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X-factor estimation and controversies: the case of Lima's airport

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X-FACTOR ESTIMATION AND CONTROVERSIES: THE CASE OF LIMA'S AIRPORT¹

ABSTRACT

In theory, X-factor regulation provides better incentives for cost reduction than previously widely-used rate-of-return regulation. However, a deeper look into how this factor is effectively estimated shows the regulator enjoys a great deal of discretion, especially when selecting the methodologies used to estimate its components.

This paper describes how the X-factor is estimated in Peru and analyzes the main controversies (both theoretical and practical) that arose when the X factor for the country's main airport was estimated. Conclusions are the following: i) careful planning of the concession process reduces the probability of unnecessary controversies when the X factor is estimated retrospectively, since this methodology requires data that needs to be collected at the time of the concession; ii) cost of capital estimation is a main source of controversies due to the subjective criteria used in its calculation and its impact in the final result; and, iii) transparent procedures improve the legitimacy of regulatory decisions, especially in contexts of limited public resources and weak institutions, typical of developing countries.

Keywords

Airport regulation; RPI-X; X factor; price caps

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1. INTRODUCTION

One of the consequences of the movement toward the private provision of public services that started in the 1980s was the surge of new regulation methodologies. The best known, proposed by Littlechild (1983), consists in allowing regulated prices to increase at a pace determined by the inflation rate and an “X factor” estimated as the difference in productivity between the regulated industry and the whole economy; thus resembling the price evolution of competitive markets. This methodology is known as RPI-X.

X-factor regulation has been increasingly adopted by telecommunication and energy regulators of a large number of countries, a tendency that can be interpreted as recognition that it provides better incentives for reducing costs than the better known and previously widely-used methodology, rate-of-return regulation. In Peru, a further reason argued to adopt X-factor regulation is that it reduces the scope for discretionary decisions, which is a desirable feature of regulation in an institutionally-weak country.

However, a deeper look into how the X-factor is effectively estimated shows that regulators enjoy a great deal of discretion, especially when selecting the methodologies and their components used to estimate the elements of the X factor. They decide, for example, whether the factor will be estimated forward or backward-looking, the length of the estimation period, the introduction of a correction factor, if an alternative constitutes a good proxy or not, etc. It is important to bear in mind that the lack of quality data is one of the characteristics of a developing economy, for which in many cases the use of discretionary criteria in regulatory processes is warranted.

This paper deals with the methodological controversies that arose when the X factor for the concession of Lima’s airport was estimated. As we will see, these were fueled by the dearth of data, the scarcity of international experiences in airport regulation, the inadequate prevision regarding information requirements at the time the airport was concessioned, and the structural problems regulators face in developing countries: inadequate administrative skills and limited human and financial resources.

The paper is structured as follows. In the following section, the environment in which regulation develops in Peru and the economics behind the X factor are explained. The third section describes the main aspects of the concession of Lima’s Airport and presents the results of the X-factor estimation. The fourth section discusses the main controversies surrounding the price review and the final section presents the main conclusions of the research.

2. LITERATURE REVIEW

Three publications document the problems of implementing price cap regulation in Peru. According to Ros (2001), the lack of statistical information and the effect of singular events

as privatization and the balancing rate, complicate the estimation of the X factor in the Peruvian telecommunications industry, so the author recommends that the result be compared with estimations made in other countries. The author also alerts about the temptation to re-estimate the X factor before the end of its term in case the monopolist achieves high rates of return, as this would distort the incentive system of the regulatory regime.

Bernstein *et al.* (2006) conducted an estimation of the X factor that should be applied to Telefónica for the period of 2004-2007. According to the authors, since it's an update rather than a first estimation, the event has a special interest for the regulatory practice, even beyond Peru. Therefore, the methodology proposed by the authors emphasizes the consistency with the initial estimate of the X factor and the purpose of price cap regulation.

Finally, Defilippi and Flor (2008) describe the most important methodological dilemmas that a developing country regulator has to face in an industry where experience in price cap regulation is scarce. They illustrate their analysis using the price review of a Peruvian port terminal as an example. The authors conclude that in contexts characterized by weak institutions and limited competition, a backward-looking estimation of the X factor using the TFP technique is desirable. They also suggest that in industries dominated by state-owned companies, the X factor should be estimated for the firm, not for the whole industry.

