatory agency SISS should make available to the public and to the utility company involved, the terms of references upon which tariff studies should be conducted. Terms of reference identify the systems to be studied (water production, water distribution, collection of waste water, and disposal), the criteria for optimisation to be applied on the operation and expansion of the systems, criteria to define demand level for planning purposes, water quality levels, quality on customers service, methodology to value raw water, and methodology to calculate the cost of capital.

The company and the general public have to make comments on the terms of references for tariff studies during 60 days. The comments should be communicated to the SISS. The regulatory agency must respond to the comments within a period of 45 days before the deadline of the request.

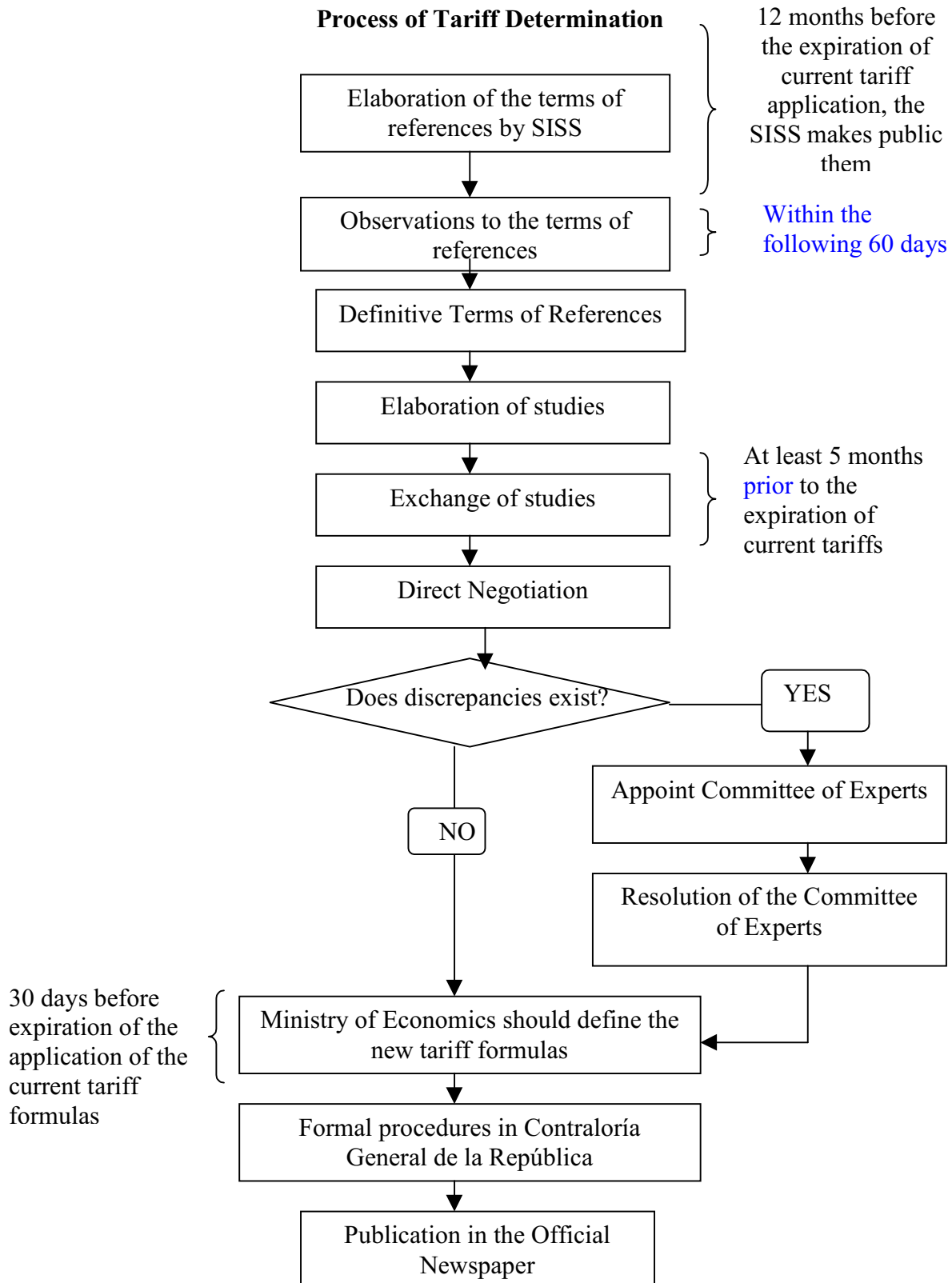
Once terms of reference on tariff studies are established, provider and regulator must agree tariff formulas for the next tariff term. The regulation establishes that regulator and the utility company should exchange their own tariff studies at least 5 months prior to the expiration of the current tariff formulas. The exchange of studies takes place formally in the presence of a public notary. Tariff studies must contain the conceptual aspects upon which they were conducted, calculus details and the results. After the exchange of tariff studies is performed, the company has 30 days to inform to the SISS on eventual disagreements. Should discrepancies exist, they must be formally presented to the SISS along with the studies supporting company's opinion. From now on, both parties involved start a process of negotiation on the differences. If within a period of 15 days after the company presentation of the discrepancies, there is no agreement between the regulatory agency and the company, the SISS is allowed to appoint a Committee of Experts. The Committee must resolve the discrepancies by making explicit its opinion on the sources of discrepancies. The opinion of the Committee of Experts is definitive and mandatory for both parties. The Committee of Experts is composed of three people. According to the regulation, one person is appointed by the SISS, another by the utility company and the third person also by the SISS chosen from a list of names previously agreed with the company.

