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

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Abstract

We study the Chilean electricity distribution industry and find that costs (the ratio of reported costs to revenues) have fallen since price caps were introduced. Cost reductions are U-shaped since 1989: strong initial cost reductions reverse every four years, coinciding with regulatory reviews. A possible explanation is that firms are behaving strategically. We then use stock market data to complement our study. We construct a measure of cumulative abnormal returns for regulated firms around their quarterly announcements, and a measure of "naïve" cost expectations which excludes any indication of the occurrence of review periods. In general, cost reports in excess of naïve cost expectations have a negative effect on returns, even after we control for company fixed effects. The exception is cost "surprises" that happen *during* review periods, which *increase* abnormal returns. The estimated effects fall over time. This is consistent with the hypothesis of strategic firms and that the regulatory regime translates these "games" into higher rates in a way that is not completely anticipated by the market. More generally, the results suggest there may be value in complementing regulatory procedures with stock market information.

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I. Introduction

Every four years you feel you are going to war.
Alejandro Jadresic, Minister of Energy (1994-1998)[2]

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, it has also been argued, can discourage efficient investments out of fear of hold-up after investments are made, particularly when consumer groups are able to 'capture' regulators.[3]

The introduction of price cap (PC) regulation was expected to correct some of these problems. In guaranteeing prices rather than returns and by using long regulatory lags, firms have the incentive to cut their costs as they get to keep the residual between prices and costs. Beesley and Littlechild (1989), for example, argue that price-cap regulation *"is less vulnerable to 'cost-plus' inefficiency and over-capitalization"* (p. 456). Moreover, price caps largely limit incentives for firms to 'game' the system, both because adjustments within review periods are predetermined and because, in practice, review procedures often include an element of yardstick competition.[4] Limiting regulatory discretion is expected to be particularly useful in developing countries. Price caps can potentially enhance political commitment, reduce fears of hold-up and lobbying by regulated firms, and therefore encourage more efficient decisions regarding investment (Levy and Spiller (1996)).[5] Another advertised benefit of price-cap regimes is the reduced burden it places on regulators. These theoretical advantages have encouraged the adoption of price cap regimes across the developed and developing world.

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[2] Di Tella and Dyck (2001), p. 1.
[3] See, for example, Posner (1969), Averch and Johnson (1962), Acton and Vogelsang (1989), *inter alia.*.
[4] This is not the place to do justice to the relevant literature. A number of key papers on price cap regulation appeared on the 1989 symposium in the *Rand Journal of Economics*. See also Riordan and Cabral (1989) on incentives for cost reductions, Sappington (1980) and Sappington and Sibley (1992) on strategic behavior of the regulated firm and Baron and Besanko (1987) on regulatory commitment. On this last issue, see also Salant and Woroch (1992) and Gilbert and Newbery (1994).
[5] Some of these features, like limited discretion, are not an inevitable component of a price-cap regulatory regime. But, the connection is often made in practice, particularly in developing countries.

Partly because of its relatively recent introduction, there is little empirical work on industry performance under price cap regulation. Some empirical work has focused on the US telecommunications sector, which has used a price cap system for a number of years. An often-cited paper by Mathios and Rogers (1989) provides evidence of significant price reductions (of up to 7%) in states that changed rate of return for price cap regulation.[6] A number of issues naturally arise. Do price reductions measure the extent of efficiency gains? Was this a one-off gain, or can we expect further efficiency gains over time? Since states adopt regulatory changes voluntarily, one should also wonder if these reductions reflect a general property of price caps or they are simply capturing the fact that these states have very active regulators (that would have achieved similar reductions with rate of return). Are these gains bound to occur in other countries that adopt price caps, or are they very dependent on having a judiciary system of US levels of independence?

Another important open question is the distribution of efficiency gains between firms and consumers. In an attempt to make price caps less vulnerable to capture by producers or consumers, it is often argued that the system should remove discretion and contain a high degree of commitment. But this may 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.

In this paper we collect data on the performance of firms in the Chilean electricity distribution industry from 1988-99, a sample where privately owned firms were operating in a regulatory system that was intended 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 (see Acton and Vogelsang (1989)). 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 (see, for example, Levy and Spiller (1996)). Perhaps the most significant feature of the Chilean price cap regime is the attempt to limit explicitly the regulator's discretion at regulatory reviews. These

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[6] This has been followed by additional studies, surveyed in Kridel, Sappington and Weisman (1996) that find at times conflicting results. As one example, Blank Kaserman and Mayo (1998) do not find that price-cap regulation has reduced toll prices.

include a request to construct a "model efficient company" from which to derive the rates that will apply to all companies of a certain type (where this is defined using customer density) using a number of steps described in the regulatory regime and a limitation to only use data generated during the review year.[7] The regulator, for example, must combine the information provided by the companies with its own estimates using pre-specified weights. Although the law originates in 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 where expected to wield considerable power.[8]

We find that a measure of efficiency (the ratio of reported costs to revenues) improves on average by 1.2% per year 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 interpreted as causal (there are other institutions and policies that 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% greater than would be expected on the basis of time trends alone. These happen to be years prior to regulatory reviews, where a new price cap is set for the next four-year interval. This pattern is consistent with strategic behavior of 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 firms' cost reports influencing the future price caps is high.

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[7] Fischer and Serra (2000) 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."* p. 183.

[8] 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 *"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, Gutierrez and Serra (2002) discuss the high profits of the distribution companies. Chilectra's return on equity, for example, went from 8% in 1988 to 32% in the period 1996-8. They argue that the profit levels of the distribution companies are much higher than those of the generating companies in spite of the fact that the latter are subject to greater risk.

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 discretion to act differently.

