

REFORMING URBAN WATER SUPPLY:

THE CASE OF CHILE

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Many observers regard Santiago's water system reform as an important example of successful reform under public management. Using a comprehensive measure of welfare compared to a counterfactual, our study finds gains that are surprisingly large given the relatively good initial conditions. This report addresses the central question of why this reform improved performance, when similar attempts to reform under public ownership have met with failure in other countries. It also addresses the question of why EMOS was not privatized, but was reformed, and what were the costs, if any, of not privatizing. It shows that political circumstances led to a regulatory framework designed to attract private investors to the water system and motivate them to operate efficiently and expand the system. Chile's unique electoral institutions sustained this framework under state operation after democracy was restored. Chile's bureaucratic institutions and norms, combined with Santiago's relatively low cost water system, allowed it to implement prices that in effect increased quasi-rents for investment in the system, while minimizing the risk of inefficiency or monopoly rents.

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In the late 1980's Chile intended to privatize the Santiago Metropolitan Sanitary Works Enterprise (Empresa Metropolitana de Obras Sanitarias, or EMOS). Instead it was ultimately reformed under public ownership, by means of a regulatory framework that mimicked the design of a concession with a private utility. (Table 1 lists the reform components.) In particular, the new regulation set tariffs so as to assure at least a 7 percent return on assets, created a neutral regulator independent of ministry intervention, and gave EMOS the right to appeal the regulator's tariff decisions. As we shall see, the changes allowed significant price increases, which helped fund improved maintenance and enabled EMOS to expand as Santiago's population grew. The reform produced net benefits in economic welfare that are surprisingly large given the relatively good initial conditions. These gains largely accrued to government, although consumers benefited from almost 100 percent coverage of expanding demand, better water pressure and fewer interruptions of service. Consumers also had to pay higher prices, but the effects were ameliorated by a direct subsidy. Employees gained from wages closer to market wages. By reducing information asymmetries, increasing managerial incentives and signaling commitment, the reform fostered important efficiency gains in EMOS. Privatization ultimately occurred in 1999, and the changes it may induce are likely to be of less significance than those introduced in 1989-90, which are the subject of this paper.

Table 1. Principal Components of the Reform

1. **Tariffs:**

Old: Ad hoc increases set by the Ministry of Economy (issued as Presidential decrees) within a ceiling (no more than 10 percent return on fixed assets).

New: Tariffs indexed to inflation and adjusted every five years according to a formula based on marginal costs. New tariff formula introduced gradually from 1990 to 1995 starting with a 30 percent real increase in 1990.
 2. **Subsidies:**

Old: Cross subsidies for smaller amounts of consumption (first ten cubic meters of consumption had lower tariffs).

New: Direct subsidy paid to the company by the municipality from federal budget for all customers within a low-income category since 1990. Covered an average of 60 percent of first 15 (later 20) cubic meters of consumption per month.
 3. **Regulator:**

Old: National Service of Sanitary Works (SENDOS), an autonomous public entity attached to the Ministry of Public Works, directly managed 11 of the country's 13 regional water offices. EMOS was autonomous.

New: Superintendent of Sanitary Services, a regulatory body attached to the Ministry of Public Works, responsible for setting tariffs, setting and enforcing technical standards, and granting concessions for water supply and sewerage services since 1990.
 4. **Company Status:**

Old: Autonomous entity under public law.

New: State-owned corporation under private commercial law since 1988.
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Many observers regard Santiago's water system reform as an important example of successful reform under public management. This report addresses the central question of why this reform improved performance, when similar attempts to reform under public ownership have met with failure in other countries. It also addresses the question of why EMOS was not privatized, but was reformed, and what were the costs, if any, of not privatizing. To answer these questions we analyze how institutions, in the broad sense of rules and norms delimitating and guiding human behavior and social interactions, influence choice and economic performance (North 1990). We examine the gains from reform comprehensively, including consumer surplus and effects on labor, buyers and government compared to a counterfactual.

As we shall show, political circumstances led to a regulatory framework designed to attract private investors to the water system, and motivate them to operate efficiently and expand the system. Chile's unique electoral institutions sustained this framework under state operation after democracy was restored. Chile's bureaucratic institutions and norms, combined with Santiago's relatively low cost water system, allowed it to implement prices that in effect increased quasi-rents for investment in the system, while minimizing the risk of inefficiency or monopoly rents. The regulation was enshrined in detailed legislation backed by constitutional safeguards. Since political institutions make it hard to change laws in Chile, this legal foundation had strong credibility. The lack of regulatory discretion also protected the regulator from politically motivated intervention, while a direct consumer subsidy reduced political incentives to press for lower tariffs.