Finally, 30 days before expiration of the application of the current tariff formulas, the Ministry of Economy should define the new tariff formulas and start formal procedures in the Contraloria General de la Republica. The process is completed with publication of the tariff formulas in the Official Newspaper. The law establishes

that tariffs are defined for periods of five years. The regulation considers mechanisms of automatic indexation to adjust tariffs by inflation within that period.

Figure 1

Schedule of the Administrative Procedures for the



d) Setting tariff formulas in Chile

Tariff regulatory system for water and sanitation provision in Chile approach a yardstick competition type of incentive regulation. In effect, tariff setting in the Chile use the concept of a “model firm” that operates efficiently. For regulated tariff design purposes, a model firm is an idealised conceptual firm that performs an efficient operation, different from each of the real utility companies.⁷ The concept of a model firm was introduced to allow the regulator to estimate the costs upon which to define tariff formulas independently of the actual firms operating in the sector. In addition, productivity improvement in the production and provision of the water and sanitation service can be incorporated in the tariff formulas over time. It can be accomplished by designing the model firm for each tariff processes.⁸

A representation of the system for tariff determination in the Chilean water sector is shown in Figure 2. The tariff model in Chile requires obtaining information that allow the regulatory authority and provider to forecast the demand for water and sanitation services that the system will face in the next 15 years. In case it is needed, parties should characterise the capacity expansion plan intended to satisfy such increasing demand⁹. More specifically, the tariff studies must include demand forecast, specification of the sources of unprocessed water, provision capacity and technical solutions anticipated to satisfy the forecasted demand and the need for wastewater treatment.

In case that to satisfy forecasted demand, expansion plans would be needed, tariff should be calculated considering incremental costs of development. For this purpose, incremental costs of development is defined as the “value equivalent to a constant per unit price which, when being applied to the incremental forecasted demand, generate revenues to cover incremental operation efficient costs and the required investment from an optimised project of expansion of the firm, such that it should be

⁷ A model firm is understood to be a firm that in its design contains the following characteristics: a) provides sanitation services with a design that includes efficiency in services provision, b) operates with all feasible interconnections among companies and systems to achieve maximum efficiency, and c) the firm develops its activities under current law and norms, given geographic, demographic and technological characteristics. Each of the model firms must have an administrative and institutional design, and a physical scheme of the model system for the stages of the sanitation service being considered [Medina (2000)].