We then complement our findings with evidence from the stock market. Following Schwert (1981) and Rose (1985), a number of papers have used stock market reactions to evaluate the effect of regulations (see also Whinston and Collins (1992) and Dnes *et al* (1998)). We modify the approach to evaluate the performance of the price cap, particularly the extent of strategic behavior by firms. We start by constructing a measure of "naïve" cost expectations that excludes any indicator of the occurrence of review years. We then look at the responses of the stock market to cost announcements by firms during review and non-review periods, taking as a benchmark a situation where there are no regulatory reviews. The relatively new 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 a vis* consumers and firms. A contributing element to this uncertainty is the fact that a left of center coalition succeeded General Pinochet's government, which had designed the regulatory regime. Another element is the recent nature of the regulatory regime, where the different actors have very little experience observing 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 revelations during review periods than during non-review periods. Generally, costs that exceed cost expectations tend to depress returns to holding the firm's stock. In review periods, however, we find that high cost reports *increase* returns. This is consistent with strategic behavior by firms that is not priced in prior to regulatory reviews, and where such high cost revelations are transformed 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 that some learning is taking place and/or that

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uncertainty is being priced in by the market. More generally, this suggests that there may be value in deriving the optimal regulatory regime incorporating information produced by the stock market.[9]

This evidence from Chile should have broader interest. By looking at the electricity sector in Chile, we can extend the evidence that has focused on price cap regimes in the developed countries of the United States and the United Kingdom and that has focused on the telecommunications industry. In particular, the Chilean approach is closer to many theoretical models of pure price cap than other regimes. As Gilbert, Kahn and Newbery (1996) 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."* (p. 19)

Our paper proceeds in five additional sections. Section II provides some institutional background and qualitative data from field research and interviews conducted in Chile in 1999. Section III describes our empirical approach. Section IV presents our main empirical results while Section V concludes.

II. Institutional Background

A basic motivation behind the regulatory reforms introduced in Chile in 1982, which included the introduction of a price-cap regime for the electricity distribution sector, seems to have been concerns over a lack of efficiency and excessive political discretion in prior regulatory regimes. Some of the main issues have been well described in the literature, and we provide a short discussion and further institutional detail in appendix II.[10] In this section we report complementary evidence on the actual performance of the regulatory regime, some of it obtained in interviews, that suggests that some participants believe the price caps have had limited effects on consumer welfare, as prices have tended to remain high and firms have tended to act strategically,

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[9] For a start in this direction, see Di Tella and Kanczuk (2002). See also Faure Grimaud (2002).

[10] More complete descriptions of the Chilean reforms are provided in Hachette and Luders (1993), Spiller and Martorell, (1996), Bernstein, (1995) and Bustos and Galetovic (2002). For a discussion of the main outstanding issues that covers aspects of cost padding and regulatory commitment, see Galetovic and Sanhueza (2001).

while promoting significant improvements in firm efficiency. For a formal discussion, see Galetovic and Sanhueza (2001).

We engaged in field research in Santiago, Chile and New York in the summer of 1999 collecting evidence and interviewing key participants to learn more about the price cap system.[11] Such evidence must remain suggestive but we feel aids in the interpretation of our findings.

Results of Price-Cap Regulation –VAD

In general, most participants felt that the system had a limited effect on prices. This is illustrated in Figure 1, which reports results from all of the completed VAD studies (the value-added of distribution, the maximum price distribution companies can charge). It shows the VADs by area of density, with the highest density area defined as area 1 proceeding to areas of lower density 2 and 3. In each figure there are 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 level of the VAD suggests more efficient companies with gains passed on to consumers. This evidence on the primary input into price determination explains why some participants argue that the Chilean price cap regime in distribution has had a limited effect. For example, focusing on the high-density distribution area, the VAD is almost unchanged between 1984 and 1996.

Incentives and Efficiency Improvements

By contrast, other indications of cost efficiency show significant improvements over the sample period. The largest and best-documented company in the industry is Chilectra. Consistent with the contention that this rule based regulatory regime combined with private ownership created strong incentives for cost efficiency, costs in Chilectra that can be identified by public operating and financial statements, by all measures, have

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[11] 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.

declined significantly. From 1990 to 1999 energy losses declined by more than 60 percent (from 13.6 % of sales in 1990 to just 5.4% of sales by 1999). Distribution employees per customer served and by employees per unit of energy supplied increased by 52 and 64 percent respectively. In part this may reflect subcontracting, but costs from operations per unit of energy sold fell 56 percent.

Regulatory Commitment

The lawsuits filed by three Chilean electricity distribution companies in response to the reinitialization proposed in 1996 illustrates the attempts of regulators to use their discretion, and the attempts to use courts to impose limits on regulatory discretion. Among other complaints, the distribution companies claimed that the regulator had abused their authority both in designating sections of a distribution territory to be of higher density (and hence lower prices) and in setting 'coincidence' factors. After the distribution companies won most issues of the case in the appeals court, this was largely reversed at the Supreme Court level on technical grounds of whether the regulator had followed the terms of the statute.

Regardless of the specific outcome, the court case itself suggests that the courts did limit regulatory discretion. Alejandro Jadresic, the Minister of Energy from 1994-1998, noted the implicit constraints imposed on regulators 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."*[12] The constraint imposed by courts on regulator discretion was also noted by the electricity regulator for the reinitialization in 2000 Oscar Landerretche, *"Presently the courts play a big role, something I'm not altogether comfortable with. Courts aren't a way to resolve technical things."*

Strategic Firms

Consultants and company executives noted that despite the elaborate rules to divorce firm reported costs from price determination, there was scope for firms to game

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[12] All quotes included in this section are from Di Tella and Dyck (2001)

the system aside from lobbying on coincidence factors. Sebastian Bernstein recognized 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."* So did the chief executive of a distribution company: *"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, to hide 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."*

Strategies to shift costs suggested to us included booking all maintenance costs in the review year when in fact they are incurred continually over a longer time 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. Investor relations personnel from companies suggested that we focus on non-review periods to get more accurate indicators of the firms' efficiency. Equity analysts and institutional investors reported to us that they treated cost information differently during review and non-review periods.