3. ECONOMIC REGULATION IN PERU

3.1 Institutional background

In 1990, the Peruvian government started a series of structural reforms aimed at changing its role in the economy, from direct provider of goods and services to investment promoter and regulator of economic activities. A large-scale privatization program was implemented, and by 1995 most of the state-owned enterprises were transferred to the private sector, including all telecommunications and the main energy sector companies. As in many other countries at the time, regulatory bodies were set to regulate natural monopolies in the latter industries.

In the transport sector reforms were implemented at a slower pace, mostly because the country's ports, airports and railways were natural monopolies and the government did not know how to regulate them. Unlike telecommunications and energy, international experience regulating privatized ports and airports was practically non-existing, and in railways it had not borne expected results. In 1999, the government followed the advice of the World Bank and created Ositrán, a regulatory body in charge of regulating monopolies in four transport modes: ports, airports, railways and highways. Several months later the first terminal operator was concessioned to the private sector and in early 2001, the Jorge Chávez International Airport (JCIA), the country's main airport serving Lima, the capital

city. Due to the lack of international experience, Ositran developed the sector's regulatory framework borrowing methodologies and procedures used in other regulated industries such as telecommunications and electricity supply.

3.2 Ositran's regulatory rationale

Ports and airports may become natural monopolies when demand is insufficient to exhaust the large economies of scale present in their cost functions. This occurs more frequently in developing countries, where local economies are usually not large enough to justify competing infrastructures. In these circumstances, market failure justifies government intervention in the form of economic regulation.

But regulation may also fail, due principally to three causes: (i) information asymmetries between regulators and the regulated firms about the characteristics of demand, technology and costs; (ii) lack of regulatory commitment that may result in the expropriation of assets due, for example, to politically-motivated pricing; and (iii), regulatory capture that may result in decisions biased towards private interests. Because of these failures, plus the additional costs of implementing regulations, government intervention may result in higher economic costs than those caused by market failures themselves (Guasch and Spiller, 1998). For these reasons, Ositran's guiding principle is that regulation is only warranted when competition is impossible or undesired, and the benefits of regulation are higher than its costs (Ositran, 2006).

3.3 Regulatory mechanisms

Ositran's goal is to eliminate the barriers that impede the functioning of competitive markets; or, if this is not possible, to replicate the discipline that market forces would impose on the regulated firm if they were present. To achieve these goals, regulation is based on two mechanisms: (i) regulation of how firms access the facilities they need to compete (access regulation); and (ii), price regulation.

Access regulation

Even when a transport infrastructure is a natural monopoly, it is possible to introduce competition in some markets; such as pilotage in ports, or ground handling in airports. However, since the monopolist that controls the infrastructure has incentives to restrict competition to recover rents foregone by regulation (Paredes, 1997); it is necessary to regulate the conditions under which firms providing these services are given access to the infrastructure. Efficient prices would then be set by market forces.

A theoretical principle commonly used to regulate access is the "Essential Facilities Doctrine", under which firms with substantial market power must grant access to their facilities to their competitors under "reasonable" conditions. The regulator only intervenes

to settle disputes or when parties are unable or unwilling to reach an agreement (Flor and Defilippi, 2003).

Access regulation is preferred to price regulation because it promotes competition and reduces the probability of regulatory failures. Ositrán only applies price regulation in markets where competition cannot be introduced.

Price regulation

The second and most common mechanism for market intervention is price regulation under the RPI-X methodology. Under this type of regulation, the firm is allowed to raise its prices at the rate of the Retail Price Index (RPI or inflation rate), minus some amount (the “X” factor) estimated to reflect the difference between expected increases in the productivity of a certain industry and that of the economy as a whole.

There is a large amount of literature that discusses the advantages and disadvantages of price cap regulation.² However, none of them represents an effective guide that regulators could use to estimate the X factor in practice.

The first effort in this direction was made by Bernstein and Sappington (2000). According to these authors, regulated prices are allowed to increase according to the following equation:

Equation 1

$$P_t = P_{t-1} \cdot [1 + RPI - X]$$

Where P_t represents the price of the service in period t , P_{t-1} represents the same price in the previous period, RPI is the Retail Price Index (the inflation rate), and X is a factor that reflects the expected increases in the firm’s productivity.