⁸ Because tariff formulas are modified every 5 years, each provider has incentives to obtain efficiency gains that might be funded through cost savings obtained within that period.

consistent with a net present value (NPV) of the project equal to zero.” [D.F.L. No 70/1988].

In the alternative case, where expansion plans are not required, tariff formulas should be calculated according to the long-run marginal costs. These types of costs represent the cost of repositioning a model firm that is starting its operation, with the appropriate size to provide services to the annual demand corresponding to a period of five year.¹⁰ The application of the tariff formulas should allow each company operating efficiently to cover its long-run total costs.

The total long-run costs from which long-run marginal costs is derived, is defined as the constant annual value required to cover operational cost and efficient investment of a optimised project of the provider, which is intended to satisfy the demand. The net present value of such a project must be equal to zero and consider a time horizon not less than 35 years.

For each provider, the procedures establish that a comparison between annual revenue and the related long-run total cost should be carried out. Total revenue must be estimated from the application of the tariff formulas to the annual demand. Should not exist differences, the tariff must be accepted. Should differences exists, tariff should be adjusted up to the point where annual revenue equals costs..

The main elements involved in the Chilean tariff process include: parameters, forecasted demand, model firm design, expansion project or replacement, criteria to value costs, and indexation rules .

Parameters. The key parameters used in the tariff determination process are expected number of years of the project, taxes, rate of capital cost¹¹, value of crude or unprocessed water, water quality, and consumer service quality.

⁹ The plan of expansion is the project of investment that includes a relevant increase in the volume of services provided by the company and/or relevant changes in the related production processes.

¹⁰ The actual estimation of the long-run total cost is transformed in annual operation and investment costs. It represents the required revenue to the reposition of the model firm considering a time horizon of 35 years. We notice here that the annual demand for the period of 5 years is considered because, according to the regulation, a tariff term lasts for that period.

¹¹ The rate of capital cost correspond to the average internal rate of return corresponding to the medium-run/long-run financial instruments offered by the Central Bank of Chile, plus a risk premium, which cannot be either lower than 3% or greater than 3.5%. In any event, the capital cost rate cannot be lower than 7%.

Forecasted demand. The criteria used to forecast present and future water and sewerage service demand, must consider: water provision coverage, sewerage service coverage, estimation of customers and number of connections, per-unit consumption, over-consumption levels, and limits to over-consumption¹². The basic inputs to forecast demand is forecasted population and target coverage levels. The rest of inputs or basic information needed is determined from historical levels.

Model firm. As we defined it before, it is a provider firm designed to supply in the most efficient manner the required services to the population, considering legal norms and geographic and technological restrictions for its operation. The basic element to be considered in its design are: compliance with legal norms, demand, investment policy and efficient management (the final choice among alternatives is performed on the basis of the minimum cost in present value terms, and considering all the technical alternatives at the moment in which tariff studies are performed, ensuring the provision of water, water losses¹³ and criteria to model the distribution network [minimum diameters, duplication of pipes, etc.]. Unprocessed water sources are ranked according to the lower cost in present value, criteria of safety and losses, and criteria on network modelling.

Valuing costs. The criteria to valuing costs to perform the calculation for the incremental cost of development, and the long-run total cost are the following: value of the required infrastructure, management expenditures, operational and maintenance costs, other costs (value of buildings and land, commercial and administrative offices, cash flow, engineering costs, design and technical inspections, other investment in vehicles and machines).

Indexation of tariffs. The Chilean regulatory system considers the design of formulas that express the tariffs as a function of price indexes. These price indexes are intended to represent the cost structure involved in the different stages of the provision. During the tariff term, the tariffs that providers are able to charge on consumers are obtained by the application of price indexes variation. According to the regulatory system the new

¹² The current limit to over-consumption is 40 m³.

