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Cost Reductions, Cost Padding, and Stock Market Prices: The Chilean Experience with Price-Cap Regulation

Every four years, you feel you are going to war.
Alejandro Jadresic, former Minister of Energy of Chile

The flaws of traditional rate-of-return regulation are well known. They include a lack of incentives to reduce costs, as well as a tendency for firms to choose the wrong mix of inputs and to misreport costs in order to inflate the revenues allowed by the regulator. Political discretion in implementing this regulatory regime may further discourage efficient investments by giving firms reason to fear holdup problems after investments are made, particularly when consumer groups are able to capture the regulator.[1]

The introduction of price-cap regulation was expected to correct some of these problems. By guaranteeing prices rather than returns and by using long regulatory lags, a price-cap system gives firms the incentive to cut their costs, since they get to keep the residual between prices and costs. Beesley and Littlechild, for example, argue that price-cap regulation "is less vulnerable to 'cost-plus' inefficiency and overcapitalization."[2] Moreover, price caps largely limit firms' incentives to game the system, both because adjustments within review periods are predetermined and because, in practice, review

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1. See, for example, Posner (1969); Averch and Johnson (1962); Acton and Vogelsang (1989).

2. Beesley and Littlechild (1989, p. 456).

procedures often include an element of yardstick competition.[3] Limiting regulatory discretion is expected to be particularly useful in developing countries. Price caps can potentially enhance political commitment, reduce holdup problems and lobbying by regulated firms, and therefore encourage more efficient investment decisions.[4] Another advertised benefit of price-cap regimes is the reduced burden it places on the regulator. These theoretical advantages have encouraged the adoption of price-cap regimes across the developed and developing world.

Partly because of the system's relatively recent introduction, little empirical work has been carried out on industry performance under price-cap regulation. Some empirical work focuses on the U.S. telecommunications sector, which has used a price-cap system for several years. Mathios and Rogers provide evidence of significant price reductions (of up to 7 percent) in states that changed rate-of-return for price-cap regulation.[5] A number of issues naturally arise. Do price reductions measure the extent of efficiency gains? Was this a one-off gain, or will further efficiency gains materialize over time? Moreover, since states adopt regulatory changes voluntarily, one should also wonder if these reductions are simply capturing the fact that these states have very active regulators (that would have achieved similar reductions with rate-of-return systems), rather than reflecting a general property of price caps. Are these gains bound to occur in other countries that adopt price caps, or are they very dependent on having a judiciary system of U.S. levels of independence?

Another important open question is the distribution of efficiency gains between firms and consumers. It is often argued that to make price caps less vulnerable to capture by producers or consumers, the system should remove discretion and contain a high degree of commitment. But this could make the system more vulnerable to strategic behavior by firms. In other words, the cost of credibility is a set of inflexible rules that may not always serve the regulatory needs of the country.

3. A number of key papers on price-cap regulation appeared on the 1989 symposium in the *RAND Journal of Economics.* See also Cabral and Riordan (1989) on incentives for cost reductions; Sappington (1980) and Sappington and Sibley (1992) on the strategic behavior of the regulated firm; Baron and Besanko (1987), Salant and Woroch (1992), and Gilbert and Newbery (1994) on regulatory commitment.

4. Levy and Spiller (1996). Some of these features, like limited discretion, are not inevitable components of a price-cap regulatory regime, but the connection is often made in practice, particularly in developing countries.

5. Mathios and Rogers (1989). Later studies, surveyed in Kridel, Sappington, and Weisman (1996), find conflicting results. For example, Blank, Kaserman, and Mayo (1998) do not find that price-cap regulation has reduced toll prices.

In this paper, we collect data on the performance of firms in the Chilean electricity distribution industry from 1988–99. The sector is characterized by privately owned firms operating in a regulatory system that was designed to operate as a pure price cap based on a significant regulatory lag (four years), with the explicit intent of reducing political discretion. The regime adopted has the properties that characterize price-cap regimes.[6] The broader institutional setting allows for a meaningful test of the performance of regulatory institutions, since Chile's judicial system and administrative bureaucracy compare favorably to other countries.[7] Perhaps the most significant feature of the Chilean price-cap regime is the attempt to explicitly limit the regulator's discretion at regulatory reviews. This includes a request to construct a model efficient company from which to derive the rates that will apply to all companies of a certain type (defined on the basis of customer density). The regulatory regime describes a number of steps to be used in constructing the model company and limits the regulator to using only data generated during the review period (which is the year prior to the review year).[8] The regulator must combine the information provided by the companies with its own estimates based on prespecified weights. Although the law dates to 1982, the emphasis on limiting discretion originated in the attempt to insulate the regulator from political pressures in the transition to democracy following the Pinochet regime, when left-of-center parties were expected to wield considerable power.[9]

We find that a measure of efficiency (namely, the ratio of reported costs to revenues) improves by 1.2 percent a year, on average, from 1989 to 1999. This pronounced reduction in costs is all the more remarkable because it includes three test years of 1991, 1995, and 1999. Although these estimates cannot be

6. See Acton and Vogelsang (1989).

7. See, for example, Levy and Spiller (1996).

8. Fischer and Serra (2000, p. 183) state that "the hypothetical efficient firm is built on the basis of the real firm that the regulators believe to be the most efficient among existing firms, introducing an elementary type of yardstick competition."

9. Fischer and Serra (2000) point out that South American regulators in general "suffer from a credibility problem as a result of the perceived threat of regulatory takings." This has resulted in weak regulators that are subject to strong pressure from the electric utility lobbies. They also state that "Chile is remarkable for the weakness of its regulator, which has never been able to impose the compensations to consumers envisaged for energy shortages. The possibility of appealing regulatory decisions to the courts has weakened the regulator even further" (p. 193). Fischer, Gutiérrez, and Serra (2003) discuss the high profits of the distribution companies. Chilectra's return on equity, for example, went from 8 percent in 1988 to 32 percent in the period 1996–98. They argue that the profit levels of the distribution companies are much higher than those of the generating companies, despite the fact that the latter are subject to greater risk.

interpreted as causal (since other institutions and policies may be causing cost reductions), they do suggest that price-cap regulation has not stood in the way of cost efficiencies, even during a period of political transition.

More importantly, we find a U-shaped pattern in cost reductions. Trends in cost reductions are reversed every four years, with costs 1.4 percent greater than would be expected on the basis of time trends alone. This reversal corresponds to years prior to regulatory reviews, when a new price cap is set for the next four-year interval. This pattern is consistent with strategic behavior by firms. Although caps are supposed to ignore information from specific firms and follow the costs of an ideal efficient company, as in the yardstick models, in practice there is a limited number of firms from which to draw the information, so the probability of each firm's cost reports' influencing the future price caps is high. Furthermore, the Chilean regulatory regime was designed with the objective of removing as much discretion from the hands of the regulator as possible, so a regulator that is captured by the industry and that incorporates inflated costs into future price caps can always claim not to have had the discretion to act differently.

We complement these findings with evidence from the stock market. Following Schwert and Rose, a number of papers use stock market reactions to evaluate the effect of regulations.[10] We modify the approach to evaluate the performance of the price cap, particularly the extent to which firms engage in strategic behavior. We start by constructing a measure of naïve cost expectations that excludes any indicator of the occurrence of review periods. We then look at the stock market's responses to cost announcements by firms during review and nonreview periods, taking as a benchmark a situation with no regulatory reviews. The relatively recent introduction of the regulatory regime means that there is a considerable amount of uncertainty concerning the evolution of the industry and the position of the regulatory agency vis-à-vis consumers and firms. The fact that a left-of-center coalition succeeded General Pinochet's government contributes to this uncertainty, as does the fact that the different actors have had very little time to observe the system at work.

Our first finding is that the occurrence of regulatory review periods has a negative effect on cumulative abnormal returns. Although the effect is not always significant at conventional levels, it suggests that the new system may be characterized by considerable uncertainty that is not priced in by the stock market. We also find that the stock market responds differently to cost reve-

10. Schwert (1981); Rose (1985). See also Whinston and Collins (1992); Dnes and others (1998).

lations during review and nonreview periods. Generally, costs that exceed cost expectations tend to depress the returns to holding a firm's stock. In review periods, however, we find that high cost reports increase returns. This is consistent with the presence of strategic behavior by firms that is not priced in prior to regulatory reviews and with the incorporation of high cost revelations into future rates by the regulator. This suggests that the emerging price caps may allow the firms to capture most of the welfare gains from their improvements in efficiency. The estimated effects fall over time, suggesting either that some learning is taking place or that uncertainty is being priced in by the market (or both). More generally, this suggests that it may be worthwhile to incorporate information produced by the stock market into the design of the optimal regulatory regimes.[11]

This evidence from Chile should have broad applications. The literature to date has analyzed evidence mainly from price-cap regimes in developed countries (primarily the United States and the United Kingdom), with a focus on the telecommunications industry. Our study thus extends the analysis along two dimensions, focusing on the electricity sector in a Latin American country. Moreover, the Chilean approach to regulating electricity distribution is closer to many theoretical models of pure price cap than other regimes. As Gilbert, Kahn, and Newbery argue, "The privatization and competitive structure of the electricity industry in Chile was the first major reorganization in the world. Its success has been one of the primary motivations for experimentation in other countries."[12]

Our paper proceeds in four additional sections. The next section provides some institutional background and describes qualitative data from field research and interviews conducted in Chile in 1999. We then describe our empirical approach. A subsequent section presents our main empirical results, while the final one concludes.

Institutional Background

The regulatory reforms implemented in Chile in 1982, which included the introduction of a price-cap regime for the electricity distribution sector, were largely motivated by the inefficiency and excessive political discretion of prior regulatory regimes. Some of the main issues are well described in the

11. For a start in this direction, see Di Tella and Kanczuk (2002); Faure-Grimaud (2002).
12. Gilbert, Kahn, and Newbery (1996, p. 19).

literature, and we provide a short discussion and further institutional detail in appendix B.[13] In this section, we report complementary evidence on the actual performance of the regulatory regime, some of which we obtained in interviews conducted during field research in Santiago, Chile, and New York in the summer of 1999.[14] This evidence suggests that some participants in the field study believe the price caps have promoted significant improvements in firm efficiency, but have had limited effects on consumer welfare, as prices have tended to remain high and firms have tended to act strategically.[15]

In general, most participants felt that the system had a limited effect on prices. Evidence consistent with this contention is illustrated in figure 1, which reports the results from the industry association's and the regulator's studies on the value-added of distribution (VAD), which is the maximum price that distribution companies can charge. The figure shows the VADs by area of density, with the highest-density area defined as area 1 and the lowest as area 3. Each panel displays three lines, identifying the VAD study commissioned by the industry association of companies (always the upper line), the VAD study commissioned by the electricity regulator (always the lower line), and the end result, which was based on an explicit weighting of two-thirds for the regulator and one-third for the company. A lower VAD level suggests more efficient companies, with gains passed on to consumers. This evidence on the primary input into price determination explains why some participants in the field argue that the Chilean price-cap regime in distribution has had a limited effect. For example, in the high-density distribution area, the VAD is almost unchanged between 1984 and 1996. Studies of specific companies are not entirely consistent with this characterization. Data from the Ministry of Economics, for example, indicate that the VAD for Chilectra (Chile's largest distribution company) fell by 18 percent in the rate-setting process of 1992 and by an additional 5 percent in the rate-setting process of 1996, which was below the company's efficiency gains since privatization.[16]