The X factor can be estimated forward or backward-looking. The former method implies forecasting the evolution of the main drivers of cost and revenues (the pace of technological change, the evolution of the cost of capital, market expectations, etc.) which requires the regulator to assign probabilities to diverse future events. The backward-looking approach, used in Peru, assumes that future productivity gains will be similar to those occurred in the past. This option reduces the scope for discretionary decisions.

3.4 The 2004 Matarani port price review

This port of Matarani is the second most important in Peru. Its only terminal was concessioned under a BOT scheme in 1999. By 2008, the only experience Ositrán had had with X-factor regulation had been the price review of this terminal carried out in 2004.

² See: Beesley and Littlechild (1989), Braeutigam and Panzar (1989), Brennan (1989), Lewis and Sappington (1989), Schmalensee (1989), Armstrong, Cowan and Vickers (1994), Crew and Kleindorfer (1996), and Laffont and Tirole (2000), among others.

According to Defilippi and Flor (2008), this process forced OSITRAN to resolve five methodological dilemmas:

1. Whether the X factor should be estimated prospectively or retrospectively;
2. The productivity index to be used to estimate the industry's productivity;³
3. Whether the X factor should be estimated for the industry or the firm, given that all other terminals in the country were managed by an state-owned company;
4. The methodology to estimate the concessionaire's opportunity cost of capital in an backward-looking estimation of the X factor; and,
5. How to estimate the terminal's initial stock of capital, an input required to estimate the terminal's productivity.

According to the authors, results suggest that in a context of low institutional development and limited competition, estimation of a retrospective X factor using the TFP technique is more desirable. Likewise, that if the industry is dominated by state-owned firms that face an incentive structure not consistent with that of a private firm, the X factor should be estimated for the concessionaire rather than for the industry. They also conclude that using a known methodology to estimate the cost of capital diminishes the likelihood of future controversies (a desirable feature of regulation in a country with weak institutions), and recommend that governments determine the value of the assets to be concessioned before transferring them to the concessionaire.

4. LIMA'S AIRPORT CONCESSION AND THE 2008 PRICE REVIEW

4.1 The concession

Peru has a network of 19 national airports. The most important is Jorge Chavez International Airport, serving Lima city. In 2000, the year previous to its concession, Lima's airport traffic totaled 4.5 million passengers, approximately 60% of the country's total. Seventeen of the remaining airports were concessioned to two operators in 2006 and 2010. Nowadays, Cusco's, the second in importance, is the only national airport still operated by a state-owned company.

Lima's airport was concessioned in 2001 for a period of 30 years to the bidder that offered to share with the government the highest percentage of the airport's gross revenues. It was awarded to a consortium led by Flughafen Frankfurt/Main AG, the operator of Frankfurt's airport. This consortium offered to share with the government 46.511% of the airport's gross revenues. A subsidiary, Lima Airport Partners (LAP), was created to operate the airport.

³ The options are: Total Factor Productivity, Data Envelope Analysis and Stochastic Frontier Analysis.

The concession contract stipulated that LAP had to comply with a series of mandatory investments during the first four years of the concession, which totaled US\$ 220 million. The concessionaire's investment commitments during the concession period amount to US\$ 1 billion.

By 2008, the year of the price review, the concession's service and revenue structure could be broken down as follows:

1. Regulated services: those related to the airport business and in whose markets the concessionaire enjoys a monopoly position: use of passenger and cargo facilities, take off/landing, aircraft parking, and boarding bridges.
2. Essential services: those related to the airport business but whose markets are competitive or potentially competitive, such as cargo handling, use of counters, offices and operational areas for airlines, and the use of facilities for supplying aircrafts (fuel, catering, etc.). These are regulated via Ositran's Access Regulation.
3. Non-regulated services: services not related to the airport business, such as renting of commercial areas. The concessionaire is not expected to enjoy a dominant position in these markets and thus, prices and access conditions are governed by supply and demand.

Prices for the regulated services were set in the concession contract for a period of eight years. The contract also stated that Ositran had to review these prices and set them from the ninth year on, for five-year periods, using the RPI-X methodology.