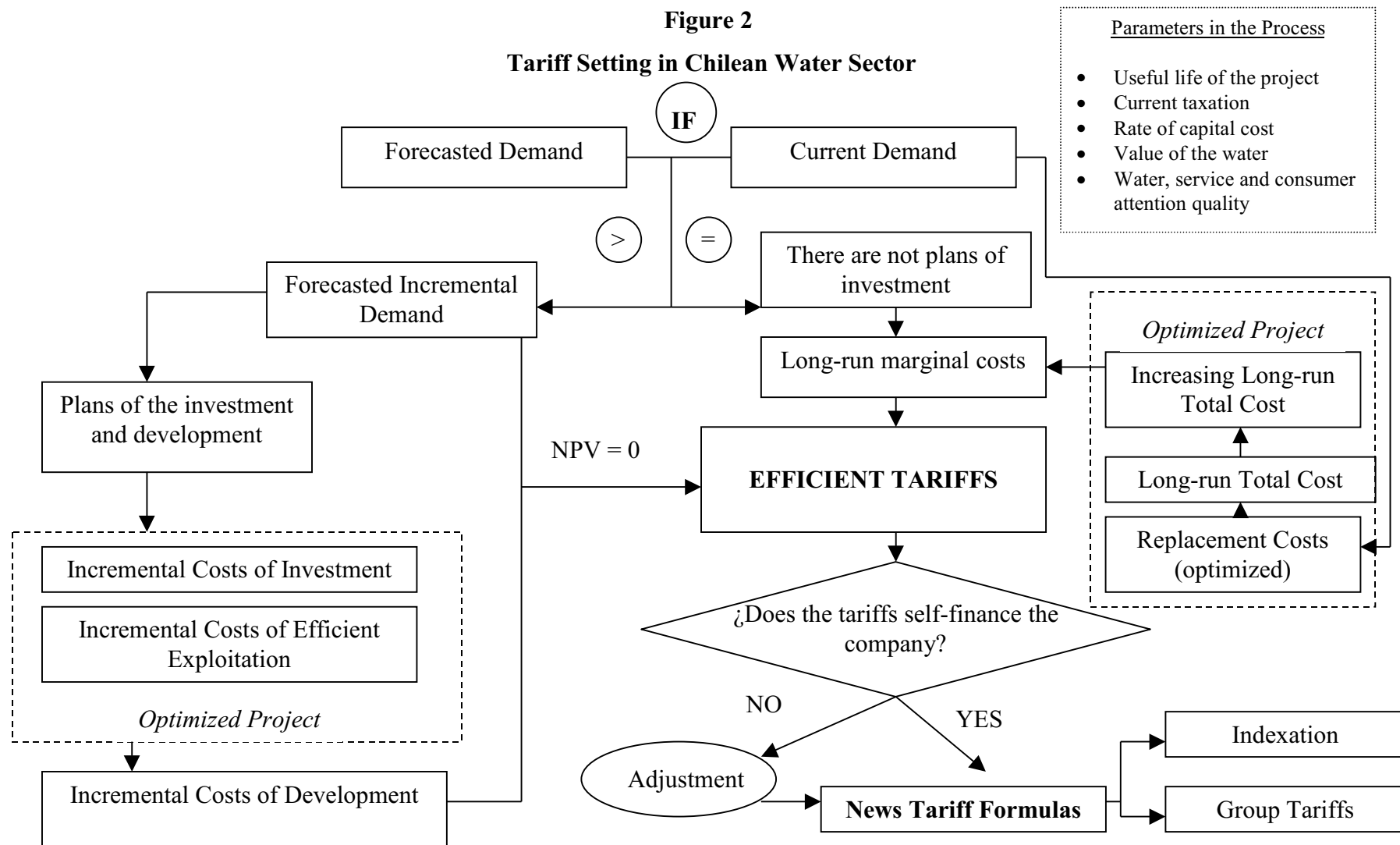
¹³ In the production stage it is considered a loss of 5% of treated volume. In case of the distribution stage, the losses considered are 1.5% of the distributed volume.

tariffs are applied once an increase of at least 3% is accumulated in any of the tariff charges.