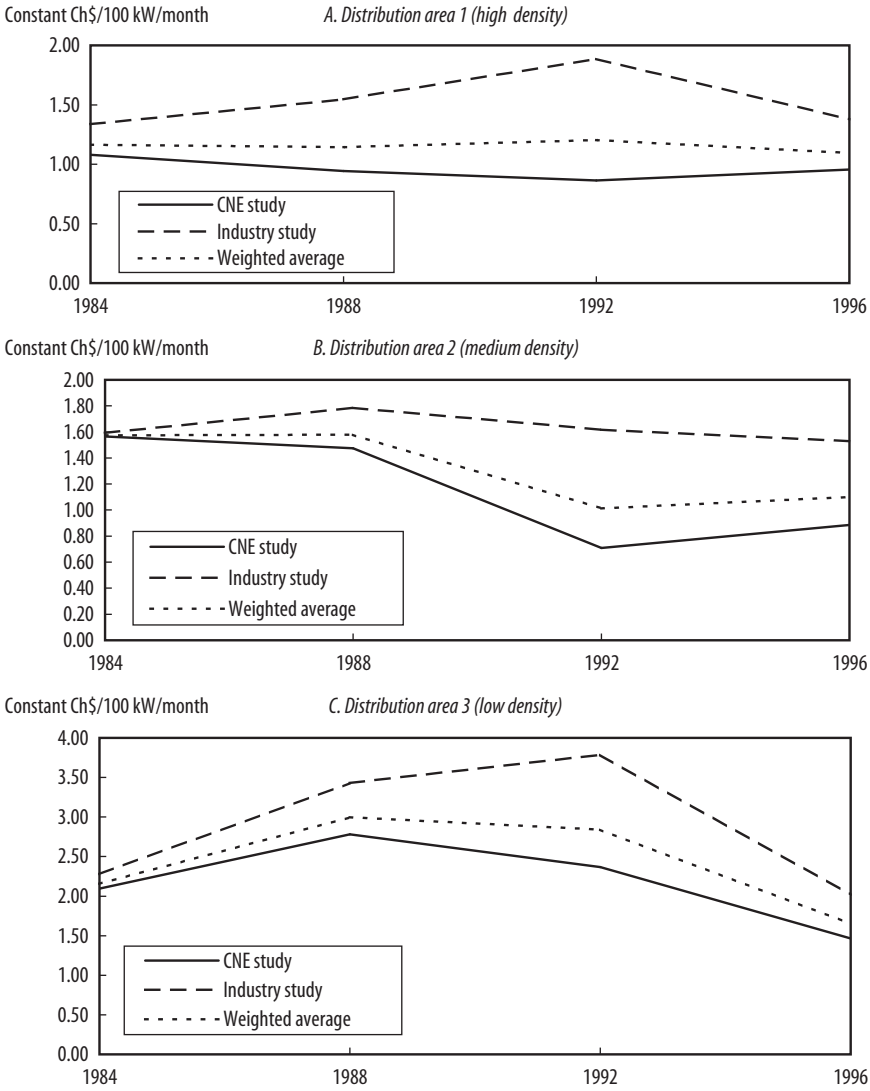
13. For a more complete description of the Chilean reforms, see Hachette and Lüders (1993); Spiller and Martorell (1996); Bernstein (1995); Fischer and Serra (2000); Bustos and Galetovic (2002); Pollit (2005); Rudnick and Mocarquer (2007). For a discussion of some outstanding issues, including aspects of cost padding and regulatory commitment, see Galetovic and Sanhueza (2002).

14. Those interviewed include a former minister of energy, the head of the National Energy Commission, a former executive director of the regulatory commission, executives from four distribution and generation companies (including the most prominent companies in the industry), equity analysts from Chilean brokerage houses and pension funds, and analysts of distribution companies headquartered in New York City.

15. For a formal discussion, see Galetovic and Sanhueza (2002).

16. Fischer, Gutierrez, and Serra (2003).

FIGURE 1. High Voltage VAD Estimates by the Government Regulator and the Industry Association of Regulated Companies[a]



Source: Sebastián Bernstein, SYNEX Consulting Engineers.

a. The figure shows the value added of distribution (VAD) for high voltage electricity by area of density, with the highest density area defined as area 1 and the lowest as area 3. In each figure, the upper line represents the VAD study commissioned by the industry association of companies, the lower line represents the VAD study commissioned by the electricity regulator (CNE), and the middle line graphs an explicit weighting of two-thirds for the regulator and one-third for the industry association. A lower VAD suggests more efficient companies with gains passed on to consumers.

In contrast to the limited change in prices, we found indications of significant improvements in cost efficiency over the sample period, which is consistent with the contention that this rule-based regulatory regime, combined with private ownership, created strong incentives for cost efficiency. We focus on Chilectra, the largest and best-documented distribution company in Chile. Chilectra's costs, which we identified from public operating and financial statements, declined significantly in the 1990s. Energy losses fell by more than 60 percent, from 13.6 percent of sales in 1990 to just 5.4 percent of sales by 1999. Distribution costs measured by employees per customer served and by employees per unit of energy supplied decreased by 52 and 64 percent, respectively. To some extent this may reflect subcontracting, but costs from operations per unit of energy sold fell 56 percent.

When we combine this information on limited movement in prices and strong improvements in efficiency, we find, not surprisingly, that returns strengthened over this period. Chilectra's return on equity increased from 8 percent in 1988 to 32 percent in 1996–98. According to Fischer, Gutierrez, and Serra, "In the 2000 rate-setting process, rates were reduced by a further 18 percent, which led to lower profit margins at first. In response, Chilectra increased labor productivity substantially. . . . [T]he profit levels in distribution are much higher than those of the generating companies, which in any event are subject to greater risks, both for lack of a secure market (they operate under competition) and because of the potential for droughts."[17] Our own discussions with industry participants revealed a general impression of higher profitability in the electricity distribution sector relative to transmission and generation.

These changes in prices and efficiency took place in the context of a regulatory regime with higher degrees of commitment. In 1996, three Chilean electricity distribution companies filed lawsuits in response to the proposed reinitialization. The case illustrates both the regulator's attempts to use its discretion and the industry's attempts to use the courts to impose limits on regulatory discretion. Among other complaints, the distribution companies claimed that the regulator had abused its authority in designating sections of a distribution territory to be of higher density (and hence lower prices) and in setting coincidence factors. The distribution companies won most of the issues in the case in the appeals court, although the Supreme Court largely reversed this decision on technical grounds of whether the regulator had followed the terms of the statute. Regardless of the specific outcome, the court case itself

17. Fischer, Gutiérrez, and Serra (2003, p. 48).

suggests that the courts did limit regulatory discretion. Alejandro Jadresic, the Minister of Energy from 1994–98, noted the implicit constraints imposed on the regulator's ability to construct an efficient model company because of the threat of judicial review: "When building the model, you end up always looking at what happens in actual companies. The cost studies are subject to the challenge of verifiability in court; the model company could be regarded as pure ungrounded imaginary construction."[18] The constraint imposed by courts on regulatory discretion was also noted by Oscar Landerretche, the electricity regulator for the reinitialization in 2000: "Presently the courts play a big role, something I'm not altogether comfortable with. Courts aren't a way to resolve technical things."

Evidence that the rules mattered is found in firm behavior. Consultants and company executives note that despite the elaborate rules to divorce firms' reported costs from price determination, there is scope for firms to game the system aside from lobbying on coincidence factors. Sebastián Bernstein, of Synex Consulting Engineers, acknowledges such gaming: "Consultants hired by the regulators would sometimes take underground lines as overhead lines. They would inflate man-hours, quantities, quality, and costs of investment. For example, they never identified volume discounts, booking full price for every item even though we knew they were getting volume discounts." The chief executive of a distribution company pointed to similar practices: "In the technical studies, both sides cheat—everyone does this. If you didn't cheat, then you would be stuck with the superintendent's numbers, which simply aren't fair. Of course, hiding information is very difficult because after you do your NRC study, the inspector from the regulator comes. But the superintendence has poor people who don't like to do much work, so it works out. When Chilectra delivers information, they use a freight truck. The guys in the regulator's office get depressed when it comes."

Interview participants suggested a variety of strategies for shifting costs, such as booking all maintenance costs in the review period (which is the year prior to when the review actually takes place), when in fact they are incurred continually over a longer period; timing efficiency plans that involve redundancies to take effect after review periods; and planning investment programs to peak around review periods to maximize the capital base. The companies' investor relations personnel suggested that we focus on nonreview periods to get more accurate indicators of the firms' efficiency. Equity analysts and institutional investors similarly reported that they treated cost information

18. All quotes included in this section are from Di Tella and Dyck (2001).

differently during review and nonreview periods, because they understand that "bad news" in the year prior to the regulatory review is, in fact, a response to the incentives that firms face.

Theory, Empirical Strategy, and Data

The extent to which the price cap is predicted to improve incentives and reduce costs depends on the degree of commitment. In price-cap regimes with limited commitment, like those that revert to rate-of-return regulation, investment incentives are distorted. The following three predictions are standard in price-cap models.[19] First, price caps provide strong incentives for cost reductions, because firms will be motivated to reduce costs if prices, not profits, are fixed in the regulatory regime. Second, the incentives to reduce costs will be strongest immediately after a reinitialization of price caps and weakest as the new rate review approaches. This prediction is based on the fact that cost reductions implemented farther away from review years will be enjoyed for longer periods, without threat of being confiscated by the regulator. Finally, firms have an incentive to increase reported costs during regulatory review periods, since cost revelations that are closer to a review year are most likely to affect future price caps.

To implement our empirical tests of these three predictions, we focus on the evolution of costs in the industry, rather than prices.[20] Our first hypothesis is that COSTS (defined as costs as a proportion of revenue) for company i in quarter q fall over time under a price cap. In other words,

$$\text{COSTS}_{iq} = \phi + \alpha \text{TIME}_q + \eta_i + \varepsilon_{iq},$$

where TIME_q is a time trend equal to one in the first quarter of 1989 and forty-four in the fourth quarter of 1999 (the end of our sample), η_i is a company fixed effect, and ε_{iq} is an error term.[21] The hypothesis suggests that α is negative. The inclusion of the company fixed effect accounts for possible differences in the initial level of costs based on a variety of factors such as

19. See, for example, Biglaiser and Riordan (2000); Cabral and Riordan (1989).

20. This approach contrasts with that of Mathios and Rogers (1989). If the version of the price-cap system used favors firms, the extent to which efficiency gains will show up in price reductions is unclear.

21. Part of the trend may initially reflect the reduction of electricity theft, which is unlikely to be replicable in later years. An alternative justification for a nonlinear trend is learning.

differences in the density of the distribution area or differences in local labor markets.

The second hypothesis we consider is that costs fall more early on in each of the four-year regulatory periods and rise later in the review period. The estimating equation is

$$\text{COSTS}_{iq} = \phi + \alpha\text{TIME}_q + \lambda\text{EARLY}_q + \delta\text{EARLY}_q^2 + \eta_i + \varepsilon_{iq},$$

where EARLY_q is a variable indicating the stage in the review period; it takes a value of one in the first quarter after a review, two in the second quarter, and so on up to sixteen in the last quarter of the review year.[22] The hypothesis is that λ is negative and δ is positive. Again, company fixed effects are included.