4.2 The price review

The Lima's airport price review started in early 2008. New regulated prices had to be in force from February, 2009 on. According to Ositran (2008), the X factor had to be estimated using the following formula: ⁴

Equation 5

$$X = [(\dot{W} - \dot{W}^e) + (\dot{T}^e - \dot{T})]$$

Where:

\dot{W} is the concessionaire's input price growth rate

\dot{W}^e is the economy's input price growth rate

\dot{T}^e is the economy's productivity growth rate

\dot{T} is the concessionaire's productivity growth rate

To estimate the economy's input price growth rate, Ositran assumed that the economy's input price growth rate equals the inflation rate plus the economy's productivity growth

⁴ Notice that this formulation is slightly different to the one proposed by Bernstein and Sappington (1998).

rate. To estimate \dot{T}^e , the economy's productivity growth rate, Ositran used the estimation made by Osiptel to estimate Telefonica's X factor the previous year.

Prior to estimate the productivity growth rate of Lima's airport, Ositran had to decide whether a single till or dual till approach was to be adopted. Under the single till approach, the average productivity of all of the services provided by the airport, regulated or not, is taken into account. Under the dual till approach, only the average productivity of regulated services is taken into account. The regulator argued that in the case of the Lima's airport non-regulated services were closely related to its airport business and that these represented less than 20% of the revenues, for which the probability of them cross-subsidizing regulated services was relatively low. Therefore, the adoption of a single till approach was warranted (Ositran, 2008).

To estimate yearly outputs, services were separated into 65 groups and their resulting production indexes were aggregated using their participation in total revenues as weights. Inputs, on the other hand, were estimated as three separate groups: labor, materials and capital. The estimation of the first two was relatively straightforward. The number of man-hours was used as proxy for the amount of labor used, and the index of materials was estimated dividing the airport's yearly purchases and expenditures in services into a price index.

The estimation of the capital input index requires knowing both the concession's initial capital stock and the value of the investments carried out by the concessionaire. The former was troublesome, since it required estimating in 2008 the value the capital invested in the airport had in 2001. To do so, Ositran estimated separately the value of the terminal from that of the runway. In the case of the terminal, it took its book value by December 31st, 2000 (S/. 125 million) and applied the accumulated depreciation rate established in the National Appraisal Regulation for the category "buildings", age "up to 35 years" and in a "regular" condition (28%). Therefore assumed that the capital invested in the terminal was worth S/. 90.2 million by the time of the concession. For the runway, Ositran determined that the overhaul carried out in 1998 had extended its lifetime from 30 to 43.4 years and estimated its value taking into account its book value applying a linear depreciation method. It estimated that the capital invested in the runway was worth S/.18 million by the time of the concession.

The estimation of the amount of capital used as input also requires the estimation of the concessionaire's WACC (weighted-average cost of capital), which is used to estimate the rental rate of capital.⁵ To estimate the cost of the shareholder's own resources, Ositran used the CAPM model. It estimated the beta factor as the average of a sample of seven listed companies owning airports under price cap regulation. As a measure of country risk, it took the difference in yields of sovereign bonds of the same maturity issued by the

⁵ Estimating the X factor requires calculating the rate the concessionaire would have paid if it had leased the assets instead of purchasing them, i.e., the rental rate of capital. See Jorgenson (1963).

Peruvian and the US Treasuries. The result was used to estimate the concessionaire's WACC rate during each concession year.

With this information, the X factor was estimated in 0.53%. However, after a long procedure in which successive appeals were presented and errors corrected, the X factor was set in 0.51%. This means that the following years regulated prices at Lima's airport were to be allowed to increase 0.51% a year above inflation (see Table 1).

Table 1: Resulting X factor

Factor	Concessionaire	Economy	Difference
<i>T</i>	-1.00%	1.69%	-2.69%
<i>W</i>	0.45%	3.68%	3.23%
X factor initially estimated			0.53%
Approved X factor			0.51%

Source: Ositran (2008)

Ositran grouped services into three service bundles and established that the X factor was to be applied as a global price cap, i.e., individual prices within each bundle could increase even higher than the RPI-X rate as long as their weighted average increase did not surpass it. The service bundles are:

Bundle 1: Use of national and domestic terminals

Bundle 2: National and domestic take off/landing, parking and boarding bridges

Bundle 3: Cargo facilities

5. CONTROVERSIES SURROUNDING THE X-FACTOR ESTIMATION

5.1 The concession's initial capital stock

Given that the impact of capital expenditures in a firm's productivity is measured as the variation of the capital stock in relation to the previous period, the determination of the concession's initial capital stock has a large influence on the estimation of productivity, especially if we take into account that the largest part of investments in infrastructure projects is represented by capital expenditures. In this case, the source of the controversy was the inexistence of an appraisal of the airport's assets, i.e. the initial capital stock, by the time of the concession.