The next section describes the circumstances that made reform politically desirable and feasible despite relatively good initial conditions in the water system, and explains why EMOS was not privatized but was reformed under public ownership. Section II analyzes the characteristics of the

reform in terms of an implicit “regulatory contract” supported by fundamental bureaucratic and judicial institutions. This section assessing how the contract addressed agency problems by improving information, raising incentives and signaling commitment. The following section (Section III) measures the effect of the reform on economic welfare and other performance measures and shows that the gains were relatively large despite good initial conditions. Finally, section IV concludes with a discussion of the implications of our findings.

I. The Decision to Reform

We might assume that governments would seek water reform where there is a pressing need to expand coverage of unmet demand, improve the operation of a poorly run company, or reduce a fiscal drain. The slow pace of reform in cities where the water system has been in crisis for years, however, suggests that serious sector problems alone are not what motivates water reforms.¹ Rather, we expect that reform occurs when a macro-economic crisis shifts political circumstances so that reform becomes politically desirable, in the sense that the political benefits outweigh the political costs, and politically feasible, in the sense that those favoring reform can win control of the veto gates and overcome opposition.

¹ For example, planned reforms were not implemented in Lima in the 1990’s even though at least a quarter of the population was not connected and those with connections had no water for 15 hours a day on average. In Mexico City, depletion of the aquifer has been causing the city to sink yet low tariffs and deficient bill collection encouraged high levels of water consumption until recently. See Alcazar and Xu 1998 on Lima and Brook-Cowan and Haggarty 1998 on Mexico City.

Under many circumstances the political costs of water system reform are likely to be high. One reason for this is that reform often reverses a long history of underpricing of water services. Water systems have low variable costs compared to their fixed costs, which means that a large part of a cost recovery tariff would take the form of quasi-rents. Since capital investments in water are very durable, a water company may be able to operate for years without recovering its fixed costs (Noll, Shirley and Cowan 1999). As a result many governments, including Chile's, have chosen to keep water tariffs low for long periods, sometimes for so long that the company begins to under-invest in maintenance as well as expansion. Political costs of water reform may also be large in cases where water has high political saliency. Some countries, such as Mexico, have laws or constitutional prohibitions against cutting off consumers who fail to pay their water bills. Another reason why the political costs of water reform may outweigh the benefits is that the beneficiaries of water reforms tend to be poor, recent migrants and the opponents tend to be wealthier, better organized workers and consumers who are already connected. For all these reasons we expect that water reform follows a crisis that changes the net political benefits from reform.

The rest of this section describes the relatively good conditions in the water system in Santiago, explains how the political equation changed in Santiago to make reform politically desirable and feasible, and discusses the political circumstances that led to the unusual reform that resulted.

A. Circumstances in the Water Sector Leading to Reform

Absent politics, the circumstances in the water sector that we expect would be likely to provoke reform are: (i) water shortages (ii) large unmet demand, (ii) deficient management; and (iv) financial problems. As we show below, none of these problems except finances were especially serious in

EMOS' case. Initial conditions in Santiago's water sector were relatively good: raw water was cheap and abundant, demand for water and sewerage was largely met, and the company was reasonably well managed. EMOS' main problems were due to a lack of funds for maintenance and expansion.

(i) *Water Shortages.* At the time of the 1990 reform there were no unpredictable shortfalls that might motivate consumer dissatisfaction, nor was there a need for costly new investments to expand supply in the near term. EMOS' main source of water was relatively abundant, good quality and cheap surface water from the Maipo River, supplemented by a lake and 90 deep wells. The system was sustainable, in the sense that EMOS own water sources were sufficient to meet Santiago's projected demand for the next 10 to 20 years (World Bank project documents).² Supply is also sufficient even during low periods, although reliance on snow melt during summer has led to some variability (field interviews with engineering faculty members, University of Chile). Furthermore, alternative sources are available, although expensive.³

(ii) *Demand.* Unmet demand for water or sewerage was not a motivating factor for reform. Since 1980, about 98 percent of EMOS' potential clients had water connections, and 90 percent had sewerage connections (see Table 2).⁴ These data overstate coverage somewhat since clients in EMOS'

² Supply in 1997 was considered sufficient to cover current average consumption until 2005 (field interviews with Superintendencia staff). Note that all field interviews took place in 1997.