III. Theory, Empirical Strategy and Data

III. a. Theory and Empirical Strategy

The extent to which price cap is predicted to improve incentives and reduce costs depends on the extent of commitment. In price cap regimes with limited commitment, like those that revert to rate-of-return regulation, investment incentives are distorted. The following predictions are standard in price cap models (see, for example, Biglaiser and Riordan (2000) and Cabral and Riordan (1989)):

1. *Price caps provide strong incentives for cost reductions.*

   Because prices, not profits, are fixed in a price cap regime there is a strong incentive for firms to reduce costs.

2. *The incentives to reduce costs will be stronger immediately after a reinitialization of price caps and weakest as the new rate review approaches.*

   Cost reductions that occur farther away from review years will be enjoyed for longer periods of time without threat of being confiscated by the regulator.

In order to implement our empirical tests of these predictions, we focus on the evolution of costs in the industry rather than prices.[13] Our first hypothesis is that COSTS (costs as a proportion of revenue) for company i in quarter q fall over time under a price cap. In other words,

$$COSTS_{iq} = \phi + \alpha\, TIME_q + \eta_i + \varepsilon_{iq}$$

where $TIME_q$ is a time trend equal to 1 in the first quarter of 1989 and equal to 44 in the fourth quarter of 1999 where our sample ends, η_i is a company fixed effect while ε_{iq} is an error term (i.i.d.). 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 upon a variety of factors such as differences in the density of the distribution area or differences in local labor markets.

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

$$COSTS_{iq} = \phi + \alpha TIME_q + \lambda\, EARLY_q + \delta\, EARLY_q^2 + \eta_i + \varepsilon_{iq}$$

where $EARLY_t$ is a variable indicating how early into the review period we are. It has a value of 1 in the first quarter after a review, 2 in the second quarter and so on up to 16 in

the last quarter of the review year.[14] The hypothesis is that λ is negative and δ is positive. Again, company fixed effects are included.

Strategic Behavior

We generate an additional prediction if we assume that firms have private information about their costs and can report either the true information, or can shift cost reports from the quarter in which they are incurred to another quarter at a private cost to the firm (cost padding). Regulators may incorporate this exaggerated cost reports in the new regulated prices, either because they are captured or because there is some commitment in the system. Interestingly, the tendency to expropriate investments by the regulator may have led to a system where there is little regulatory discretion, but this allows the firms to game the system. If regulators were truly setting prices according to the efficient firm construct, such padding should not affect the prices they face (as in the yardstick model of Shleifer (1985)). But, to be legally enforceable by the courts, price caps have to keep some resemblance to actual costs, so the extent to which the system has achieved this separation is testable. It is likely that the private costs for the firm from such behavior increase the greater the extent of cost shifting.[15]

3. *There is an incentive to increase reported costs during Regulatory Reviews.*

The incentives for cost exaggeration will be stronger the closer we are in time to a review period. The reason is that cost revelations that are closer to a review year have more probability of affecting future price caps.

As one way to explore this prediction, we introduce a review year dummy in the above specifications.

Another approach to explore the role that regulatory commitment (lack of discretion) and strategic misrepresentation by the firm play in affecting firm behavior we

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[13] This approach contrasts with that of Mathios and Rogers (1989). If the version of the price-cap system used favors producers it is unclear whether the extent of efficiency gains will show up in price reductions.
[14] We do a robustness check excluding review years.
[15] For example, it is desirable 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 by managers inside the firm and by analysts outside the firm.

consider the possibility that the interaction between firm and regulator is observed by a third actor, the stock market. In a stable environment it is likely that any freedom that firms have to exaggerate costs in order to influence future rates is already priced in by the stock market. In Chile however, the relatively new introduction of the system combined with the delicate political transition following the Pinochet regime introduce enough uncertainty about the rules of the game that it is possible that this is not the case. It is indeed possible that the stock market is simply unsure as to the extent to which firms will be able and willing to try and game the system, or as to how much regulatory latitude will exist for apparently exaggerated cost reports, or as to how much public tolerance for high utility rates will be forthcoming. This suggests that review periods will be years of relative uncertainty, and that the stock market may respond *positively* to a high cost report.

A simple way to construct a test is to start by defining what can be called "naïve" cost expectations. This is the cost that is expected by a market participant with the best available knowledge but that is *unaware* of the occurrence of regulatory reviews. We then define a cost surprise as the difference between the actual reported cost and this measure, and define β as the effect of cost reports that exceed naïve expected costs on abnormal stock market returns.[16] The following four possibilities are suggested, depending on whether the stock market believes the firm announcement represents the truth or an attempt to influence the future price caps, and whether the regulator incorporates the reports into the calculation of the future caps or ignores them:

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[16] 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.

Figure 2 – Possible effects of the revelation of higher than expected costs on abnormal stock market returns in a review year

	Regulator Incorporates– either because of capture or because law allows no discretion	**Regulator Ignores** – may use wider sources of information in resetting price cap
Truthful firm – cost information reflects true costs	$\beta=0$	$\beta\leq0$
Strategic firm – cost information can be shifted	$\beta>0$	$\beta\leq0$

The simplest case to consider is where cost information is truthful and does not affect future prices. This is the "normal" one for firms that operate in unregulated industries and for regulated firms in non-review years. This situation 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 that the regulator will not translate fully into higher rates, will lead to lower values of equity.

This situation is to be contrasted 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 corner of Figure 2. 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, maybe as the firm's position in the bargaining with the regulator. Alternatively, the cost report maybe interpreted as the amount that the regulator has hinted to the firm that will be accepted. In these scenarios future prices will be higher as a result of cost reports, and costs are expected to be lower than those reported in the review period, so there should be a positive relationship between cost revelations and returns of the regulated firms. Interestingly, the very same lack of discretion that allows efficient investments to occur without fear of being confiscated is the same feature that permits a

captured the regulator to use cost reports to the detriment of consumers and argue that the system leaves him no option.