We generate an additional prediction if we assume that firms have private information about their costs and can either report the true information or shift cost reports from the quarter in which they are incurred to another quarter at a private cost to the firm (that is, cost padding). The regulator may incorporate these exaggerated cost reports in the new regulated prices, either because of capture or because there is some commitment in the system. One limit to such behavior is that the regulatory review can be reopened if profits are excessive (basically, because Chile is a sovereign country and because there are explicit provisions for doing so if the rate of return exceeds 15 percent). Any additional income that companies earn from leasing their lines to cable or telecom companies does not count toward their regulated income.[23]

The regulator's tendency to expropriate investments may have led to a system with little regulatory discretion, but this allows the firms to game the system. If the regulator were truly setting prices according to the efficient-firm construct, such padding should not affect the prices firms face (as in Shleifer's yardstick model).[24] To be legally enforceable by the courts, however, price caps must resemble actual costs, so the extent to which the system has achieved this separation is testable. The private costs of such behavior for the firm will probably increase as the extent of cost shifting rises.[25]

The third prediction states that the incentives for cost exaggeration will be stronger the closer the next review period, since cost revelations that are closer to a review year are most likely to affect future price caps. To explore

22. We do a robustness check excluding review years.
23. See Pollitt (2005).
24. Shleifer (1985).
25. For example, firms will want to limit the number of periods with inaccurate accounting information, to the extent that there are costs to keeping two sets of books or information is used both by managers inside the firm and by analysts outside the firm.

this prediction, we introduce a review period dummy in the above specifications for the year prior to the review year. To further explore how regulatory commitment (or lack of discretion) and strategic misrepresentation by the firm affect firm behavior, we consider the possibility that the interaction between the firm and the regulator is observed by a third actor—namely, the stock market. In a stable environment, the stock market probably already prices in any freedom that firms have to exaggerate costs in an effort to influence future rates. This may not be the case in Chile, however, given the relatively recent introduction of the system and the delicate political transition following the Pinochet regime. The stock market may be unsure of the extent to which firms will be willing and able to game the system, or how much regulatory latitude will exist for apparently exaggerated cost reports, or how tolerant the public will be of high utility rates. This suggests that review periods will be years of relative uncertainty, and that the stock market may respond positively to a high cost report.

To construct a simple test, we define what can be called naïve cost expectations as the cost that is expected by a market participant with the best available knowledge but with no information on the occurrence of regulatory reviews. We then define a cost surprise as the difference between the actual reported cost and this measure, and we define β as the effect of cost reports that exceed naïve expected costs on abnormal stock market returns.[26] This setup generates the following four possibilities, depending on whether the stock market believes that the firm's announcement represents the truth or a strategic attempt to influence future price caps and whether the regulator incorporates the reports into the calculation of future caps (either because of capture or because the law allows no discretion) or ignores them (and uses wider sources of information in resetting price cap). See table 1.

The simplest case to consider is the one in which cost information is truthful and does not affect future prices, as the regulator uses a wider source of information than just the most recent cost information ($\beta \leq 0$). This is the normal situation for firms that operate in unregulated industries and for regulated firms in nonreview years; it corresponds to the top right quadrant of a truthful firm and a regulator that uses a wider source of information than just the most recent cost information. We predict that higher costs, which depress earnings and which are not translated fully into higher rates by the regulator, will lead to lower values of equity in this case.

26. An alternative approach is to use cost expectations that incorporate the information on the occurrence of review years and thus focus on the case of strategic firms as a benchmark.

TABLE 1. Possible Effects of the Revelation of Higher-than-Expected Cost on Abnormal Stock Market Returns in a Review Year

	Regulator incorporates reports	*Regulator ignores reports*
Truthful firm—cost information reflects true costs	$\beta = 0$	$\beta \leq 0$
Strategic firm—cost information can be shifted	$\beta > 0$	$\beta \leq 0$

This situation contrasts with that of a strategic firm and a regulator that incorporates this information into higher rates either because of capture or because the regulatory regime leaves little discretion in the hands of the regulator, which corresponds to the bottom left quadrant ($\beta > 0$). In this case, the stock market may interpret the cost revelations as the amount that the firm will propose to the regulator for the next review period, perhaps as its bargaining position with the regulator. Alternatively, the cost report may be interpreted as the amount that the regulator has hinted that it will accept. In these scenarios, the cost reports will increase future prices, and actual costs are expected to be lower than reported costs in the review period. Consequently, there should be a positive relationship between a regulated firm's cost revelations and its returns. Interestingly, the very same lack of discretion that allows efficient investments to occur without fear of confiscation also permits a captured regulator to use cost reports to the detriment of consumers and then argue that the system left no option.[27]

A third possibility is that the market believes the regulator will ignore the information produced by a strategic firm ($\beta \leq 0$). In this case, the market will accord little value to the information, so cost reports should have either no impact on stock prices or a negative effect if the market thinks that such cost padding is costly to the firm. Finally, the fourth possibility is that the regulator will incorporate the reports produced by a truthful firm. In this case, the cost revelation produces two offsetting impacts. First, the market believes these are real costs and thus responds in the traditional way, such that higher costs reduce equity value. Second, the market also believes the regulator will set a more generous price cap, leading to higher revenues in the future. In this case, the higher reported costs will not lead to lower stock market prices.

Empirically, we define the stock market response to information concerning each firm in each quarter as STOCK_{itq}, which is the cumulative abnormal

27. If costs are mean reverting, the regulator may set a price that is too high, delivering a positive coefficient for the relation between the cost surprise and the stock price of the company. This would have nothing to do with strategic behavior, however, as it results from the stochastic properties of the cost process and the regulatory framework.

return surrounding the window in which information about firm performance (costs and revenues) is revealed to the public and may be incorporated into equity prices. The subscript t denotes a distinction between quarters that fall in review periods and those that do not. As our right-hand-side variable, we introduce $\text{COSTSURPRISE}_{itq}$, a measure of the difference between actual costs and expected costs under the assumption that regulatory periods are not different from nonreview periods. It is constructed by taking the actual level of COSTS_{itq} and subtracting the best estimator of COSTS_{itq}, given all the available information at $t-1$ but excluding information on the occurrence of review periods. Finally, REVIEWYEAR_{tq} is a dummy variable that takes the value of one during the year in which the information taken into account in the new prices is generated (specifically, the year prior to the change in regulated prices, which in our sample includes the years 1991, 1995, and 1999). The decision to include the full year prior to the review follows the information provided to us by the key informants and the institutional data available from the National Energy Commission.[28] In brief, data on company performance (which are used to evaluate the profitability of a model company) arrive at the regulator's office during different months of the prior year. The regulator calculates the new tariffs in the first half of the following year (the actual year in which the rates are changed, which in our sample includes 1992, 1996, and 2000), and these rates are put in place in July through October (the date follows Chile's historical practice).

The estimating equation is

$$\begin{aligned}\text{STOCK}_{itq} = {} & \alpha + \beta\text{COSTSURPRISE}_{itq} * \text{REVIEWYEAR}_{iq} \\ & + \psi\text{COSTSURPRISE}_{itq} + \gamma\text{REVIEWYEAR}_{iq} + \varepsilon_{itq},\end{aligned}$$

where ψ measures the effect of bad news on STOCK and is expected to be negative, γ is the effect of review periods, and β provides an estimate of the effect of cost surprises on stock market returns in a review year. We expect β to behave as discussed earlier.

Data

The electricity distribution companies in our sample account for 94 percent of total production in the central connected grid in Chile (based on 1991 data), from the time the companies were privatized (in most cases between

28. See (www.cne.cl). For example, in the latest available accounting period (2004), the information gathered concerns the model firm for 2003 and includes the wage information provided to us by Ernst and Young for December 2003.

1989 and 1991) to 1999. We use a broad measure of costs, taking the sum of the cost of goods sold and sales and administrative expenses. Since cost shifting occurs in many categories, this aggregate measure of costs should capture cost shifting if it does take place. These data are available on a quarterly basis from the financial statements that publicly traded utilities are required to file as part of their listing requirements, and this information is what equity analysts use.

We divide costs by revenues. This normalization has a number of attractive features relative to using raw cost data. The ratio is quite insensitive to cost and revenue changes of the same magnitude, which are common in the industry (that is, the system has a strong pass-through element). For example, according to the price-cap formula, prices automatically adjust to changes in the cost of purchased power (which can change every six months). They also adjust for known and expected cost drivers unrelated to company actions.[29] Implicitly, we are assuming that the ratio is driven primarily by cost changes. This is fairly accurate for Chile, where prices for the value added of distribution moved very little over the sample period.

Other cost measures and normalizations are possible, but they severely limit the number of firms and number of observations. These other possibilities include the cost information used explicitly in the VAD studies, controllable costs that exclude the costs of purchased power, costs per unit of output, costs per employee, and costs per customer. Cost information used explicitly in the VAD studies for firms, for example, is only collected once every four years, and it is not available to equity investors. Unfortunately, information on the volume of power purchases is only available after 1996 and then only on an annual basis.[30] Appeals to the office that regulates the electricity sector, individual companies, industry associations, and equity analysts only produced quarterly data for one company. Information on customers and employees was also only available on an annual basis, for limited time periods, and for a subset of companies. We used the information we were able to collect to verify that our findings are not sensitive to the choice of cost normalization. Specifically, our refined cost measures are highly correlated with our base measure and produce qualitatively similar results for Chilectra, the one company for which much of this information is available.

29. Specifically, the formula calls for prices to be adjusted based on the movement of a composite index (with the weights specific to each company) that includes increases in the consumer price index, the copper price index, the wholesale prices index, and an earnings index.

30. On the strategic use of power purchase expenses, see Baron and de Bondt (1979); Kaserman and Tepel (1982).

TABLE 2. Summary Statistics[a]

Variable	*No. observations*	*Mean*	*Std. deviation*	*Minimum*	*Maximum*
COSTS	399	0.832	0.052	0.696	1.030
COSTSURPRISE	377	–0.001	0.036	–0.100	0.161
STOCK	394	0.016	0.083	–0.258	0.180
EARLY	399	10.138	5.113	1	20
TIME	399	23.521	12.530	1	44
REVIEWQUARTER	399	0.140	0.348	0	1
REVIEWYEAR	399	0.281	0.450	0	1
POST_REVIEWQUARTER	399	0.135	0.343	0	1
POST_REVIEWYEAR	399	0.271	0.445	0	1

a. The data definitions and their sources are given in appendix A.

Table 2 presents summary statistics for our variables, and table 3 lists their correlation coefficients. Among the firms in our sample, the average level of costs as a proportion of revenues is 83 percent. Costs as a percentage of revenues decline from a mean value of 89 percent in 1989–90 to just 78 percent in 1998–99. The next section reports the results of our empirical tests, in which we control for firm fixed effects, quarterly effects, and so forth, but visual inspection of the raw data is suggestive. Declines in costs appear to be concentrated immediately after rate reviews, and the rate of decline slows later in the period. The review periods are themselves distinct, with costs tending to spike in the final quarter of the reference year used for reinitializing rates.