³ Water rights are tradeable but costly. Water rights are almost entirely allocated to private parties. The water market functions poorly, with few transactions and high transaction costs, in part because of the high cost of physically changing canal flows and in part because much of the water rights are not legally inscribed but are exercised on the basis of traditional holdings (Chile has allowed private water rights since the 1920's). EMOS purchased 33 shares (a share is equivalent to at least 22 liter/second 85 percent of the time) between 1990-93 at an average cost of US\$10,000 per share. This is a small purchase, as evidenced by the fact that EMOS owns 1,369 shares of the Río Maipo water, while total shares are 8,133. There have been too few transactions to know how typical this purchase price would be. Herme and Easter 1995 and Rios and Quiroz, 1995.

⁴ These numbers overstate coverage somewhat because the indigent population without legal housing (about 5

definition did not include households in informal settlements that had been built without networks nor did it incorporate several poor communities just outside its concession boundary.⁵ The population without connections to the piped water system in Santiago were overwhelmingly poor. Most lived in informal settlements built without a secondary network and would probably not have been able to finance the cost of connecting, which could reach more than US\$1,000 (field interviews). The Pinochet administration's program to eliminate illegal settlements and rental tenements in the city center added to the number of unconnected consumers, by leading many poor people to relocate to the far south of Santiago in areas with little existing infrastructure (Gilbert, 1993). These unconnected citizens had little political influence, as we explain below.

Demand for sewage treatment was low at the time of the reform, even though only about 1 percent of wastewater was being treated (raised to 3 percent in 1995). Santiago had higher rates of water born disease than in the rest of the country because food crops were irrigated with contaminated water, but consumers had little information about the health risks.⁶ More recently, with the outbreak of cholera in Peru in 1993 and the rising economic importance of Chile's agricultural exports, concerns over the health and economic effects of irrigating food crops with untreated wastewater have increased.⁷

percent of the city's population) are excluded.

⁵ The legal responsibility for building housing connections and networks ready for hookup to EMOS' infrastructure lay with the developer, or in the case of poor, informal settlements, with the local government. Santiago's 40 odd municipalities lacked the funds to build networks or housing connections.

⁶ Polluted wastewater was used to irrigate 130,00 ha, including 7,000 ha used for growing raw vegetable crops for immediate consumption in the metropolitan region. Santiago averaged 150 cases of typhoid per 100,000 a year from 1985 to 1991 (compared to a rate of 50 cases per 100,000 for all of Chile) and epidemiological analysis suggests that the higher rate of endemic typhoid in Santiago was causally linked to irrigating vegetables with polluted water (World Bank 1994).

⁷ The Santiago metropolitan region produces about 40 percent of Chile's exportable fruit (fruit represents about 85 percent of agricultural exports for human consumption). (World Bank 1994).

Table 2. Coverage of Water and Service

<i>Year</i>	<i>Client Population (000)</i>	<i>% with Water Connection</i>	<i>% with Sewerage Connection</i>
1980	3,597	98.6	85.0
1981	3,675	97.8	83.9
1982	3,750	98.5	84.6
1983	3,860	98.6	84.6
1984	3,926	98.6	87.0
1985	4,049	99.0	87.3
1986	4,287	99.0	88.1
1987	4,250	99.2	90.0
1988	4,422	99.2	90.3
1989	4,593	99.2	90.5
1990	4,816	98.0	90.3

Source: EMOS, *Statistical Bulletin*, various.

(iii) *Management.* Mismanagement is often a motivation for reform, but this was not a significant problem in Santiago. In 1990, at the time of the reform, EMOS served a water and sewerage concession area that covered most of the Santiago metropolitan region, with water connections to some 4.7 million people.⁸ EMOS was regarded as efficiently managed and performing well in comparison with other water companies in the region (World Bank 1992, p. 34).⁹ Connections were almost entirely metered, and bill collection rates were over 80 percent, high by regional standards. Unaccounted-for-water or UFW was high at 31 percent of total water produced in 1989, but this rate was down from 38 percent in 1987.¹⁰ Furthermore, according to World Bank 1992, high UFW was

⁸ The population in EMOS' concession area at that time represented 87 percent of the population of Santiago; the rest of the city was served by a small municipal and a private water company. The private company, Lo Castillo (later Aguas Cordillera), operated in a largely high income neighborhood with about 5 percent of the population of Santiago. It had been set up by the developer and allowed to remain in private hands. The municipal company, Maipu, is in a middle to low income area of Santiago and served about 7% of the metropolitan population (See Table 6 of the statistical appendix).