A third possibility is where the market believes the regulator will ignore the information produced by a 'strategic firm.' In this case, the market will accord little value to the information so there should be no impact of the information on stock prices, and a negative effect if it thinks that such cost padding is costly to the firm. In the fourth possibility, the regulator will incorporate the reports produced by a truthful firm. In this case, there are two offsetting impacts of the cost revelation. First, the market believes these are real costs and so responds in the traditional way of higher costs reducing the value of equity. But it also believes the regulator will be setting 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 $STOCK_{itq}$, the cumulative abnormal return surrounding the window where information about firm performance (costs and revenues) is revealed to the public and may be incorporated into equity prices. The subscript t refers to the fact that we will make a distinction between quarters that fall in review periods and those that do not. As our right hand side variable we introduce $COSTSURPRISE_{itq}$, a measure of the difference in actual costs from expected costs under the assumption that regulatory periods are not different from non-review 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. The estimating equation is

$$STOCK_{itq} = \alpha + \beta \, COSTSURPRISE_{itq} * REVIEW_{tq} +$$

$$+ \psi \, COSTSURPRISE_{itq} + \gamma \, REVIEW_{tq} + \varepsilon_{itq}$$

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 us with an estimate of the effect of cost surprises on stock market returns in a review year, and the expectation is that it behaves as Figure 2 suggests.

III. b. Data

Our sample consists of electricity distribution companies in Chile that account for 94 percent of total production in the central connected grid (based on 1991 data), from the time they are privatized (the majority of which take place between 1989 and 1991) to 1999. We use a broad measure of costs taking the sum of costs of goods sold and sales and administrative expenses. Since cost shifting as reported to us comes 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 financial statements the publicly traded utilities are required to file as part of their listing requirements and such cost information is what equity analysts focus upon.

We divide costs by revenues. This normalization has a number of attractive features relative to using raw cost information. The ratio is quite insensitive to cost and revenue changes of the same amount that are common in the industry (i.e. there is a strong element of pass through in the system). For example, according to the price cap formula, prices automatically adjust to changes in the costs of purchased power (which can change every six months). They also adjust for known and expected drivers of costs unrelated to company actions.[17] Implicitly, we are assuming that the ratio is driven primarily by cost changes which as we reported earlier is fairly accurate for Chile where prices for the value-added of distribution move very little over this period.

Other cost measures and normalizations are possible but could not be implemented without severely limiting 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 (this cost information is also not available to investors in equities). Unfortunately, information on the volume of power purchases was only available after 1996 and then only on an annual basis. [18] 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. Giving us some confidence that our findings are not sensitive to the choice of cost normalization, our refined cost measures are highly correlated with our base measure and produce qualitatively similar results for Chilectra, one company where we were able to collect much of this information.[19]

As reported in Table 2, which presents summary statistics for our variables and their correlation coefficients, 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% in 1989-1990 to just 78% in 1998-1999. The next section reports the results of our empirical tests, where we are careful to control for firm fixed effects, quarterly effects, etc., but visual inspection of the raw data is suggestive. Declines in costs appear focused immediately after a rate review and the rate of decline slows later in the period. The review periods are themselves distinct, with the appearance of a cost spike particularly in the final quarter of the reference year used for reinitializing rates.

Following standard event study methodology our measure of stock market response is a firm's cumulative abnormal return around the window where information is revealed. We construct a CAPM cumulative abnormal return. We first estimate the industry-beta by using the capitalization-weighted daily stock returns of the industry and the returns on the market index. The daily abnormal returns are the daily returns for the firms less the industry's beta times the daily market return. We cumulate abnormal returns over the information window. For the date which information is revealed to the market we use the dates of the annual reports submitted to IBES and the dates of the

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[17] Specifically the formula calls for prices to adjust based on the movement of a composite index (with the weights specific to each company) of the increases in CPI, Copper price index, wholesale prices index, and earnings index.
[18] See Baron and deBondt (1979) and Kaserman and Tepel (1982) on the strategic use of power purchase expenses.
[19] Available from authors.

quarterly financial reports available in the Global Access Database.[20] Our window ends 5 trading days after this event, to allow for information to be communicated widely and incorporated in prices. We use as the starting date for the window both 5 days before announcement and 25 days before announcement. Based on discussions with market participants, the wider window was seen as more appropriate for it captured the possibility of information leakage to the market prior to the event.[21]

To estimate the *COSTSURPRISE*, we take reported costs and subtract predicted 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, or 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 and cost surprises. Reflecting the strong performance of the distribution sector the average cumulative abnormal return in event windows is 1.6 percent with significant variability with 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.

IV. Empirical Results

In Table 3 we present the basic results for our unbalanced panel. We have 11 electricity distribution companies and we use quarterly data. We have an average of 39.9 observation per company with a minimum of 15 and a maximum of 44. Regression (1) shows that a time trend is negative and significant determinant of costs for our sample, even after controlling for company fixed effects and including dummies for the four quarters in the year to control for any seasonal effects that may be present. The estimated

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[20] For the 4th quarter (annual) reports, we make use of the report dates in IBES. The report release dates vary across years and across firms but mostly are around 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 financials become public after 30 trading days from the end of the quarter, except for the last quarter of each year.
[21] Our results are qualitatively similar, albeit less significant, in a much shorter [-5, +5] window.

effects are economically significant. Since the data is quarterly, they suggest that each year reported costs as a proportion of revenues have dropped by 1.2 %. Although our estimates cannot be interpreted as causal, there are other institutions that may be causing the cost reductions besides price cap regulation, they do suggest that price cap regulation has not stood in the way of cost efficiencies.