Following standard event-study methodology, we measure the stock market's response through a firm's cumulative abnormal return around the window in which information is revealed. We construct a capital asset pricing model (CAPM) cumulative abnormal return. We first estimate the industry's beta using the industry's capitalization-weighted daily stock returns and the returns on the market index. The daily abnormal returns are the firm's daily returns less the industry's beta times the daily market return. We cumulate abnormal returns over the information window. For the date on which information is revealed to the market, we use the dates of the annual reports submitted to the Institutional Brokers' Estimate System (IBES) and the dates of the quarterly financial reports available in Michigan State University's Global Access Database.[31] Our window ends five trading days after

31. For the fourth quarter (annual) reports, we use the report dates in IBES. The report release dates vary across years and across firms, but most are released in late March. Global Access provides release dates for quarterly reports of a smaller set of companies, and we use these dates for the full sample. We assume the quarterly financial statements become public thirty trading days after the end of the quarter, except for the last quarter of each year.

TABLE 3. Correlation Coefficients[a]

Variables	*COSTS*	*COST SURPRISE*	*STOCK*	*EARLY*	*TIME*	*REVIEW QUARTER*	*REVIEW YEAR*	*POST_REVIEW QUARTER*	*POST_REVIEW YEAR*
COSTS	1.000								
COST SURPRISE	0.625	1.000							
STOCK	–0.028	–0.040	1.000						
EARLY	0.202	0.169	–0.261	1.000					
TIME	–0.725	0.021	–0.003	–0.115	1.000				
REVIEWQUARTER	–0.002	0.064	–0.472	0.530	0.122	1.000			
REVIEWYEAR	0.027	0.083	–0.163	0.700	0.135	0.643	1.000		
POST_REVIEWQUARTER	0.041	–0.111	0.302	–0.516	–0.103	–0.142	–0.221	1.000	
POST_REVIEWYEAR	0.096	–0.086	0.202	–0.620	–0.206	–0.232	–0.361	0.611	1.000

a. The data definitions and their sources are given in appendix A.

this event, to allow for the information to be widely communicated and incorporated into prices. We use two starting dates for the window: five days before the announcement and twenty-five days before the announcement. Our discussions with market participants indicate that the wider window is more appropriate because it captures the possibility of information's being leaked to the market prior to the event.[32]

To estimate the COSTSURPRISE, we subtract predicted costs from reported costs. Operationally, we predict the value of COSTS using a regression of a company's COSTS on its lagged COSTS, a time trend, and seasonal dummies estimated on the full sample up to period *t.* Our results are robust to using measures of predicted costs from regressions that estimate the parameters using the full sample, as well as to simpler specifications that exclude the lagged term. We use the above specification as it yields the highest *R* squared.

Table 2 also provides summary statistics for abnormal returns (the variable STOCK) and cost surprises, which reflect the strong performance of the distribution sector. The average cumulative abnormal return in event windows is 1.6 percent, with significant variability (a standard deviation of 8.3 percentage points). The mean value of our cost surprise variable is zero, with a standard deviation of 3.6 percentage points.

Empirical Results

Table 4 presents the basic results for our unbalanced panel. Our sample includes eleven electricity distribution companies, and we use quarterly data. We have an average of 39.9 observations per company, with a minimum of fifteen and a maximum of forty-four. Regression 1 shows that a time trend is a negative and significant determinant of costs for our sample, even after we control for company fixed effects and include dummies for the four quarters in the year to control for any seasonal effects that may be present. The estimated effects are economically significant. Since the data are quarterly, they suggest that reported costs as a proportion of revenues have dropped by 1.2 percent each year. Although our estimates cannot be interpreted as causal, given that other institutions may be causing the cost reductions, they do suggest that price-cap regulation has not stood in the way of cost efficiencies.

32. Our results are qualitatively similar, albeit less significant, in a much shorter window [−5, +5].

TABLE 4. The Evolution of Costs over Time under a Price-Cap Regime, 1989–99[a]

Explanatory variable	*(1)*	*(2)*	*(3)*
TIME	–0.0030***	–0.0032***	–0.0030***
	(0.0001)	(0.0005)	(0.0001)
TIME^2		7.5e–06	
		(1.1e–05)	
REVIEWYEAR			0.0142***
			(0.0003)
Constant	0.8933***	0.8948***	
	(0.0041)	(0.0056)	
Summary statistic			
No. observations	399	399	399
No. companies	11	11	11
Seasonal dummies	Yes	Yes	Yes
Company fixed effects	Yes	Yes	Yes
R^2	0.55	0.55	0.57

***Statistically significant at the 1 percent level.

a. The dependent variable is COSTS, defined as reported costs divided by reported revenues. TIME is a time trend equal to one in the first quarter of 1989 and forty-four in the fourth quarter of 1999. TIME^2 equals TIME squared. REVIEWYEAR is a dummy variable equal to one in the year prior to when the regulatory review takes place, and zero otherwise. Robust standard errors are in parentheses.

Regression 2 includes a squared time trend to evaluate whether these cost reductions have weakened over time. We find no evidence for this possibility. The estimated coefficient increases slightly, implying cost reductions of 1.3 percent a year. Regression 3 incorporates review year dummies. We obtain similar results for the continued and significant improvements in cost efficiency. Notably, the review year dummy is positive and significant. This dummy implies that trends in cost reductions are reversed in review years, with costs on average 1.4 percent above those in nonreview years.

Table 5 explores our second hypothesis: namely, that costs fall more during the early phase of a review period. The intuition behind this prediction is that cost reductions that occur early in the review period provide benefits over more periods and are thus more desirable. Regression 1 in the table tests this hypothesis by including a variable (EARLY) that indicates how far into a regulatory period (of 4 years = 16 quarters) we are, EARLY, and its square, EARLY^2. The results favor the theoretical prior that cost reductions are strongest early in the regulatory periods, when the firm still has many future quarters in to benefit from the cost reduction. The estimated coefficients suggest that costs have a U-shaped distribution, with a minimum in the fifth quarter. Toward the end, costs equal the intercept, indicating that the firms reverse any earlier cost gains in the last quarters. The fact that firms

TABLE 5. The Evolution of Costs within Review Periods, 1989–99[a]

Explanatory variable	*(1)*	*(2)*
EARLY	–0.0019	–0.0020
	(0.0014)	(0.0016)
EARLY^2	0.0002**	0.0002
	(7.6e–05)	(0.0001)
TIME	–0.0031***	–0.0032***
	(0.0001)	(0.0002)
Constant	0.9096***	0.9058***
	(0.0068)	(0.0074)
Summary statistic		
No. observations	399	287
No. companies	11	11
Seasonal dummies	Yes	Yes
Company fixed effects	Yes	Yes
R^2	0.57	0.58

***Statistically significant at the 1 percent level; **statistically significant at the 5 percent level.

a. The dependent variable is COSTS, defined as reported costs divided by reported revenues. EARLY is a time trend equal to one in the first quarter of the four-year period between review years and sixteen in the fourth quarter of the fourth year. EARLY^2 equals EARLY squared. In column 2, review years are excluded. Robust standard errors are in parentheses.

record no cost gains toward the end of the regulatory period is consistent with the idea that late cost revelations may be an attempt to influence future price caps. To reduce the influence of the regulatory review periods, regression 2 repeats regression 1 excluding these periods. The results reveal a similar U-shaped pattern, although the effects are somewhat less precisely estimated.

Table 6 incorporates stock market information to further explore the effect of the price-cap regime. Regression 1 shows that cost reports that exceed our simple measure of expected costs have a negative influence on the cumulative returns to holding the firm's stock. The effect of cost surprises on STOCK is negative, although not significant. As suggested earlier, this specification could be mixing up observations for which the expected effect is negative with observations for which it is positive. Regression 2 in table 6 shows that the review period dummy (defined as the last two quarters of the year prior to the year in which a regulatory review is taking place) is negative and significant, suggesting that returns are 11 percent lower, on average, in quarters corresponding to a year in which regulatory reviews are taking place. A possible interpretation of this coefficient is that review years introduce a significant amount of uncertainty, which is not priced in by the market. When we study this phenomenon over time in table 7, we find that the negative effect is larger (that is, more negative) in the early review periods than in later

TABLE 6. The Effect of Cost Announcements on Stock Returns in Review and Nonreview Periods[a]

Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
COSTSURPRISE	−0.129	−0.087	−0.301*	−0.053	−0.352
	(0.143)	(0.142)	(0.169)	(0.141)	(0.224)
REVIEWYEAR		−0.029***	−0.030***	−0.019*	−0.020*
		(0.010)	(0.009)	(0.010)	(0.010)
REVIEWYEAR*COSTSURPRISE			0.606**		0.665**
			(0.262)		(0.297)
POST_REVIEWYEAR				0.032***	0.032***
				(0.011)	(0.011)
POST_REVIEWYEAR*COSTSURPRISE					0.198
					(0.307)
Constant	0.017***	0.026***	0.025***	0.015**	0.015**
	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)
Summary statistic					
No. observations	377	377	377	377	377
No. companies	11	11	11	11	11
Company fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.00	0.03	0.04	0.05	0.06

***Statistically significant at the 1 percent level; ** statistically significant at the 5 percent level; * statistically significant at the 10 percent level.

a. The dependent variable is STOCK, defined as the cumulative abnormal return of stocks inside a thirty-day window [−25, +5] around the dates on which the quarterly financial reports of each company are made public. REVIEWYEAR is a dummy equal to one for all four quarters of the year prior to the regulatory review. POST_REVIEWYEAR is a dummy equal to one in the four quarters of the year following the regulatory review. COSTSURPRISE is the forecast error of COSTS (costs/revenue). The best prediction of COSTS at time q is assumed to be estimated by the data available up to q, according to the following specification:

$$\text{COSTS}_{iq} = \alpha + \beta\text{COSTS}_{iq-1} + \gamma\text{TIME}_q + \delta\text{SEASONAL\_DUMMIES} + u_i + \varepsilon_{iq}.$$

The forecast value of COSTS_{iq+1} is based on the estimated coefficients, and the surprise is the positive or negative deviation of the real value from its forecast. The estimated coefficients change as more data become available over time. Robust standards are in parentheses.

review periods, suggesting that participants are learning about the workings of the system.

Regression 3 in table 6 provides some of our most important results, showing that cost surprises (that is, costs that exceed the naïve cost expectation) generally reduce stock market returns, and the effect is significant at the 10 percent level.[33] Importantly, review periods again have a negative and well-defined effect on prices. Cost surprises that take place in a review year tend to increase the firm's stock returns significantly.