⁹ EMOS was created in 1977 as an autonomous decentralized government company.

¹⁰ Defined as the difference between the volume of water produced and the volume billed (i.e. the losses due to leaks, metering inefficiencies, theft, and the like). In 1984 unaccounted-for-water averaged 12 percent in the US and 15 percent in Canada (Brooke-Cowen, Dianderas, and Yepes, 1996).

not the result of mismanagement but of failure by the Ministry of Finance to permit EMOS sufficient investment funds to maintain its system, something we discuss in the next section.

Overstaffing was not a problem thanks to a 1977 effort by the Pinochet government to reduce the size of the public sector and expand competitive procurement from private provider through outsourcing. By contracting out such activities as meter distribution, reading and repair, network maintenance, and transport, EMOS reduced its staff from 3,200 workers in 1977 to 1,700 by December 1989, or from an average of 2.4 staff per 1000 water connections in the early eighties to 2.1 in 1990.¹¹

(iv) *Financial Problems.* Finance was the one area where EMOS had serious problems. The company ran a loss before taxes from the early 1980's until 1987, largely because its tariffs were not allowed to increase in real terms. Tariffs during this period were substantially below World Bank estimates of EMOS' long run marginal costs (World Bank, 1992, p. 33).¹² EMOS' rate of return on total assets in 1989 was only 2.7 percent, which was still better than the average return of all Chile's public water companies at that time: negative 1.6 percent (Table 3).

EMOS' low cash flow, combined with borrowing constraints imposed by the Ministry of Finance to keep the debt of state owned enterprises low, explain why the company under-invested in maintenance and expansion. Some of EMOS' facilities were old and much in need of repair and replacement by 1990. For example it had collection and treatment works dating to 1917 and 20% of its network of

¹¹ Some observers suggested that EMOS might have been understaffed in certain skills as a result of these reductions (World Bank, 1986 and field interviews).

pipes exceeded their usable life of 30 years (Raquel Alfaro 1987). This contributed to 52 pipe breaks per 100 Kms in 1989, compared to a US average of 17. The World Bank estimated in 1986 that EMOS would need to invest US\$ 118.6 million from 1987-1989 to meet projected demand and maintenance needs; but its actual investment for that period was only \$24 million (all figures in constant 1989 dollars).¹³ Although service was still reasonably good, without additional funds the company would not be able to keep water pressure up, avoid even more frequent service interruptions and expand the system to keep up with population growth (field interviews).

¹² The World Bank estimated long run marginal costs of EMOS' 1982 to 1985 water and sewerage investment program (at a discount rate of 11 percent) at 25.7 US cents/M3. In comparison, its actual tariff rate for water and sewerage of 10.5 US cents/M3 in 1987 and 11.5 in 1988 (ibid, p. 53).

¹³ World Bank 1986b. These projection investment requirements are probably an overestimate since they were based on demand estimates that assumed a lower price than actually was charged (a 9 percent real increase in 1987, 6 percent in 1988, and 9 percent in 1989, compared to actual real increases of 17 percent in 1987 and 10 percent in 1988 and 1989. Nevertheless, most observers agree that EMOS was seriously underinvesting in maintenance and expansion during this period.

Table 3. Rate of Return on Assets of Water Companies
(% after tax profits/total assets)

	EMOS	TOTAL STATE ENTERPRISES	PRIVATE & MUNICIPAL	ALL WATER COMPANIES
1988	3.6	-1.4	-0.1	-1.4
1989	2.7	-1.6	13.4	-0.8
1990	4.8	-1.1	3.9	-0.8
1991	6.6	-0.2	1.6	-0.1
1992	8.4	0.9	4.0	-0.9
1993	9.7	3.4	6.5	3.6
1994	11.5	5.1	7.2	5.2
1995	11.0	5.9	10.0	6.3

Source: SSS, 1995.