Regression (2) evaluates if these cost reductions have gotten weaker over time by including a squared time trend. There does not seem to be any evidence for this. The estimated coefficient increases slightly, implying cost reductions of 1.3 % per year. Regression (3) include review year dummies. Similar results obtain 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 non-review years.

Table 4 explores our second hypothesis: that costs fall more during the early phase of a review period. The intuition behind this prediction is that cost reductions that occur early on in the review period provide benefits during more periods, and are hence more desirable. Regression (1) in Table 4 tests this hypothesis by including a variable that indicates how far into a regulatory period (of 4 years = 16 quarters) we are, *EARLY*, and its squared *EARLY*^{2}. The results favor the theoretical prior that costs reductions are strongest early on in the regulatory periods, when the firm has still many quarters to come to benefit from each cost reduction. The estimated coefficients suggest that costs are U-shaped, with a minimum in the fifth quarter. Towards the end costs equal the intercept, so during the last quarters the firms reverse any cost gains made until then. The fact that there are no longer cost gains towards the end of the regulatory period is consistent with the idea that late cost revelations maybe an attempt to influence future price caps. In order to reduce the influence of the regulatory review periods, regression (2) repeats regression (1) excluding them. It shows a similar U-shaped pattern, although the effects are somewhat less precisely estimated.

Table 5 incorporates the stock market as another source of information to understand 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 in Figure 2, it is possible that this specification maybe mixing up observations where the expected effect is negative with observations where it is positive. Regression (2) in Table 5 shows that the review period dummy (defined as the last two quarters of a year where a regulatory review is taking place) is negative and significant, suggesting that on average returns are 11% lower 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, and that this is not priced in by the market. Interestingly, when we study this over time in Table 6, we find that the negative effect of the early review periods is bigger (i.e. more negative) than the effect in later review periods, suggesting that there is some learning by participants about the workings of the system.

An important result is presented in regression (3) in Table 5. It shows that in general cost surprises (i.e. costs that exceed the "naïve" cost expectation) reduce stock market returns, an effect that is significant at the 10% level (but see Table A5 below where results are significant at the 5% level). Review periods have again a negative and well-defined effect on prices. Interestingly, cost surprises that take place in a review year tend to *increase* significantly the firm's stock returns.

This evidence is consistent with the hypothesis that market participants believe the firm is behaving strategically and that the regulator will be forced to use this 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.

When we study the effects over time in Table 6 (and in Table A6) we find that this effect falls, reinforcing the idea that the market learns to expect the interaction between firm and regulator to take place along these lines. Since individual reviews include only a limited number of years (the first review in particular only has two preceding years), Table 6 partitions the sample into one containing the first and second review and the other containing the second and third reviews. Similar results emerge from looking at individual reviews.

Regression (4) introduces a post review period dummy and finds that such periods tend to significantly increase stock returns. There are big 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 A5 uses a shorter measure inside the review period of just two quarters (the last two), with somewhat stronger results. Table A6, 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 is natural to assume) the private costs that a firm bears associated with shifting increase with the number of periods of distorted information and/or the time gap between reported and actual costs.

V. Conclusions

Price caps are the regulatory regime of choice today. Virtually all of the countries that have privatized their utilities in recent years have adopted price cap regimes. Partly as a result, there has been considerable interest in the theoretical properties of price caps. Some of this work suggests that the system provides adequate incentives for cost reductions and can limit regulatory discretion. Others warn of inefficiencies that may result, including distortions due to incorrect pricing, and the possibility of a sustained shift of returns to producers.[22] There has been, however, little empirical work in the area. Most researchers refer to the empirical work of Mathios and Rogers (1989) and the case studies contained in Levy and Spiller (1996). Our paper seeks to contribute to empirical understanding of price caps regimes, and more generally, the costs of inflexible rules when firms behave strategically.

We study the performance of the electricity distribution industry in Chile in the 1990's 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, characterized as it was by the transition to democracy following the military regime led by General Pinochet. We document strong reductions in the ratio of reported costs to revenues, in the order of 1.2% a year. This finding is

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[22] See, for example, Beesley and Littlechild (1989), Breautigam and Panzar (1993), Levy and Spiller (1994), Schmalensee (1989), *inter alia*).

consistent with strong incentives for cost reductions under a price-cap regime, such as those argued in the literature.

There is also evidence suggesting 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 on. We also find that cost reductions reverse during the last year of each review period. A natural hypothesis is that firms are trying to influence the regulators. Although caps are supposed to ignore information from specific firms and follow the costs of an ideal "efficient company", as in the yardstick models, there is 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 discretion to act differently.
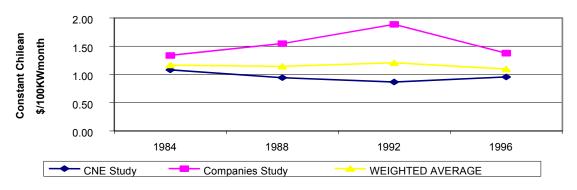
We then propose a method that incorporates information generated by a third party (the stock market) to evaluate the hypotheses that firms behave strategically. The starting point is the finding that cumulative abnormal returns around the dates when firms announce quarterly results are negative during review periods, suggesting 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 non-review years and compare them to market reactions during review years. Bad news (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 they *increase* them during review years. In a non-review 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 the same size 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 presence of regulator that incorporates the information into the future price levels, either

because he is captured, or because he is benevolent but feels the regulatory regime constrains him to do so.

In summary, the efficiency gains with a price cap system seem large. It also seems clear that the system has not stood in the way of such gains being captured by producers. More generally, our results suggest there may be value in complementing regulatory procedures with stock market information.[23]

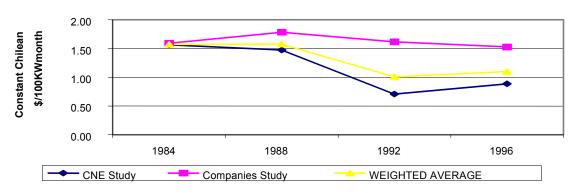[23] For a start in this direction, see Di Tella and Kanczuk (2002).