The evidence in table 6 is consistent with the hypothesis that market participants believe, first, that the firm is behaving strategically and, second, that

33. The results are significant at the 5 percent level in table A-1 in appendix A.

TABLE 7. Time Sensitivity of the Interactions of Cost Surprises with the Review Periods[a]

Explanatory variable	*First and second reviews (before 1996)*	*Second and third reviews (after 1992)*
COSTSURPRISE	–0.308	–0.197
	(0.223)	(0.233)
REVIEWYEAR	–0.019	–0.031***
	(0.013)	(0.010)
REVIEWYEAR*COSTSURPRISE	1.327**	0.226
	(0.326)	(0.384)
Constant	0.017**	0.025***
	(0.007)	(0.006)
Summary statistic		
No. observations	222	263
No. companies	9	11
Company fixed effects	Yes	Yes
R^2	0.04	0.04

***Statistically significant at the 1 percent level; **statistically significant at the 5 percent level.

a. The dependent variable is STOCK, defined as the cumulative abnormal return of stocks inside a thirty-day window [–25, +5] around the dates on which the quarterly financial reports of each company are made public. REVIEWYEAR is a dummy equal to one for all four quarters of the year before the regulatory review. COSTSURPRISE is the forecast error of COSTS (costs/revenue). The best prediction of COSTS at time q is assumed to be estimated by the data available up to q, according to the following specification:

$$\text{COSTS}_{iq} = \alpha + \beta\text{COSTS}_{iq-1} + \gamma\text{TIME}_q + \delta\text{SEASONAL\_DUMMIES} + u_i + \varepsilon_{iq}.$$

The forecast value of COSTS_{iq+1} is based on the estimated coefficients, and the surprise is the positive or negative deviation of the real value from its forecast. The estimated coefficients change as more data become available over time. Robust standards are in parentheses.

the regulator will be forced to use these cost data to set the new prices for the following review period. It also suggests that the market is somewhat surprised by the extent of the cost reports. This effect falls over time, however, reinforcing the idea that the market learns to expect this type of interaction between the firms and the regulator (see table 7). Since individual reviews include only a limited number of years (the first review, in particular, only has two preceding years), table 7 partitions the sample into two subsamples, one containing the first and second review and the other containing the second and third reviews. Similar results emerge when we look at individual reviews.

Regression 4 in table 6 introduces a post-review-period dummy and finds that such periods tend to significantly increase stock returns. We find large average effects in stock returns considering the pre- and the post-review periods. Cost surprises in post-review periods do not have a significant effect on returns.

Table A-1 in appendix A uses a shorter measure inside the review period of just two quarters (the last two), with somewhat stronger results. Table A-2, again using the shorter review period, presents slightly stronger evidence in favor of the hypothesis that the effects fall over time. Cost shifting would be limited to and focused on the last few quarters if (as it is natural to assume) the private costs to a firm as a result of shifting increase with the number of periods of distorted information or with the time gap between reported and actual costs.

Conclusions

Price caps have been a popular solution to the problem of regulating private monopolies. Virtually all of the countries that privatized their utilities in the 1990s adopted price-cap regimes. Partly as a result, there has been considerable interest in the theoretical properties of price caps. Some studies suggests that the system provides adequate incentives for cost reductions and can limit regulatory discretion. Others warn of potential inefficiencies, including distortions stemming from incorrect pricing, and the possibility of a sustained shift of returns to producers.[34] Little empirical work has been undertaken in the area, however, and most researchers refer to the empirical work of Mathios and Rogers and the case studies contained in Levy and Spiller.[35] Our paper seeks to contribute to the empirical understanding of price-cap regimes and, more generally, the costs of inflexible rules when firms behave strategically. It also complements the descriptions and analyses of the Chilean electricity sector, which, together with the experience of the British reforms, has been influential in shaping the profession's perception of how much can be achieved by good regulation of private monopolies.[36]

We study the performance of the electricity distribution industry in Chile in the 1990s under price-cap regulation, an institution that was put into place with the explicit objectives of increasing efficiency and limiting regulatory discretion at a time of considerable political uncertainty. Given that

34. See, for example, Beesley and Littlechild (1989); Breautigam and Panzar (1993); Levy and Spiller (1994); Schmalensee (1989).

35. Mathios and Rogers (1989); Levy and Spiller (1996).

36. On the British reforms, see Armstrong, Cowan, and Vickers (1994); Green and Newbery (1997).

the sector has undergone relatively few regulatory reviews to date, the evidence we present is only suggestive and should be interpreted in the context of broader studies of the industry.[37] We document reductions in the ratio of reported costs to revenues, on the order of 1.2 percent a year. This finding is consistent with strong incentives for cost reductions under a price-cap regime, as argued in the literature. We also find evidence consistent with strategic behavior by firms. The time profile of cost reductions within the four-year period between regulatory reviews is U-shaped, with most of the cost reductions taking place early in the process. We also find that cost reductions are reversed during the last year of each review period. A natural hypothesis is that firms are trying to influence the regulator. Although caps are supposed to ignore information from specific firms and reflect the costs of an ideal efficient company, as in the yardstick models, the regulator has a limited number of firms from which to draw the information in practice. Furthermore, the Chilean regulatory regime was designed with the objective of removing as much discretion from the hands of the regulator as possible, so a regulator that is captured by the industry and that incorporates inflated costs into future price caps can always claim not to have had the discretion to act differently.

We then propose a method that incorporates information generated by a third party (namely, the stock market) to evaluate the hypothesis that firms behave strategically. Our starting point is the finding that cumulative abnormal returns around the dates when firms announce quarterly results are negative during review periods, which suggests that there is considerable uncertainty that is not priced in by the market. Alternatively, the different actors may be learning about the workings of the new system. We then construct a measure of cost expectations that ignores information on the occurrence of review periods. We study the reactions of the stock market to firm announcements in nonreview years and compare them to market reactions in review years. Bad news (that is, cost reports that are higher than our measure of naïve cost expectations) depresses the returns to holding the firm's stock in normal times, but it increases these returns in review years. In a nonreview year, a one-standard-deviation (3.6 percentage point) unexpected increase in costs is associated with a negative cumulative abnormal return of 1.07 percentage points, whereas in a review year, a similar surprise increase in costs produces a positive cumulative abnormal return of 2.15 percentage points. Interestingly, the estimated effects fall over time. This evidence is consistent with firms' behaving strategically and the regulator's incorporating the infor-

37. See Fischer, Gutiérrez, and Serra (2003).

mation into future price levels, either because of capture or because the regulatory regime requires it.

In sum, the price-cap system seems to have promoted large efficiency gains. It also seems clear that the system has allowed producers to capture at least a part of those gains. More generally, our results suggest it may be worthwhile to complement regulatory procedures with stock market information.[38]

Appendix A: Supplementary Tables

TABLE A-1. The Effect of Cost Announcements on Stock Returns in Review and Nonreview Periods, Alternative Definition[a]

Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
COSTSURPRISE	–0.129	–0.034	–0.283**	0.046	–0.218
	(0.143)	(0.127)	(0.140)	(0.123)	(0.141)
REVIEWQUARTER		–0.111***	–0.114***	–0.103***	–0.107***
		(0.011)	(0.011)	(0.011)	(0.010)
REVIEWQUARTER * COSTSURPRISE			1.067***		1.016***
			(0.273)		(0.267)
POST_REVIEWQUARTER				0.067***	0.068***
				(0.013)	(0.013)
POST_REVIEWQUARTER*COSTSURPRISE					0.329
					(0.396)
Constant	0.017***	0.034***	0.033***	0.026***	0.026***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Summary statistic					
Number of observations	377	377	377	377	377
Number of companies	11	11	11	11	11
Company fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.00	0.22	0.25	0.28	0.31

***Statistically significant at the 1 percent level; **statistically significant at the 5 percent level.

a. The review period is defined as the last two quarters in the review year. The dependent variable is STOCK, defined as the cumulative abnormal return of stocks inside a thirty-day window [–25, +5] around the dates on which the quarterly financial reports of each company are made public. REVIEWQUARTER is a dummy variable equal to one for the last two quarters of the year before the regulatory review. POST_REVIEWYEAR is a dummy variable equal to one in the first two quarters after the end of each regulatory review. COSTSURPRISE is the forecast error of COSTS (costs/revenue). The best prediction of COSTS at time q is assumed to be estimated by the data available up to q, according to the following specification:

$$\text{COSTS}_{iq} = \alpha + \beta\text{COSTS}_{iq-1} + \gamma\text{TIME}_{q} + \delta\text{SEASONAL\_DUMMIES} + u_i + \varepsilon_{iq}.$$

The forecast value of COSTS_{iq+1} is based on the estimated coefficients, and the surprise is the positive or negative deviation of the real value from its forecast. The estimated coefficients change as more data become available over time. Robust standards are in parentheses.

38. See Di Tella and Kanczuk (2002).

TABLE A-2. Time Sensitivity of the Interactions of Cost Surprises with the Review Periods, Alternative Definition[a]

Explanatory variable	*First and second reviews (before 1996)*	*Second and third reviews (after 1992)*
COSTSURPRISE	−0.316**	−0.114
	(0.177)	(0.204)
REVIEWQUARTER	−0.130***	−0.078***
	(0.013)	(0.013)
REVIEWQUARTER*COSTSURPRISE	1.327***	0.226
	(0.326)	(0.384)
Constant	0.032	0.029***
	(0.005)	(0.005)
Summary statistic		
Number of observations	222	263
Number of companies	9	11
Company fixed effects	Yes	Yes
R^2	0.34	0.13

***Statistically significant at the 1 percent level; **statistically significant at the 5 percent level.

a. The review period is defined as the last two quarters in the review year. The dependent variable is STOCK, defined as the cumulative abnormal return of stocks inside a thirty-day window [−25, +5] around the dates on which the quarterly financial reports of each company are made public. REVIEWQUARTER is a dummy variable equal to one for the last two quarters of the year before the regulatory review. COSTSURPRISE is the forecast error of COSTS (costs/revenue). The best prediction of COSTS at time *q* is assumed to be estimated by the data available up to *q*, according to the following specification:

$$\mathrm{COSTS}_{iq} = \alpha + \beta \mathrm{COSTS}_{iq-1} + \gamma \mathrm{TIME}_q + \delta \mathrm{SEASONAL\_DUMMIES} + u_i + \varepsilon_{iq}.$$

The forecast value of COSTS_{iq+1} is based on the estimated coefficients, and the surprise is the positive or negative deviation of the real value from its forecast. The estimated coefficients change as more data become available over time. Robust standards are in parentheses.

TABLE A-3. Data Definitions and Sources

Variable	*Definition*	*Source*
COSTS	The firm's reported operating costs over revenue	Chilean Securities and Exchange Commission (CSV)
COSTSURPRISE	Deviation of the reported cost per revenue from its forecasted value. The best prediction of COSTS at time *q* is assumed to be estimated by the data available up to *q*, according to the following specification: $\mathrm{COSTS}_{iq} = \alpha + \beta \mathrm{COSTS}_{iq-1} + \gamma \mathrm{TIME}_q + \delta \mathrm{SEASONAL\_DUMMIES} + \mu_i + \varepsilon_{iq}$ The forecasted value of COSTS_{iq+1} is based on the estimated coefficients, and the surprise is the positive or negative deviation of the real value from this forecast	Estimated separately for each quarter and for each company using cost per revenue data from CSV

(*continues*)

TABLE A-3. Data Definitions and Sources (*Continued*)

Variable	*Definition*	*Source*
STOCK	Cumulative abnormal returns of company stocks inside a thirty-day [−25, +5] window around the dates that the quarterly financial reports become public	Calculated using stock price data from Datastream and date information from the Institutional Brokers' Estimate System (IBES) and Michigan State University's Global Access Database
TIME	The quarter number, which takes a value from one in the first quarter of 1989 to forty-four in the fourth quarter of 1999	Author's definition
EARLY	Time trend equal to one in the first quarter of the four-year period between review years and sixteen in the fourth quarter of the fourth year	Author's definition
REVIEWYEAR	Dummy variable equal to one if the year is 1991, 1995, or 1999, and zero otherwise	Authors' definition. Note that regulatory reviews occur in 1992, 1996, 2000
REVIEWQUARTER	Dummy variable equal to one if the quarter is one of the last two quarters of the year prior to the regulatory review and 0 otherwise	Authors' definition
POST_REVIEWYEAR	Dummy variable equal to one in the first four quarters of the year after the regulatory review, and 0 otherwise	Authors' definition
POST_REVIEWQUARTER	Dummy variable equal to one in the first two quarters after the end of the regulatory review, and 0 otherwise	Authors' definition
Seasonal dummies	A set of four dummies taking a value of one in the corresponding quarter, and zero otherwise	Authors' definition

Appendix B: Institutional Background and Regulatory Reforms

Chile's approach to regulating the power sector prior to 1982 was to use rate-of-return regulation for vertically integrated utilities dominated by state-owned firms, which resulted in the typical problems of political manipulation and asymmetric information.[39] The Electricity Law of 1931, amended in 1959, specified a maximum rate of return on fixed assets of 10 percent, with assets revalued annually. In the 1960s, prices were set so that firms did not even approach the maximum rate of return, and the financial situation deteriorated

39. For a thorough discussion of regulation in Chile, see Bustos and Galetovic (2002).

further under the Allende government (1970–73), when there were limited price increases despite hyperinflation. The Pinochet government responded in 1974–79 by adjusting prices upward to reflect revalued assets, but the companies clearly enjoyed advantages in having more intimate knowledge of their costs.[40]

The electricity reforms that produced the price-cap system for regulating distribution were designed to both increase efficiency and reduce political discretion over decisionmaking in the industry. Electricity reform began in 1978, when the National Energy Commission (CNE) was established and a committee was formed to make recommendations. It was formalized four years later, in the General Law on Electric Power Services of 1982 (DFL 1 of the Ministry of Mining).[41] The reforms moved to stimulate efficiency in electricity generation through the introduction of competition.[42] For distribution, the legislation called for a version of price-cap regulation.