Tariff is defined as a maximum price that utility companies might charge to consumers. The law requires that tariff be determined according to stage of the service provision and by system. The tariff structure also considers variable and fixed charges and explicitly differentiates by seasonal demand. In the event of differences in demand by season, tariff structure includes, for each stage of the service and system, the following items: variable charge in high demand season (tariff per cubic meter in $\$/\text{m}^3$), variable charge in low demand season ($\$/\text{m}^3$), and variable charge because of over consumption ($\$/\text{m}^3$) (applies only in high demand season).¹⁴ In the absence of seasonality, there is only a uniform variable charge. Regarding fixed charges, the current tariff structure considers only a fixed charge per customer, which depends on the diameter of the connection. The explicit consideration of differences in demand by seasons is intended to introduce in the tariff structure the differences in the costs of service provision.

¹⁴ Charge because of over-consumption is applied on the amount of cubic meters that exceed the customer average consumption within periods defined as high seasonal demand.

Figure 2
Tariff Setting in Chilean Water Sector



3.2 Tariff System for water provision in Argentina (Buenos Aires concession)

To provide a different case of study on tariff regulatory schemes for water and sanitation provision, we turn now our attention to the regulatory tariff scheme currently applied in the case of Buenos Aires, Argentina. To that purpose, we choose to focus on the case of the Buenos Aires water concessions, one of the greatest concession program ever implemented in the developing world. Although the study of different aspects of the concession appear to be a good opportunity to learn on the design of actual regulations in the water sector, considering the purpose of this report we focus only on the tariff setting regulation.

a) Water and sanitation system provision in Buenos Aires

Since May 1993, the provision of water and sanitation services in Buenos Aires operates under a system of concession [see conceptual aspect of franchise operation in section 2.4]. In effect, during 1992 a bidding process was implemented to allocate the concession for the provision of water services and sanitation in Buenos Aires, including the Capital Federal and Provincia de Buenos Aires. The bidding scheme was designed to induce bidders to compete on the basis of offering the lower tariff, subject to operation standards and a commitment on investment plan. The concession was designed to last for 30 years.

The winning bidder, and current operator of the Buenos Aires concession is Aguas Argentinas, a private company including among others stockholder Suez-Lyonaise des Eaux, Aguas de Barcelona, Banco de Galicia, Vivendi, and Anglian Water. Perhaps surprising, the concession was won with a bid to reduce the tariffs by 26.9%, and included a commitment of developing a plan of investment during the concession term of about US\$ 4,000 million [Alcázar, et. al. (2000); Ferro (2000)].¹⁵

The concession triggers the creation of an independent regulatory body to monitor and enforce compliance of the concession contract and regulate in general the operation of Aguas Argentinas. The regulatory authority in Buenos Aires was created in 1993 under the name of Ente Tripartito de Obras de Servicios de Saneamiento (ETTOS). Among other duties, ETTOS is responsible for setting tariff, approve and monitor investment plan, and oversee customer service provision according to the term of the concession.

b) Tariff regime in the Buenos Aires concession

Tariff regulation regime in Buenos Aires concession have been criticized by been opaque and open to the exercise of strategic actions from the operator and arbitrary moves from the regulator. In principle, the way in which tariffs are set suggests that the regulatory system corresponds to a cost of service type of regulation. However, some analysts have also suggested that the regulation consider a mix of cost of service and a price-cap type of regulation [Alcázar, et.al. (2000); Ferro (2000)].

The tariff system correspond to a cost of service type of regulation because tariff after concession were tied to the prevailing tariff before it, when the provider was the state owned company Obras Sanitarias de la Nación. Tariff level under such operation regime was likely defined on the basis of the cost of the water and service provision. The tariff regime after the concession have also a price-cap component, because the bidding process focussed on the competition for tariff reductions, and the winning bid on tariff reduction becomes a cap on the tariffs level.