Figure 1: VAD Cost studies by government and regulated companies

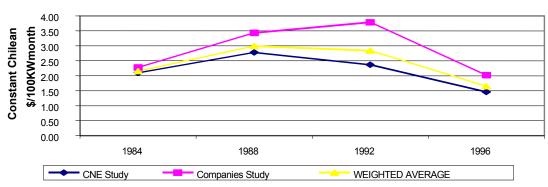**Estimates for the Value Added of Distribution**
Area 1, High Voltage

Estimates for the Value Added of Distribution
Area 2, High Voltage

Estimates for the Value Added of Distribution
Area 3, High Voltage

Source: Sebastien Bernstein, SYNEX consulting.

Table 1: Chile Electricity Distribution Companies (1991)

System	Included in sample	Publicly Traded Throughout Period?	Customers (in 1,000)	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
Others			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: Based on Spiller and Martorell (1996)

Table 2: Summary Statistics

Variable	Obs	Mean	Std. Dev	Min	Max
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
Review_quarter	399	0.140	0.348	0	1
Review_year	399	0.281	0.450	0	1
post_Review_quarter	399	0.135	0.343	0	1
post_Review_year	399	0.271	0.445	0	1

	Correlation Coefficients								
	COSTS	COSTSURPRISE	STOCK	EARLY	TIME	Review quarter	Review year	Post_ Review quarter	Post_ Review year
COSTS	1								
COSTSURPRISE	0.625	1							
STOCK	-0.028	-0.040	1						
EARLY	0.202	0.169	-0.261	1					
TIME	-0.725	0.021	-0.003	-0.115	1				
Review_quarter	-0.002	0.064	-0.472	0.530	0.122	1			
Review_year	0.027	0.083	-0.163	0.700	0.135	0.643	1		
Post_Review_quarter	0.041	-0.111	0.302	-0.516	-0.103	-0.142	-0.221	1	
Post_Review_year	0.096	-0.086	0.202	-0.620	-0.206	-0.232	-0.361	0.611	1

Note: The data definitions and their sources are given in the Appendix.

Table 3: The Evolution of Costs over Time under a Price Cap Regime, 1989-1999.

	Dependent Variable: *COSTS*		
	(1)	(2)	(3)
TIME	-0.0030***	-0.0032***	-0.0030***
	(0.0001)	(0.0005)	(0.0001)
TIME²		7.5e-06	
		(1.1e-05)	
Review_year			0.0142***
			(0.0003)
Constant	0.8933***	0.8948***	
	(0.0041)	(0.0056)	
Seasonal Dummies	Yes	Yes	Yes
Company Fixed Effects	Yes	Yes	Yes
Number of Obs.	399	399	399
Number of Companies	11	11	11
R^2	0.55	0.55	0.57

Note: Robust standards are in parentheses. *** denotes significance at the 1% level. Dependent variable is *COSTS*: reported costs divided by reported revenues *Time*: a time trend equal to 1 in the first quarter of 1989 and to 44 in the fourth quarter of 1999. *Time²*: *Time x Time*.

Table 4.: The Evolution of Costs within Review periods, 1989-1999.

	Dependent Variable: *COSTS*	
	(1)	(2) No Reviews
EARLY	-0.0019 (0.0014)	-0.0020 (0.0016)
EARLY^2	0.0002** (7.6e-05)	0.0002 (0.0001)
TIME	-0.0031*** (0.0001)	-0.0032*** (0.0002)
Constant	0.9096*** (0.0068)	0.9058*** (0.0074)
Seasonal Dummies	Yes	Yes
Company Fixed Effects	Yes	Yes
Number of Obs.	399	287
Number of Companies	11	11
R^2	0.57	0.58

Note: Robust standard errors are in parentheses. ******* denotes significance at the 1% level; ****** denotes significance at the 5% level. * denotes significance at the 10% level. Dependent variable is *COSTS*: reported costs divided by reported revenues *Early*: a time trend equal to 1 in the first quarter of the 4-year period in between review years and to 16 in the fourth quarter of the fourth year. *Early^2*: *Early x Early*. In columns (8) and (9), review years are excluded.

Table 5: The effect of cost announcements on stock returns in review and non-review periods

	Dependent Variable: *STOCK*				
	(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)
Review_year		-0.029***	-0.030***	-0.019*	-0.020*
		(0.010)	(0.009)	(0.010)	(0.010)
*Review_year*COSTSURPRISE*			0.606**		0.665**
			(0.262)		(0.297)
Post_review_year				0.032***	0.032***
				(0.011)	(0.011)
*Post_review_year *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)
Company fixed effects	yes	yes	yes	yes	yes
Observations	377	377	377	377	377
Number of companies	11	11	11	11	11
R^2	0.00	0.03	0.04	0.05	0.06

Notes: Robust standard errors are in parentheses. *** denotes significant at 1%; ** denotes significant at 5%; * denotes significant at 10%. Dependent variable *(STOCK)* is the cumulative abnormal return of the stocks inside a thirty day window [-25, +5] around the dates on which the quarterly financial reports of each company are made public. (source: I/B/E/S and Global Access). *Review_year* is a dummy equal to 1 for all four quarters of the review year. *Post_review_year* is a dummy equal to 1 in the first four quarters after the end of each review year. *COSTSURPRISE* is the forecast error of *COSTS* (cost/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:

$$COSTS_{i,q} = \alpha + \beta \, COSTS_{i,q-1} + \gamma \, TIME_q + \delta \, seasonal \, dummies + u_i + e_{i,q}.$$

The forecasted value of $COSTS_{i,q+1}$ 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 becomes available in time.