B. Political Circumstances Leading to Reform

(i) *Crisis*. As mentioned, we expect reform is more likely to occur after a crisis alters the political costs and benefits to the decision-makers. The crisis which played this role in Chile was the hyperinflation and shortage of goods followed by the 1973 military coup, which overthrew the elected Socialist President Salvador Allende and brought to power the dictatorship of Army General Augusto Pinochet. The Pinochet government's ideology was based on free market principles and advocated small and efficient government; early in its tenure the Pinochet administration decided to sell EMOS.¹⁴

(ii) *Political Costs and Benefits*. Although the government was committed to privatize EMOS, it was not a particularly important component of the government's privatization program, which explains the long delay in moving forward. As we have seen, most of the usual motivations for change were

¹⁴ In keeping with these principles the administration removed all quantitative restrictions on trade and reduced tariffs to 10 percent across the board; privatized virtually all state owned finance and manufacturing enterprises and much public infrastructure; and replaced a public pay-as-you-go social security system with one based on private pension funds. It also eliminated most subsidies and transfers and required profitable SOEs to pay dividends, while, as we have seen, pushing public agencies to reduce their in-house staff and procure services competitively.

absent or weak in Santiago's water system. Moreover, many of the main beneficiaries of reform were not important constituencies of the Pinochet government.

The main potential beneficiaries of a water reform are: (i) users who would otherwise not be connected, (ii) those already connected consumers who value the benefits from improvements in service quality more than the cost from higher prices, and (iii) private investors who benefit from the expansion in construction of water infrastructure or the opportunity to operate the firm. In the case of Santiago, the first two groups of beneficiaries were not a powerful force for reform. Their interests did not coincide: EMOS' existing customers could expect to see their water bills increase if EMOS expanded more rapidly. This reduced their motivation to organize and jointly pressure for reform. More importantly, even if they had organized they would not have had a sympathetic hearing, since neither new nor existing EMOS customers were important supporters of the Pinochet administration. The military government's strongest support in general was rural and upper income (Mendez 1990). Santiago in particular was not an important source of support throughout Pinochet's tenure. Evidence for this can be found in the city's voting record. The metropolitan area had the second highest vote of any region in the country against Pinochet's new constitution in the 1980 plebiscite -- 36 percent voted no compared to 30 percent nationwide (*El Mercurio* September 12, 1980). The city also had the second highest vote against the continuation of the Pinochet regime in the 1988 plebiscite-- 58 percent of Santiago voted against Pinochet versus 53 percent in the rest of the country (*El Mercurio* October 7, 1988).

Although Santiago was not a constituency of Pinochet's supporters, the government had an interest in national water reform and in the sale of EMOS. Other Chilean water companies were performing much worse than EMOS and operated in cities where the government had more supporters.

Hence there was an interest in improving their regulation, and since water is regulated nationally any change would also affect EMOS.

Furthermore, the administration had one constituency group in Santiago that wanted reform in the 1980's. If EMOS had more capital to invest, contractors and developers would benefit from more contracts with EMOS as well as from expanded real estate development. The municipal area had been reduced from 100,000 hectares to 60,000 in the mid-1980's to control sprawl which meant that most new development in Santiago took the form of greater density within the EMOS concession area, rather than movement into areas where rival water companies might operate. This restriction combined with advances in anti-seismic construction fostered a surge of high rise development in Santiago in the mid 1980's. Because of EMOS' deteriorating financial situation, these contractors were not confident that it could expand its infrastructure fast enough to meet demand or maintain enough pressure to accommodate new development (field interviews). The developers and construction contractors were part of the constituent base of the Pinochet government.¹⁵ Developers and contractors strongly supported EMOS' privatization and help draft the water legislation in the late 1980's (interviews with members of Chilean Chamber of Construction).

The major opposition to reform came from EMOS' workers. Although layoffs due to outsourcing had occurred under public ownership, EMOS' workers believed they still had much to fear from privatization. Firing state enterprise workers was difficult, so previous reductions in

¹⁵ Weyland 1997 cites the strong support of the leading confederation of businessmen (CPC, the Confederation of Manufacturing and Trade) for the military government's economic program throughout the administration.

the 1970's, had been voluntary, through early retirement and agreements with private contractors to hire EMOS staff whose job was outsourced.¹⁶ EMOS' workers feared outright dismissals under a private owner (interviews with union officials). Moreover, even if they could retain their jobs, EMOS' workers expected that privatization would reduce their job security.¹⁷