LAP argued that the initial value of the airport's assets was small relative to its own investments, thus resulting in negative productivity during the first years of the concession. This argument supported its claim that prices of regulated services should increase by 7% during the following years.

The concessionaire argued that Ositran developed an ad hoc methodology that cause the overvaluation of the airport's assets, and that the use of book values was dismissed by de facto assuming that it would undervalue them, even though it was included among the accepted methodologies in Ositran's own regulations.

As for the methodology used by Ositran to estimate the terminal's value, LAP questioned its subjectivity regarding the use of the National Appraisal Regulation's depreciation tables. It argued that the use of an airport's terminal more closely resembles that of hospitals and theaters than that of an office building, that its age was 36, not 35 years and that the terminal was in a "bad" conservation condition. If Ositran had used the category "hospital, theaters and the like", age "up to 40 years" and condition "bad", the accumulated depreciation rate would have been 73% instead of 28%. Moreover, the concessionaire argued that assuming that the terminal has depreciated 28% in 35 years implicitly assumes that it has a lifetime of 125 years, which is not a reasonable result. According to international standards, the lifetime of an airport would be 50 years, approximately.

Ositran answered LAP's criticisms arguing that in the case of Matarani port terminal, where an appraisal had been done by the time of the concession, the book value was a third of the appraisal value. Considering the similarities in accounting practices of the state-owned companies managing both infrastructures before their concession, it was reasonable to assume that there was a large difference between the airport's assets book and appraisal values. It also argued the use of rate obtained from the National Appraisal Regulation was a more objective procedure that assuming arbitrarily and subjectively what would be the terminal's lifetime.

5.2. WACC estimation

Four aspects of the WACC estimation were the subject of controversy: changes in the estimation approach, the concessionaire's debt/capital structure, the relevant financial costs concept and the estimation of the cost of capital.

Changes in the estimation approach

Between 2004 and 2007 Ositrán had set the prices the concessionaire could charge for new services, such as the use of cargo facilities and boarding bridges. In these occasions Ositrán had estimated the concessionaire's cost of capital using a forward-looking approach, assuming that current market conditions would prevail in the future. Therefore, the estimated cost of capital rate was the same for the following years. During the 2008 review, however, the regulator had used a backward-looking approach, thus estimating the historical WACC for each concession year and introducing its average in the X-factor formula.

Ositrán answered that between 2004 and 2007 prices for new services were estimated under rate-of-return regulation, which is forward-looking. However, the approach taken to estimate the X factor for Lima's airport was backward looking, thus taking into consideration historical figures when possible. The regulator added that this methodology was consistent with the one used to estimate the X factor in the telecommunications industry.

Debt/capital structure

This controversy arose because the concessionaire had secured financing for its investments from the third year of the concession, i.e., it had financed its operations during the first two using only shareholder's resources. Thus, the WACC rates estimated for the first year were much higher (14.68%) than the one of the final year of the analyzed period (8.97%). This would imply the introduction an artificial productivity gain that distorted the X-factor estimation.

According to LAP, the regulator failed to recognize the singularity of the concession's initial conditions, arguing that it was reasonable to expect that all of the investments will be financed in the future. Its proposal was to use not the historical but the projected debt/capital structure, as it is common in finance.

Ositrán answered that both regulation theory and experience backed the use of historical accounting to estimate the cost of capital (see Morin, 2006; and Kolbe, Read and Hall, 1984).

Average financing vs. effective cost

Ositrán estimated each year's financing costs according to the average financing costs concept: it divided the concessionaire's interest, debt maintenance and issuance payments by the book value of debt. LAP, on the other hand, argued that the right concept to use

was the effective cost of debt: the internal rate of return of all projected financing-related disbursements during the debt period. The concessionaire supported its claim by arguing that considering issuance costs only in the year financing was secured instead of spreading them during the debt period would exaggerate financial costs that year and generate an artificial productivity gain the following year.