Tariff in the Buenos Aires concession were originally conceived to last a term of five years, period after which the cap would be modified based upon the investment plan for the next tariff term. Further, tariff was also subject to extraordinary adjustment because of indexation clause which tied tariff increase to changes in the costs faced by the company instead of regular inflation rate.¹⁶ Upon completion of the five years term, tariff are expected to be subject to a revision. In practice; however, tariff were adjusted as consequence of contract renegotiation of 1997.

c) Tariff structure in the Buenos Aires concession

Tariff regime in the Buenos Aires concession can be characterised in general as a property tax. Tariff system in application before the concession was implemented was not modified by it. One of the main characteristics of the water provision in Buenos Aires at the time of the concession was that almost all consumers were unmetered; and because of that, water tariff regime considered both, metered and unmetered consumers.

The basic structure of water tariff in Buenos Aires for the unmetered consumers consist of a uniform flat rate, which depend on two variables; namely, the type of consumer (residential, non-residential, or real state) and the service provided to that consumer (water or

¹⁵ It turn out that tariff reduction eroded over time. Among other reasons, it was the consequence of a renegotiation of the concession contract implemented in 1997.

water and sanitation service) [Alcázar, et.al. (2000)]. The flat uniform rate according to the variables above, is then corrected by a scalar K, which represent the fraction of the corresponding tariff level to be actually applied on the consumer.¹⁷ The corrected tariff is then adjusted on criteria related to characteristics of the served property (location, size, type of construction, and even age of it). In the case of metered consumer the tariff also consists on a flat rate equivalent to a 50% of the tariff of an unmetered consumer, plus a variable charge consisting in the tariff prevailing before the concession corrected by factor K.¹⁸

4. Comparative Assessment of the Tariff Regulatory Systems in Chile and the Buenos Aires Concession

i) Tariff as a signal for consumer decisions

The tariff structure in the case of Chile is intended to provide incentives on consumer for water conservation by making each consumer face the true cost of provision. To that purpose tariff are established by systems of provision, distinguish between seasons, and correspond to a type of ascending block because it consider charges in the case of over-consumption. In contrast, the flat tariff structure in the Buenos Aires concession does not appears to generate such incentive because for the majority of consumer tariff does not depend on actual consumption.

ii) Cross-subsidies

The Chilean tariff structure for water and sanitation services explicitly intend to avoid cross-subsidies. Under the current tariff system in Chile, it is likely that any two consumers receiving water and sanitation services within the same system will face the same costs. In the same fashion, water tariffs faced by consumers in the north region, where water is a scarce resource are higher than those faced by customers in the south, where water is available, and

¹⁶ The contract considered that an extraordinary tariff review would be triggered whenever the cost index increased (or decreased) by an accumulative rate of 7% in one year.

¹⁷ For example, just before the concession K took value equals 1, after the concession was allocated, the factor K was set equals to 0.731, which correspond to the winning bid of tariffs reduction of 29.6%. Since 1998, factor K takes value of 0.8741 [Ferro (2000)].

¹⁸ Because variable charges apply only for consumption greater than 30 cubic meters per month, it seems that tariff structure for metered consumers in Buenos Aires approach to an ascending block scheme.

therefore the cost of provision are lower.¹⁹ In sharp contrast, the tariff structure in the Buenos Aires concession clearly involve cross subsidies among consumers, were the extent of such cross subsidy appears to depend on the differences between the set of property characteristics among consumers being considered in the tariff design.

iii) Tariff term

The length of the tariff term should be long enough to allow providers to avoid costs associated to tariff renegotiation and also make it possible that they be able to recover efficiency enhancing investment. However, at the same time, tariff term should be short enough to trespass on customers the efficiency gains whenever they do exists. As usual a trade-off seems to be present in the decision. In the case of Chilean tariff system as well as in the Buenos Aires concession, the regulation originally considered a tariff term lasting five years and clauses of indexation for tariff adjustment within that period. As for the tariff term, renegotiation did occur on the Buenos Aires concession and tariff cap increased before the five years period. In the Chilean case, three tariff process have been completed as it was established in the regulation, and no renegotiation or tariff revision have occurred.

iv) Transparency

One of the features of the Chilean tariff regime is the introduction of procedures intended to increase its transparency. In effect, all interested parties know in advance the regulatory steps, associated timing, rights and obligations. The extent to which the goal of transparency has been achieved, seems to be still a matter of discrepancies²⁰. As for the Buenos Aires concession, the tariff design and implementation has been criticized because of its lack of transparency and because it allow to the provider to exploit information asymmetries with respect to the consumer. Consider for example the possibility of the

¹⁹ It is believed that cross-subsidies are still present to some extent in the Chilean case. That might be the situation because the actual tariffs for systems that are closed to each other from a geographic perspective are obtained by averaging the specific tariffs for each system.