Table 6: Time sensitivity of the interactions of Cost Surprises with the Review periods

	Dependent Variable: *STOCK*	
	1st and 2nd Reviews (<1996)	2nd and 3rd Reviews (>1992)
COSTSURPRISE	-0.308 (0.223)	-0.197 (0.233)
Review_year	-0.019 (0.013)	-0.031*** (0.010)
*Review_year*COSTSURPRISE*	1.327** (0.326)	0.226 (0.384)
Constant	0.017** (0.007)	0.025*** (0.006)
Company fixed effects	yes	yes
Number of Observations	222	263
Number of companies	9	11
R^2	0.04	0.04

Notes: Robust standard errors are in parentheses. *** denotes significant at 1%; ** denotes significant at 5%;* denotes significant at 10%. Dependent variable *(STOCK)* is the cumulative abnormal return of the stocks inside a thirty day window [-25, +5] around the dates on which the quarterly financial reports of each company are made public. (source: I/B/E/S and Global Access). *Review_year* is a dummy equal to 1 in the review year. *COSTSURPRISE* is the forecast error of *COSTS* (cost/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:

$COSTS_{i,q} = \alpha + \beta\, COSTS_{i,q-1} + \gamma\, TIME_q + \delta\, seasonal\ dummies + u_i + e_{i,q}.$

The forecasted value of $COSTS_{i,q+1}$ is based on the estimated coefficients, and the surprise is the positive or negative deviation of the real value from this forecast. The estimated coefficients change as more data becomes available in time

Appendix I:

Table A5: The effect of cost announcements on stock returns in review and non-review periods (review period defined to be the last two quarters in the review year)

	Dependent Variable: *STOCK*				
	(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)
Review_quarter		-0.111***	-0.114***	-0.103***	-0.107***
		(0.011)	(0.011)	(0.011)	(0.010)
*Review_ quarter * COSTSURPRISE*			1.067***		1.016***
			(0.273)		(0.267)
Post_review_quarter				0.067***	0.068***
				(0.013)	(0.013)
*Post-review quarter * 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)
Company fixed effects	yes	yes	yes	yes	Yes
Number of Observations	377	377	377	377	377
Number of companies	11	11	11	11	11
R^2	0.00	0.22	0.25	0.28	0.31

Notes: Robust standard errors are in parentheses. *** denotes significant at 1%; ** denotes significant at 5%;* denotes significant at 10%. Dependent variable *(STOCK)* is the cumulative abnormal return of the stocks inside a thirty day window [-25, +5] around the dates on which the quarterly financial reports of each company are made public. (source: I/B/E/S and Global Access) *Review_quarter* is a dummy equal to 1 for the last two quarters of the review year. *Post_review_quarter* is a dummy equal to 1 in the first two quarters after the end of each review year. *COSTSURPRISE* is the forecast error of *COSTS* (cost/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:

$$COSTS_{i,q} = \alpha + \beta\, COSTS_{i,q-1} + \gamma\, TIME_q + \delta\, seasonal\ dummies + u_i + e_{i,q}.$$

The forecasted value of $COSTS_{i,q+1}$ is based on the estimated coefficients, and the surprise is the positive or negative deviation of the real value from this forecast. The estimated coefficients change as more data becomes available in time.

Appendix (Continued):

Table A6: Time sensitivity of the interactions of Cost Surprises with the Review periods
(review period defined to be the last two quarters in the review year)

	Dependent Variable: *STOCK*	
	1st and 2nd Reviews (<1996)	2nd and 3rd Reviews (>1992)
COSTSURPRISE	-0.316** (0.177)	-0.114 (0.204)
Review_quarter	-0.130*** (0.013)	-0.078*** (0.013)
*Review_quarter*COSTSURPRISE*	1.327*** (0.326)	0.226 (0.384)
Constant	0.032 (0.005)	0.029*** (0.005_
Company fixed effects	yes	yes
Number of Observations	222	263
Number of companies	9	11
R^2	0.34	0.13

Notes: Robust standard errors are in parentheses. *** denotes significant at 1%; ** denotes significant at 5%;* denotes significant at 10%. Dependent variable *(STOCK)* is the cumulative abnormal return of the stocks inside a thirty day window [-25, +5] around the dates on which the quarterly financial reports of each company are made public. (source: I/B/E/S and Global Access). *Review_quarter* is a dummy is equal to 1 for the last two quarters of the review year. *COSTSURPRISE* is the forecast error of *COSTS* (cost/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:

$COSTS_{i,q} = \alpha + \beta\, COSTS_{i,q-1} + \gamma\, TIME_q + \delta\, seasonal\ dummies + u_i + e_{i,q}.$

The forecasted value of $COSTS_{i,q+1}$ is based on the estimated coefficients, and the surprise is the positive or negative deviation of the real value from this forecast. The estimated coefficients change as more data becomes available in time.

Appendix I (Continued):