The regulator answered that the estimated WACC is not a discount rate, thus using the effective cost of debt would be inconsistent with economic theory. It also argued that the use of average financing costs was consistent with regulatory theory and it was used by Osipitel to estimate the X factor.

The concessionaire's cost of capital

Two components of the cost of capital estimation were subject to controversy: the beta factor and the country risk. According to the concessionaire, a sample of seven airports subject to price cap regulation was too small to effectively reflect the risk of the airport industry. It proposed to use a sample of 27 airports. Ositran argued that the seven airport companies considered in the sample were similar to LAP in both incentives scheme and property type and that the sample proposed by the concessionaire included companies managing airport subject to types of regulation different to price caps.

As for the country risk, LAP argued that Ositran's methodology of using each concession year's country-risk average was wrong. Given that the X factor is estimated for the long run, the concessionaire argued that the best country risk indicator should reflect at least a business cycle, as it is done by regulators in Mexico and Brazil. Ositran answered that the concessionaire's arguments could be valid for a forward-looking estimation of a discount rate but not for the estimation of the WACC rate as an X factor component. It added that the cited regulators estimate X factors under approaches different to index numbers, for which their methodologies were not relevant for this case.

LAP also claimed that the estimated cost of capital should include premia for liquidity (2%) and regulatory risk (1%) as it was done in previous regulatory processes. In the case of the liquidity premium, it cited financial literature to support its claim that it required a compensation for the limitations its shareholders have to transfer the concession to third parties. Ositran argued that it does not constitute a regulatory practice to include a liquidity premium in the estimation of the cost of capital and added that even though the concession contract imposes certain restrictions for transferring their shares, it does not preclude it.

As for the regulatory risk premium, Ositran argued that the concessionaire did not estimate it. Moreover, the regulator acknowledged its existence but it considered that it was already included in the beta (estimated as the average of a sample of airports subject to price-cap regulation), thus adding a premium would duplicate the return for this risk.

5.3 Bundles of services

According to Ositrán, one of the factors that popularized the use of price caps was that under this mechanism the regulator only needs to determine the average price level, allowing the regulated firm to freely determine the price structure. Since the regulated firm has a better knowledge of each service's costs and demand, the resulting prices would be efficient, i.e., resemble those estimated using the Ramsey rule (Ramsey, 1928). Price caps are in this sense superior to other regulatory mechanisms that require the regulator to set both price level and structure.

However, for this outcome to occur two conditions need to be met. Firstly, that all services are provided under a monopoly. Secondly, that there is only one type of consumer that acquires all of the services provided by the monopolist. Consequently, all consumers benefit when relative prices of some services decrease and all of them suffer when others rise. For this reason, Ositrán bundled services provided at Lima's airport according to their users: passengers, airlines and cargo users. The regulator also argued that failing to separate these services according to types of users would allow the concessionaire to obtain additional benefits in the short term reducing the price of some services (take off/landing, for example) increasing others that generate a higher share of revenues (such as fees for terminal use). This would generate rent transfers from passengers to airlines.

The concessionaire criticized the regulator for establishing the bundles. Citing Laffont and Tirole (2000) and Armstrong and Vickers (1991), argued that separating regulated services into bundles would reduce social welfare. It added that airport regulators in Mexico and the UK give regulated firms total flexibility to determine the price structure

Ositrán argued that according to Laffont and Tirole (2000), social welfare would only be maximized if the regulator estimates not only the X factor but the quantity of each service that would be demanded and that any deviation from these estimations would result in prices that do not guarantee social welfare maximization. It also argued that Armstrong and Vickers (1991) findings refer to firms producing a single good but supplying several markets regulated under average price regulation. This is not the case of LAP but it is the case of regulated airports in Mexico and UK.

6. CONCLUSIONS

Several conclusions can be drawn from the analysis of the controversies regarding the estimation of the X factor for the concession of Lima's airport. The first is that careful planning of the concession process reduces the probability of unnecessary controversies when this factor is estimated backward-looking, since this methodology requires data that needs to be collected at the time of the concession. The second is that cost of capital estimation is a main source of controversies due to the subjective criteria used in its calculation and its impact in the final result. The third and more important conclusion is that transparent procedures improve the legitimacy of regulatory decisions, especially in contexts of limited public resources and weak institutions, typical of developing countries.

As one can see in this case, the fact that arguments were openly discussed reduces the probability of a bias.

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