²⁰ Some authors have pointed out that during the implementation of the first tariff process in 1989-1990, not all formalities were followed. In particular, some utility companies complaint that they did not have the chance to effectively participate in the process, having instead a passive role. The situation changes during the implementation of the second and third tariffs process in 1994-1995, and 1999-2000. After the third tariff process, and because of complaints from customers that faced bill increase, the SISS has just recently requested to the companies to provide further information to customers on the result of the tariff process. It is not clear at this point the precise reasons behind the complaints; but they may be in part related to an effort to improve the targeting of the water subsidy program.

provider to increase tariff by just reclassifying consumers among categories (residential vs non-residential) or property characteristics (location, size, etc.).

v) Participation

Although the Chilean tariff regulatory framework initially did allow only participation of the regulatory agency (SISS) and the regulated company, part of the reforms introduced in 1998 were intended to increase participation and the transparency of the process, allowing also the possibility of intervention of the general public. In contrast, for the case of the Buenos Aires concession public participation is not considered by the contract in the tariff process, and it is basically a matter to be resolved by the regulator and the provider within the framework of the concession contract.

vi) Information requirements

The implementation of the tariff regulation in Chile as well in the Buenos Aires concession, requires that the regulator interact with providers. In particular, in the case of Chile, the regulator should be able to obtain detailed information on several aspects related to costs and operation of each utility company whose tariff formulas are being regulated. Furthermore, the regulator should be able to design an optimised model firm. . Two flaws are associated to this regulatory system. First, a potential difficulty faced by the regulator in this situation is related to asymmetries of information. In effect, although the Chilean case can be considered an example of yardstick competition, the design of a model firm requires to obtain information from actual operator in order to conduct the tariff studies.²¹ Second, because of the way in which a model firm is defined, the implementation of the tariff regulation appears to be very intensive in the use of resources, the reason is that to construct the model firm, the regulator (or the consultant team hired by it) is forced to micro-manage the regulated firm.

5. Conclusion

The operation of natural monopolies in the provision of infrastructure imposes a regulatory challenge. On one hand it is desirable from the society standpoint to take

²¹ One way to avoid this problem, which have been considered in anticipation of privatisation of companies, is that the state be able to keep a participation in the company ownership. Although it may contribute to reduce information asymmetries, it will not completely eliminate them.

advantages of having one operator providing the good or service. On the other hand there is the risk that the unique provider exert market-power reducing social welfare. Conceptually, the need of regulation is out of question. However, the specific forms that the regulation should take it less clear. In this report we have identified four general alternative models of regulatory regimes with strong reference to water and sanitation service provision: cost of service (cost +), price-cap, yardstick competition, and franchise operation. Furthermore, we also discussed the types of incentives that they involve, the requirement for implementation, and also its potential flaws.

We have also examined actual ongoing experiences in the context of two tariff regulatory regimes in Latin American countries. First, we explore the tariff regulatory scheme used in the case of Chile. This system is in place since the end of the eighties, and at present three tariff process have been implemented. Second, we also reviewed tariff design and related aspects, in the context of the Buenos Aires concession for the provision of water and sanitation service, which is one of the bigger concession ever allocated in the developing world. These two cases represent very different regulatory models being actually used in the context of developing countries. Both cases are useful in the extent that provide the opportunity to learn not only by studying each of them in isolation, but also allowing comparison and contrast among them.

Finally, we did evaluate each of the tariff system in isolation as well as proceed to comparing both of them. We believe that the conclusions that comes from that analysis are potentially useful for enhancing the design of tariff regulatory systems in the context of thereform process being pursued elsewhere.

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