The committee crafting the system had a clear understanding of the potential efficiency and political gains of a price-cap regime. Sebastián Bernstein, the head of the committee that drafted the 1982 law, describes the process as follows:

> Yardstick is a term we learned later, but in many ways that is an accurate way to characterize our model. The system was consciously designed to decentralize decisionmaking away from politicians and regulators. We had no reference books to turn to, but instead thought that the best way to regulate would be to simulate a market. In a market, you do not set prices—they are set by the most efficient company in the industry. This was a radical departure from what we had been doing looking at costs. We also knew that there were political troubles when prices had to be adjusted. We wanted to avoid politics by having a

40. Sebastián Bernstein, coauthor of the Electricity Law of 1982, noted, "We discovered that the book information didn't represent anything. At the time, we had an inflation rate of 500 percent a year. We were not sure what was in the books. It is very hard to go inside the company. They could convince you of anything. The main goal of managers at the time was to lobby to raise prices." See Di Tella and Dyck (2001, p. 4).

41. The stated objectives of the law are "to simplify the regulatory scheme and the tariff-setting process and to limit the discretionary role of government; to establish objectively measurable criteria for determining tariffs in a way which results in an economically efficient allocation of resources; to provide a competitive rate of return on investments in the sector to stimulate private investment; and to ensure availability of service to all who request it." Enersis S. A., "Form F-1: Prospectus for Sale of Shares," New York, 1993, p. A-10.

42. Spiller and Martorell (1996) provide a more detailed description of the generation sector. Some of its key components include the division of the electricity supply sector into a free market for large consumers (less than 2 megawatts) and a regulated market for small consumers. In the regulated market, prices for distributors are set twice a year based partly on expected short-run marginal costs over the next four years and partly on free market prices.

> rule-based system with automatic adjustments. We had the idea that the efficient company should not be your company, and it shouldn't be based on reported costs. Our idea was to use replacement costs applied to the actual structure of the grid and impartial information on the costs of services.[43]

Formally, DFL 1 sets a maximum price for the markup distribution companies can charge consumers for their service (called the value added of distribution, or VAD). This price is fixed for four years subject to automatic adjustments, and it is then revised systematically in review periods using a specific formula. The maximum price is designed to cover selling, general, and administrative costs; maintenance and operating costs; a factor for distribution losses; and a 10 percent real return on investment, based on the new replacement value of assets employed in distribution. To reduce the incentive for firms to misreport costs, the costs considered are not those reported by individual companies, but rather the costs of a model efficient company (taking into account the three types of density of distribution networks and whether lines are overhead or underground).[44] The costs of the model efficient company are based on the costs of a single test company (or the area of a company). No firms are informed of the choice beforehand, and the regulator is allowed to improve the test company results if costs are viewed as imprudent. Between reviews, prices are to be adjusted solely based on interim automatic adjustments using a weighted average factor (with the weights defined separately for each company) that includes increases in the consumer price index (CPI), the copper price, wholesale prices, and the earnings index published by the National Institute of Statistics.

This price cap thus features the four properties proposed by Acton and Vogelsang: the use of price ceilings; the definition of the price ceilings based on a bundle of services; the periodic adjustment of the price ceilings using "a preannounced adjustment factor that is exogenous to the firm" in intervals of several years; and the review and possible adjustment of the baskets and weighting schemes used by the industry.[45] This particular price-cap system also meets Levy and Spiller's three tests of commitment, which focus on

43. Di Tella and Dyck (2001, p. 5).

44. As Bernstein states, "There were only small differences in costs as firms increased in size, so long as we accurately characterized their density. This gave us an important idea: we could provide just three standards that would completely characterize all firms in the industry. This parsimony was essential because it would allow us to avoid discussions company by company. We knew if that was the situation, we could never prevail. The company could always produce more information—literally they could provide us with meters of documents" (Di Tella and Dyck 2001, p. 5).

45. Acton and Vogelsang (1989, p. 370).

substantive restraints on discretion, formal and informal constraints on changing the system, and institutions to enforce these constraints.[46]

While the regulator can choose the test company (or area), DFL 1 requires that both firms and the regulator can solicit cost studies and guarantees firm-generated studies a weight in the final determination.[47] The regulator is not allowed to use its own staff to prepare studies (both firms and the regulator have to use independent consultants from an approved list, who are in turn required to operate according to detailed terms of reference), and cost studies are only allowed to focus on one year of data, with no inclusion of past data or data from other countries. The legislation also requires prices to be reset if this procedure produces a rate of return for firms that is below 6 percent.[48]

The legislature and the courts provided formal constraints on changing the system. Passage of a new electricity law would require approval of both houses of the bicameral legislature, where one party rarely holds a majority in both chambers. Firms have the right to take the regulator to court if they feel the regulator has overstepped its regulatory authority, and the previous prices would hold pending judicial determination. The Supreme Court was credited with independence based on past records of impartial responses.[49]

Informal constraints on changing the system arose from the privatization of distribution companies and the widespread ownership of these companies. By 1991, the electricity sector consisted of two integrated companies, eleven power generation and transmission companies, fourteen electric power cooperatives, and twenty-one electricity distribution companies.[50] Almost all distribution assets are owned by publicly traded companies (see table B-1).

46. Levy and Spiller (1996). Limits on political discretion are not a necessary feature of price caps. In the case of the United Kingdom's price-cap regime, for example, Beesley and Littlechild argue that regulators have significant discretion during the reinitialization of price caps, with no formal constraints on the level of prices in the reinitialization: "The U.K. regulator is deemed to be a person to whom public policy may be safely delegated, subject only to judicial review on the question of whether his actions are legitimate in terms of the act. In the U.K., neither government nor regulators have given detailed reasons for their decision on *X*. This reduces the bases for challenge (by company, competitors, or customers)" (Beesley and Littlechild 1989, p. 461).

47. In case of a dispute over the findings of the regulator, the VAD would depend two-thirds on the estimate of the government's consultants and one-third on the estimate of the firm's consultants.

48. The procedure needed to produce an estimated rate of return of between 6 and 14 percent.

49. Unlike the United Kingdom, there were no independent regulator's offices. In Chile, the electricity regulator is headed by a political appointee, staffed by regular civil servants, and located inside the Ministry of Energy.

50. Spiller and Martorell (1996).

TABLE B-1. Electricity Distribution Companies in Chile, 1991

System and company	*Included in sample?*	*Publicly traded throughout period*	*Customers (in thousands)*	*Energy (GWh)*
Norte Grande Interconnected System				
EDELNOR	No	No	140	139
Central Interconnected System				
CHILECTRA Metro	Yes	Yes	1,106	4,741
CGEI	Yes	Yes	365	1,138
Rio Maipo	Yes	Yes	285	1,119
SAESA	Yes	No	114	328
EMEC	Yes	Yes	110	289
FRONTEL	No	No	107	184
CONAFE	No	No	94	271
EMEL	Yes	Yes	91	195
ELECDA	Yes	Yes	84	187
EMELAT	Yes	Yes	46	187
EMELARI	Yes	Yes	39	90
ELIQSA	Yes	Yes	35	90
EE DEL SUR	No	No	16	29
EE PTE ALTO	No	No	14	26
CE LITORAL	No	No	13	14
Other			12	22
Total			2,531	8,932
Aysen Isolated System				
EDELAYSEN	No	No	14	148
Punta Arenas Isolated System				
EDELMAG	Yes	Yes	36	72

Source: Authors' compilation, based on Spiller and Martorell (1996).

Shares in distribution companies are held by employees, management, foreigners (through the cross-listing of company shares on U.S. stock exchanges as American Depositary Receipts, or ADRs), and indirectly by a wide cross-section of the Chilean population through the Chilean private pension funds created in 1982. This ownership structure meant that tough regulatory decisions could hurt the private pension scheme and Chilean firms' standing in international markets, factors which the regulator was unlikely to be able to ignore. Interestingly, the presence of foreign funds has increased over time.

Comments

Alexander Galetovic: Many think that price-cap regulation was conceived and first used in the United Kingdom in the late 1980s, as part of the privatization of British Telecom. In fact, it was invented in all but name nearly a decade earlier in Chile, first applied to set the tariffs of Chilectra, a publicly owned electricity distribution firm, in October 1980 and later made official in a 1982 law that radically reformed the regulation of electricity.[1] When generation and distribution companies were privatized in the second half of the 1980s, a clear set of rules had been in place for several years. These rules have remained essentially unchanged for more than a quarter century and presided over a massive expansion of generation, transmission, and distribution capacity during the golden years of Chilean growth. All in all, Chile's regulation has been quite successful.

Relative success does not imply perfection, however, and it is fair to say that the list of shortcomings is rather long. One of these shortcomings is that distributors have made substantial efficiency gains while tariffs have lagged behind.[2] Distribution companies systematically earn high returns, well above the 10 percent real rate granted by regulatory rules. It thus seems that the regulator has been unsuccessful in passing efficiency gains to consumers.

Pundits have offered many explanations. One is that distributors wield formidable lobbying power over a weak regulator. Another culprit is deficiencies of the so-called efficient-firm standard as a regulatory technique. Cost padding and exaggeration surely also play a part, especially in view of the rather silly "arbitration" rule that averages the regulator's and the firms' cost estimations of the efficient firm. But while a lot has been said and anecdotes abound, little empirical work has tested these beliefs. For this reason, Di Tella and Dyck's interesting paper is a welcome evaluation of the workings and performance of

1. Sebastián Bernstein (personal communication).
2. See Fischer, Gutiérrez, and Serra (2005); Fischer and Serra (2007).

the Chilean distribution price cap. They confirm—this time with evidence—that no matter how hard you try, you cannot regulate without looking at the costs of the real firm. They also provide a clever method for figuring out whether firms influence their tariffs by exaggerating costs.