Data Definitions and Sources

Variable	Definition	Source
COSTS	The Firm's Reported Operating Costs over Revenue	CSV (Chilean securities and exchange commission)
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: $COSTS_{i,q} = \alpha + \beta\, COSTS_{i,q-1} + \gamma\, TIME_q + \delta\, seasonal\ dummies + u_i + e_{i,q}$ The forecasted value of $COSTS_{i,q+1}$ 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 by using the cost per revenue data from CSV (Chilean securities and exchange commission)
STOCK	Cumulative Abnormal Returns of company stocks in [-25 +5] day window around the dates that the quarterly financial reports become public	Calculated by using the stock price data of Datastream and the date information from I/B/E/S and Global Access
TIME	The quarter number which takes the value: 1 in the first quarter of 1989 up to 44 in the fourth quarter of 1999	
EARLY	Time trend equal to 1 in the first quarter of the 4-year period in between review years and to 16 in the fourth quarter of the fourth year	Author's definition
Review_Year	Dummy variable which equals: 1 if year is 1991, 1995 or 1999, and 0 otherwise	Authors' definition
Review_Quarter	Dummy variable which equals: 1 if quarter is one the last two quarters of the review years. (i.e. 1 if quarter is equal to 11, 12, 27, 28, 43 or 44; and 0 otherwise)	Authors' definition
Post_Review_Year	Dummy variable which equals: 1 in the first four quarters from the end of the review years (i.e. 1 if quarter is equal to 13, 14, 29, 30; and 0 otherwise)	Authors' definition
Post_Review_ Quarter	Dummy variable which equals: 1 in the first two quarters from the end of review years, and 0 otherwise	Authors' definition
Seasonal Dummies	A Set of 4 Dummies Taking the Value 1 in the corresponding quarter.	

Appendix II:

Institutional Background and Regulatory Reforms[24]

The approach to the power sector in Chile prior to 1982 was to use rate of return regulation for vertically integrated utilities dominated by firms owned by the state and the result was typical problems of political manipulation and asymmetric information. The Electricity Law of 1931, amended in 1959, specified a maximum rate of return on fixed assets of 10 %, with assets revalued annually. But in the 1960s, prices were set so that firms did not even approach the maximum rate of return and the financial situation deteriorated further under the Allende government (1970-1973) when there were limited price increases despite hyperinflation. The government responded in the 1974-1979 period adjusting prices upward to reflect revalued assets, but here the companies clearly enjoyed advantages in having more intimate knowledge of the costs.[25]

The electricity reforms that produced the price cap system in distribution were designed to both increase efficiency and reduce political discretion over decision making in the industry. Electricity reform began in 1978, when the National Energy Commission (CNE) was established and a committee formed to make recommendations and was formalized in the Mining Law of 1982 (DFL 1).[26] The reforms moved to stimulate efficiency at the generation level through the introduction of competition.[27] 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. Sebastian Bernstein, the head of the committee who drafted the 1982 law, argued,

> *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 decision-making 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, prices are not set by yourself, they are set by someone else, 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*

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[24] For a thorough discussion of regulation in Chile, see Bustos and Galetovic (2002), especially pp 23-6.

[25] Sebastian Bernstein, co-author of the Electricity Law of 1982, noted, "We discovered that the book information didn't represent anything. We had at the time an inflation rate of 500% 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.

[26] 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: Enersis S.A., 1993, p. A-10.

[27] 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 the free market for large consumers (>2MW) and the regulated market for small consumers. In the regulated market, prices for distributors are set twice a year based in part on expected short run marginal cost over the next 4 years and partly on free market prices.

avoid politics by having a 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.[28]

Formally, DFL 1 sets a maximum price for the mark up distribution companies can charge consumers for their service (called the value-added of distribution or VAD) that is fixed for four years subject just to automatic adjustments and then revised more systematically using a specific formula in review periods. 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. Critically, to reduce the incentive for firms to misreport costs, the costs considered are not to be those reported by individual companies but instead costs of a "model efficient company" (taking into account the three types of density of distribution networks and whether lines are overhead or below ground).[29] The basis for the costs of the model efficient company is the costs of a single 'test company' (or area of a company). No firms are informed of the choice beforehand and regulators are 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 that is a weighted average factor (defined separately for each company) of the increases in CPI, Copper price, wholesale prices, and earnings index published by the National Institute of Statistics.

This price cap thus has the four properties proposed by Acton and Vogelsang (1989), with a ceiling for prices, price ceilings based on a bundle of services, price ceilings 'adjusted periodically by a pre-announced adjustment factor that is exogenous to the firm' (p.370) and 'in longer intervals of several years' the adjustment factors, baskets and weighting schemes by the industries are reviewed and possibly changed' (p. 370). This particular price cap system also meets Levy and Spiller's (1996) three tests of commitment, which focus on substantive restraints on discretion, formal and informal constraints on changing the system, and institutions to enforce these constraints.[30]

While regulators can choose the test company (or area), DFL 1 requires that firms in addition to regulators be allowed to solicit cost studies and firm studies are guaranteed

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[28] Di Tella and Dyck (2001), p.5.

[29] As Bernstein argued. "*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 we had that 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.

[30] Limits on political discretion is not a necessary feature of price caps. In the UK version of price-cap, for example, Beesley and Littlechild (1989) argue that regulators have significant discretion during reinitialization of price caps with no formal constraints on the level of prices in the reinitialization. "The UK 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 UK, neither government nor regulators have given detailed reasons for their decision on X. This reduces the bases for challenge (by company, competitors, or customers)." (p. 461)

a weight in the final determination.[31] Regulators are not allowed to use their own staff in preparing studies (both firms and regulators 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 years' worth of data rather than a retrospective look at past data and 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.[32]

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 held a majority in both chambers. Firms had the right to take the regulator to court if they felt the regulator had overstepped his regulatory authority and the previous prices would stay in place pending judicial determination. The Supreme Court was credited with independence based on past records of impartial responses.[33]

Informal constraints on changing the system are provided by the privatization of distribution companies and the widespread ownership of these companies. By 1991, the electricity sector consisted of 2 integrated companies, 11 power generation and transmission companies, 14 electric power cooperatives and 21 electricity distribution companies (Spiller and Martorell (1996)) with almost all distribution assets owned by publicly-traded companies (See Table 1). Shares in distribution companies were held by employees, management, foreigners (through the cross listing of company shares on American stock exchanges as ADRs) and indirectly by a wide cross section of the Chilean population through the purchase of shares by 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.

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[31] In case of a dispute over the findings of the regulator. The VAD would depend 2/3 on the governments' consultants estimate and 1/3 on the firms' consultant estimate.

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

[33] Unlike the UK, there was 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.

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