It is useful to put the Chilean price cap into perspective, both conceptually and historically. Any price-cap regime has at least three parts: a pricing rule, a valuation source, and the price cap. The Chilean price cap is quite standard in that tariffs are set every four years, and between review years prices only change in response to variations in exogenous variables (namely, the inflation rate and the price of key inputs like copper).[3] The pricing rule and valuation source, however, are quite peculiar to Chile.

Consider first the pricing rule, which maps costs into a tariff. In Chile, the price of distribution (the so-called value added of distribution, or VAD) equals the intertemporal average cost of one kilowatt of distribution capacity. Formally, assume that the distributor must supply Q kilowatts, requires $K(Q)$ units of capital, which have a useful life of T years, and spends c pesos per kilowatt every year in operation and maintenance costs. The Chilean tariff per kilowatt of distribution capacity then equals

$$p = c + \frac{K(Q)}{Q \cdot R},$$

with $R \equiv \int_0^T e^{-rt}\, dt$, where $r = 10$ percent real by law. A pricing rule such as the above equation has several desirable properties. In particular, it is the Ramsey-Boiteaux tariff when capital costs have to be recovered over time, and it is thus allocatively efficient subject to the firm's self-financing constraint. Nevertheless, this pricing rule is somewhat peculiar. In most price-cap regimes around the world, tariffs are not equal to the intertemporal average cost, but are instead quite arbitrary.[4]

The second peculiarity of the Chilean price cap is the valuation source. The law mandates that the regulator is to obtain all the technical parameters and unit costs that determine c and $K(Q)$ by designing and valuing an efficient firm from scratch each time tariffs are set. The efficient firm is, in principle, a completely independent entity with no direct relation to the actual firm, as it operates with the best available technology and serves actual demand at least cost. It is not a fantasy, however, for it is designed obeying the topographic,

3. By contrast, no allowance is made for exogenous productivity improvements—the X factor is set equal to zero.

4. See Newbery (1997); Bustos and Galetovic (2007).

demographic, and technological constraints faced by the actual firm. In other words, the efficient firm operates at minimum cost with the best technology available at the time of the tariff review, but it is adapted to the properties of actual topography and demand.[5]

Of course, almost three decades of information economics might suggest some naïveté on the part of Chilean lawmakers. How can a regulator expect to know what is efficient? Here, a little historical context is useful. Efficient-firm regulation was conceived in the late 1970s, when all distributors were public firms controlled de facto by managers and unions. Until then, no agency in the central government was capable of evaluating the cost estimates that utilities presented to justify their tariffs. Tariffs were reviewed by the government's budget office, which, lacking the skills to confront an informed agent, routinely rubber-stamped whatever the distributors proposed. This led to large allocative and productive inefficiencies that were prompted by overinvestment, overstaffing, above-market wages for most workers, and relaxed working conditions. Consequently, the National Energy Commission was created in the late 1970s with the specific mandate of overseeing public utilities and fixing their tariffs. The efficient-firm standard was part of a package of reforms meant to inform an up-to-then very poorly informed regulator, detect gross inefficiencies, and control managers; it wasn't meant to substitute for knowledge about the actual firm.

Be that as it may, the efficient-firm standard is almost ideal for testing whether distributors inflate costs and successfully influence regulators. If the standard is fully exogenous and tariffs are independent of the actual firm, higher-than-expected costs (that is, a negative cost surprise) should always make returns fall. Even better, if the regulator ignores the real firm while setting tariffs, strategic cost surprises are useless and should not be observed in the first place. By contrast, if the actual firm influences the regulator, strategic cost surprises may inform the market that tariffs will be set higher than expected. Indeed, Di Tella and Dyck's regression 3 in table 6 implies that a one-standard-deviation negative cost surprise during a year before the tariff review (1991, 1995, and 1999 in their paper) increases returns by 220 basis points.[6] By contrast, a negative cost surprise reduces returns by 110 basis points if it does not occur during the year before a review takes place. The

5. On the efficient-firm standard and its application to regulate Chilean distributors, see Rudnick and Donoso (2000); Bustos and Galetovic (2007).

6. The authors call 1991, 1995, and 1999 review years, although the reviews took place in 1992, 1996, and 2000. In any case, 1991, 1995, and 1999 are the correct dates to insert interaction dummies, as I argue below.

efficient-firm standard thus does not seem to be exogenous after all. Moreover, Di Tella and Dyck seem to have found the smoking gun: distributors exaggerate costs during review years to get higher tariffs.

But did they really find the smoking gun? The paper's thesis is that strategic cost surprises generate abnormally high returns because they raise tariffs. To test this, the interaction dummies must be inserted in the exact quarters in which negative cost surprises can plausibly influence the regulator. Di Tella and Dyck rightly choose the four quarters of the year before the review year. To explain why, let me briefly review the timing of each tariff review. Since October 1980, distribution tariffs are set in Chile every four years in either late October or early November.[7] Six months before, in late May, the National Energy Commission publishes the methodology that must be used to calculate the value added of distribution, and both the regulator and distributors then have four months to conduct their study. For example, in the 1992 review, the tariff-setting process started in mid-May 1992, and tariffs were then set on 27 October.

On the face of it, one might think that the authors should have inserted interaction dummies for the first three quarters of 1992, 1996, and 2000, instead of the four quarters of 1991, 1995, and 1999. As practitioners and stock analysts know, however, the distributors report to the regulator their costs of the year before a tariff review takes place—in this case 1991, 1995, and 1999. Thus, the interaction dummies were inserted precisely in those quarters in which the information likely to be considered by the regulator is generated. Moreover, the results are even stronger when the authors only insert dummies for the last two quarters of 1991, 1995, and 1999 (as column 3 in table A-1 shows, the effect nearly doubles). It seems reasonable to believe that information generated toward the end of the year will give the market a sharper idea of what the regulator will see while setting tariffs.

The only doubt I am left with concerns strategic cost surprises. Di Tella and Dyck should have reported each of the forty-four quarterly cost surprises they computed. Results would be strengthened if one finds that cost surprises were systematically negative and large in 1991, 1995, and 1999, but did not exhibit any systematic pattern in irrelevant quarters. By contrast, if they are not systematically negative in the key quarters, then one would wonder whether distribution firms act strategically after all, for what would be the point of strategically reporting costs that are lower than expected?

7. Thus there have been seven reviews to date, and this paper considers three—1992, 1996, and 2000.

All in all, this is an important paper. The evidence is convincing, and the authors have developed an interesting method for testing whether firms use strategic cost surprises to influence regulators. A straightforward but important lesson is that regulators should examine the evolution of costs over the entire period between tariff reviews and be particularly skeptical of cost increases that occur right before the tariff review begins. While this may sound obvious after reading Di Tella and Dyck's paper, I doubt that most regulators are aware of it, much less that they do anything about it.

William W. Hogan: Di Tella and Dyck address the incentive regulation scheme applied to the Chilean electricity distribution system, covering the period between 1989 and 1999. Chile was an innovator in restructuring the electricity system to allow for greater reliance on competition and markets. Previous studies focus on policies for generation competition through a wholesale market design built on principles of economic dispatch. The wholesale market is an interesting topic, but it leaves out the important transmission and distribution sectors. The case of high voltage transmission is a separate and separable topic, with many debates about the best approach to regulating transmission systems. There is little controversy, however, about the character of electricity distribution systems, which comprise the local collection of wires and meters that connect final customers to the high voltage grid. The distribution system is generally deemed to be a natural monopoly. As such, it lends itself to various forms of incentive regulation that have been much discussed and debated in the literature.

Joskow provides a recent overview of the theory and much of the practice in the case of electricity.[1] In a world of assumed uncertainty and asymmetric information between regulator and firm, the fundamental tension is to ensure the firm's financial viability while balancing the trade-off between the goals of providing high-powered incentives for efficiency and ensuring a maximum rent extraction from the regulated company. For example, an idealized price-cap model with fixed prices set independently of the firm's performance would provide very strong incentives for cost reductions. Traditional cost-of-service regulation emphasizes setting prices equal to the firm's reported costs for the maximum in rent extraction, but it provides poor incentives for efficiency. There are many alternatives in between these two extremes. Theoretical and empirical work seeks to analyze and evaluate the incentives induced and the results produced by alternative implementations of the idealized models.

1. Joskow (2006).

The case of Chile and the research of Di Tella and Dyck raise general questions that could be addressed in other countries. As part of their research, Di Tella and Dyck collected quantitative data supplemented by interviews in 1999 that add insight to the numbers and the models. One of the interesting features of the Chilean experience is that the innovative models were developed independently in Chile, without apparent reference to work on similar problems in other countries. The authors quote Sebastián Bernstein, who headed the committee drafting the 1982 reform law: "Yardstick is a term we learned later, but in many ways that is an accurate way to characterize our model. The system was consciously designed to decentralize decisionmaking away from politicians and regulators. We had no reference books to turn to, but instead thought that the best way to regulate would be to simulate a market." Based on this alone, the Chilean innovations are impressive.

There is a political economy story here about limiting the discretion and political control of regulators. The basic idea was to create a model distribution company in each of five zones and then optimize this company based on a comparison with other distribution companies in Chile, to produce an efficient-standard company that would provide the regulatory yardstick for setting the distribution prices of the real regulated company. This is one form of benchmarking.[2] Although benchmarking has many obvious attractions as a management tool used to point to opportunities to improve company operations, it can be much more problematic in setting prices for regulated companies.[3] Yardstick competition based on the performance of other identical companies has great theoretical appeal, as long as the yardstick derives from identical companies. The fundamental difficulty arises in dealing with real companies, which are never identical. In the case of Chile, "the methodology has been complex to apply, with bitter disputes among the parties involved."[4]

Di Tella and Dyck complement their research with an effort to theorize and examine the data to answer a number of interesting questions about the performance of this particular model. The paper addresses four broad questions. First, are the incentives sufficient to produce cost reductions? Based on the interviews and case studies included in the paper, the broad answer is probably yes. As Di Tella and Dyck observe, however, the evidence is consistent with induced cost reductions, but it is not dispositive because there is no real control group for comparison.

2. Farsi, Fetz, and Fillipini (2007).
3. Shuttleworth (2005).
4. Rudnick and Donoso (2000).

Second, does this yardstick competition provide an effective means of rent extraction and lower prices for customers? Apparently, the broad answer is no. Although there is evidence of material reductions in costs, the data and the interviews suggest that relatively little of the improved efficiency has been translated into prices.

Third, does the Chilean scheme conform to the theory of yardstick competition, according to which prices are set independently of the observed costs of the regulated firm, or do firms behave strategically to influence the yardstick? This is perhaps the most interesting part of the paper. Di Tella and Dyck collect data on company cost performance and stock prices. They present a theoretical model and hypotheses, which they explore using econometric estimates based on pooled data for companies in Chile. The collective results support the hypothesis that a company's own actions have a direct impact on the estimates that will be developed in a review period when the yardstick is reset. Compared to a naïve model, actual costs decline more until the review period and then decline less. For stock prices, Di Tella and Dyck use an event model analysis to show a positive impact on stock valuation as a result of a cost surprise increase above a simple trend, but only during the review period. It is hard to see how these results could be squared with any theory that does not include regulators' and consultants' peeking at the company results in the interest of producing yardsticks that are not unreasonable. This peeking, of course, undermines the incentive properties of yardstick competition and presents the opportunity for strategic behavior by the regulated firm.

Figure 1 of the paper reveals a troubling feature of this implementation of yardstick competition. The data show the yardsticks calculated by two different sets of consultants, one hired by the regulator and one hired by the company. Any delusion that there is a simple way to set the yardstick is quickly dispelled by these figures. The price differences are substantial, and the bias is clear, with the regulator's consultants coming in low and the companies' consultants coming in high. This does not look like objective yardstick calculation. The presence of fixed weights for averaging the two estimates gives little comfort for those who hope objectivity in the yardstick is producing strong incentives.

Finally, what are the other incentive effects of the optimized model-company yardstick regulation? Di Tella and Dyck suggest that yardstick competition in Chile probably reduced costs as measured over this period, but the strategic behavior of firms runs against this conclusion. Furthermore, other incentive effects may be even more important in the long run. For example, the Chilean model-company approach is very similar in spirit to the "opti-

mal deprival value" price regulation found in New Zealand. In the face of uncertainty, this form of regulation creates an ex post asymmetry that provides a bias against capital investment. The difficulty is that repeated optimization of the model company to set the price cap in effect always assumes that investments are made with perfect foresight. If the allowed return is set in the usual ex ante way, as is typically the case, the earned return can never be more than the allowed return and will usually be less. This creates a slow bleed with a bias against capital investment, until the situation becomes dire and the rules are changed. It would be interesting to explore whether the Chilean data could be applied to further empirical work addressing this long-term incentive effect.

If such work is undertaken, it would be useful to reconsider the cost measure employed in the econometric model. Di Tella and Dyck argue that normalizing total costs by total revenues provides the best measure for their purposes, and this choice expands the available data for the statistical analysis. However, what is being measured is a combination of cost reductions and revenue increases, which confuses the interpretation of the efficiency results. A more appealing approach would be to normalize for numbers of customers and quantities of delivered energy. Rudnick and Donoso use the latter approach to compute their benchmarks.[5] Their model and data set may provide additional leverage for Di Tella and Dyck's analysis.

This concern about the cost measure does not extend to the stock price analysis. Assuming the cost variable is defined the same way (that is, costs as a proportion of revenue), increases in this variable should reflect either higher costs or lower revenues, both of which should result in lower, not higher, stock valuations. The impressive stock market results thus seem to provide robust evidence of assumed strategic behavior, or at least behavior that leads the stock market to believe that the company's performance affects its own yardstick.

5. Rudnick and Donoso (2000).

References

Acton, Jan Paul, and Ingo Vogelsang. 1989. "Introduction: Symposium on Price-Cap Regulation." *RAND Journal of Economics* 20(3): 369–72.

Armstrong, Mark, Simon Cowan, and John Vickers. 1994. *Regulatory Reform: Economic Analysis and British Experience.* MIT Press.

Averch, Harvey, and Leland L. Johnson. 1962. "Behavior of the Firm under Regulatory Constraint." *American Economic Review* 52(5): 1053–069.

Baron, David P., and David Besanko. 1987. "Commitment and Fairness in a Dynamic Regulatory Relationship." *Review of Economic Studies* 54(3): 413–36.

Baron, David P., and Raymond R. de Bondt. 1979. "Fuel Adjustment Mechanisms and Economic Efficiency." *Journal of Industrial Economics* 27(3): 243–61.

Beesley, Michael E., and Stephen C. Littlechild. 1989. "The Regulation of Privatized Monopolies in the United Kingdom." *RAND Journal of Economics* 20(3): 454–72.

Bernstein, Sebastián. 1995. "Pragmatic Privatization." *Independent Energy* 25(2): 30–36.

Biglaiser, Gary, and Michael H. Riordan. 2000. "Dynamics of Price Regulation." *RAND Journal of Economics* 31(4): 744–67.

Blank, Larry, David Kasserman, and John Mayo. 1998. "Dominant Firm Pricing with Competitive Entry and Regulation: The Case of IntraLATA Toll." *Journal of Regulatory Economics* 14(1): 35–53.

Braeutigam, Ronald R., and John C. Panzar. 1993. "Effects of Change from Rate-of-Return to Price-Cap Regulation." *American Economic Review* 83(2): 191–98.

Bustos, Alvaro, and Alexander Galetovic. 2002. "Regulación por empresa eficiente: quién es realmente usted?" *Estudios Públicos* 86 (otoño): 145–82.

———. 2007. "Monopoly Regulation Chilean Style: The Efficient Firm Standard in Theory and Practice." In *Regulatory Economics and Quantitative Methods: Evidence from Latin America,* edited by Omar O. Chisari. Cheltenham: Edward Elgar.

Cabral, Luis M. B., and Michael Riordan. 1989. "Incentives for Cost Reduction under Price Cap Regulation." *Journal of Regulatory Economics* 1(2): 93–102.

Di Tella, Rafael, and Alexander Dyck. 2001. "Strategy of the Firm under Regulatory Review: The Case of Chilectra." Case 9-701-044. Harvard Business School.

Di Tella, Rafael, and Fabio Kanczuk. 2002. "Good Regulation through Stock Market Prices." Harvard Business School.

Dnes, Antony, and others. 1998. "The Regulation of the United Kingdom Electricity Industry: An Event Study of Price-Capping Measures." *Journal of Regulatory Economics* 13(3): 207–26.

Farsi, Mehdi, Aurelio Fetz, and Massimo Fillipini. 2007. "Benchmarking and Regulation in the Electricity Distribution Sector." CEPE Working Paper 54. Zurich: Centre for Energy Policy and Economics.

Faure-Grimaud, Antoine. 2002. "Using Stock Price Information to Regulate Firms." *Review of Economic Studies* 69(1): 169–90.

Fischer, Ronald, and Pablo Serra. 2000. "Regulating the Electricity Sector in Latin America." *Economía* 1(1): 155–99.

———. 2007. "Efectos de la privatización de servicios públicos en Chile." University of Chile.

Fischer, Ronald, Rodrigo Gutiérrez, and Pablo Serra. 2003. "The Effects of Privatization on Firms and on Social Welfare: The Chilean Case." Research Network Working Paper R-456. Washington: Inter-American Development Bank.

———. 2005. "The Effects of Privatization on Firms: The Chilean Case." In *Privatization in Latin America: Myths and Reality,* edited by Alberto Chong and Florencio López-de-Silanes. Stanford University Press.

Galetovic, Alexander, and Ricardo Sanhueza. 2002. "Regulación de servicios públicos: hacia dónde debemos ir?" *Estudios Públicos* 85 (verano): 101–37.

Gilbert, Richard J., Edward P. Kahn, and David M. Newbery. 1996. "International Comparisons of Electricity Regulation." In *International Comparisons of Electricity Regulation,* edited by Richard J. Gilbert and David M. Newbery. Cambridge University Press.

Gilbert, Richard J., and David M. Newbery. 1994. "The Dynamic Efficiency of Regulatory Constitutions." *RAND Journal of Economics* 25(4): 538–54.

Gómez-Ibáñez, José A. 1999. "Commitment and Flexibility: Strategies for Regulating Privatized Infrastructure." Discussion Paper. Harvard University, Kennedy School of Government, Taubman Center for State and Local Government.

Green, Richard, and David M. Newbery. 1997. "Competition in the Electricity Industry in England and Wales." *Oxford Review of Economic Policy* 13(1): 27–46.

Hachette, Dominique, and Rolf Lüders. 1993. "Privatization in Chile: An Economic Appraisal." San Francisco: ICS Press.

Joskow, Paul. 2006. "Incentive Regulation in Theory and Practice: Electricity Distribution and Transmission Networks." Working Paper in Economics 0607. University of Cambridge.

Kaserman, David L., and Richard C. Tepel. 1982. "The Impact of the Automatic Adjustment Clause on Fuel Purchase and Utilization Practices in the U.S. Electric Utility Industry." *Southern Economic Journal* 48(3): 687–700.

Kridel, Donald J., David E. M. Sappington, and Dennis L. Weisman. 1996. "The Effects of Incentive Regulation in the Telecommunications Industry: A Survey." *Journal of Regulatory Economics* 9(3): 269–306.

Levy, Brian, and Pablo T. Spiller. 1994. "The Institutional Foundations of Regulatory Commitment: A Comparative Analysis of Telecommunications Regulation." *Journal of Law, Economics, and Organization* 10(2): 201–46.

———, eds. 1996. *Regulation, Institutions, and Commitment: Comparative Studies of Telecommunications.* Cambridge University Press.

Mathios, Alan D., and Robert P. Rogers. 1989. "The Impact of Alternative Forms of State Regulation of AT&T on Direct-Dial, Long-Distance Telephone Rates." *RAND Journal of Economics* 20(3): 454–72.

Newbery, David M. 1997. "Determining the Regulatory Asset Base for Utility Price Regulation." *Utilities Policy* 6(1): 1–8.

Pollitt, Michael G. 2005. "Electricity Reform in Chile: Lessons for Developing Countries." Working Paper in Economics 0448. University of Cambridge.

Posner, Richard A. 1971. "Taxation by Regulation." *Bell Journal of Economics and Management Science* 2(1): 22–50.

Rose, Nancy L. 1985. "The Incidence of Regulatory Rents in the Motor Carrier Industry." *RAND Journal of Economics* 16(3): 299–318.

Rudnick, Hugh, and Jorge A. Donoso. 2000. "Integration of Price Cap and Yardstick Competition Schemes in Electrical Distribution Regulation." *IEES PES Transactions on Power Systems* 15(4): 1428–33.

Rudnick, Hugh, and Sebastian Mocarquer. 2007. "Benchmark Regulation and Efficiency of Electricity Distribution: Strengths and Weaknesses." Working Paper 07GM0943. Piscataway, N.J.: IEEE.

Salant, David J., and Glenn A. Woroch. 1992. "Trigger Price Regulation." *RAND Journal of Economics* 23(1): 29–51.

Sappington, David E. M. 1980. "Strategic Firm Behavior under a Dynamic Regulatory Adjustment Process." *Bell Journal of Economics* 11(1): 360–72.

Sappington, David E. M., and David S. Sibley. 1992. "Strategic Nonlinear Pricing under Price-Cap Regulation." *RAND Journal of Economics* 23(1): 1–19.

Schmalensee, Richard. 1989. "Good Regulatory Regimes." *RAND Journal of Economics* 20(3): 417–36.

Schwert, G. William. 1981. "Using Financial Data to Measure Effects of Regulation." *Journal of Law and Economics* 24(1):121–58.

Shleifer, Andrei. 1985. "A Theory of Yardstick Competition." *RAND Journal of Economics* 16(3): 319–27.

Shuttleworth, Graham. 2005. "Benchmarking of Electricity Networks: Practical Problems for Its Use for Regulation." *Utilities Policy* 13(4): 310–17.

Spiller, Pablo T., and Luis Viana Martorell. 1996. "How Should It Be Done? Electricity Regulation in Argentina, Brazil, Uruguay, and Chile." In *International Comparisons of Electricity Regulation,* edited by Richard J. Gilbert and Edward P. Kahn. Cambridge University Press.

Whinston, Michael D., and Scott C. Collins. 1992. "Entry and Competitive Structure in Deregulated Airline Markets: An Event Study Analysis of People Express." *RAND Journal of Economics* 23(4): 445–62.