Worker opposition to the reform was not a deterrent, however. EMOS workers were not part of the Pinochet government's constituency. Trade unions in general had been vocal opponents of the administration from the outset, and most of EMOS workers had opposed the regime according to field interviews with union leaders.¹⁸ Moreover, in other privatizations the Pinochet government had overcome opposition from workers who might otherwise have engaged in disruptive strikes or demonstrations, such as those in ports, electricity or telecommunications, through a combination of compulsion and compensation (World Bank 1995).¹⁹

C. Why Was EMOS Not Privatized but Reformed?

In this section we first explain the political circumstances that delayed and ultimately stopped the intended sale of EMOS in 1989. We then discuss how political changes combined with Chile's

¹⁶ EMOS' ordinary retirement package was one month for each year of service; workers asked to retire were given two months (field interviews). Activities which might still be outsourced included bill collection, engineering and the company kitchen.

¹⁷ Field interviews. Line workers represent approximately 60 percent of EMOS' staff and have their own unions. (EMOS has three unions; one for operators and other line workers, one for clerical staff and one for professional and technical staff. Almost 100 percent of eligible staff are unionized.) EMOS has had low turnover except for the outsourcing.

¹⁸ Weyland 1997 argues that workers in general were strong opponents of the Pinochet government because it had limited trade union rights. Also, according to surveys before the election of 1989, the Pinochet administration had strong support from upper income groups (Mendez 1990) and business associations (Weyland 1997).

¹⁹ The usual compensation was the chance to buy 10 percent of the shares at the offer price by borrowing on workers' severance pay.

electoral and political institutions led the government to privatize the water regulation without privatizing ownership of the assets of Santiago's state-owned water company.

(i) *Why Was EMOS Not Privatized?* The sale of water assets had low political saliency for the Pinochet administration and for that reason it moved more slowly to privatize EMOS than other utilities. One reason for low saliency was the relatively minor water problems in Santiago combined with the relatively small proportion of beneficiaries who were constituents of the regime. Hence, there was little push for rapid change. A second cause was financial: privatization in other sectors would bring much higher revenues than in water. EMOS was one of the few water companies that would command a good price and in 1991 the sales value of EMOS was estimated at about US\$150 million. In contrast the four telecommunications transactions raised over \$540 million and three of the 14 electricity transactions generated US\$220 million. Thus, in the 1970's and most of the 1980's, the administration focused on other, more pressing sectors.

In addition, the leadership believed that they had a longer window of opportunity to privatize water than they ultimately had. Although a plebiscite on the continuation of the regime was scheduled for 1988, General Pinochet was convinced that he would win this vote and stay in power until 1997 (Constable and Valenzuela 1990).²⁰ For all these reasons, new water legislation was only enacted in 1988-90, after all of industry and much of telecommunications and electricity had been privatized.

The defeat of General Pinochet in the October 1988 plebiscite left the regime with little time to pass all the planned water legislation and sell EMOS before national elections were due to be held on

²⁰ Constable and Valenzuela 1990 further argue the General regarded the polls suggesting his defeat as biased and

December 14, 1989.²¹ The government was already in negotiations with a Spanish buyer for EMOS and could conceivably have gone ahead and sold the company before the elections. The privatization of EMOS should have attracted private investors willing to pay a good price. Private investors had viewed the country as a relatively good risk according to Chile's scores in investor risk ratings in the second half of the 1980's.²² In addition, institutions to protect private property in water were in place, as evidenced by Chile's historical tradition of private water rights, the fact that a private water company was already operating in Santiago, the successful privatization of other infrastructure, and the constitutional protections against expropriation. Moreover, Chile's constitution and electoral rules described below would have made it very difficult for a new regime to reverse privatization, or repeal or rewrite the water legislation.

Against these protections, however, potential buyers would weigh pre-electoral uncertainty that might have led them to deeply discount their bids. National polls as early as March 1989 suggested that the military backed candidate, Hernan Büchi, was not a sure winner of the plebiscite (Table 4). Private investors voiced fears that if the opposition won they would drastically increase expenditures and accelerate inflation (Weyland 1997). There were also concerns that the military might intervene if their candidate lost (Constable and Valenzuela 1989). To privatize EMOS at a deep discount right before the elections was politically risky since the firm was widely regarded as a company that should

ignored them.

²¹ Ninety percent of eligible voters participated in the plebiscite and 55 percent voted against the continuation of the Pinochet regime (*El Mercurio*, October 7, 1988).

²² Chile's ICRG score, which gives a value to private sector assessments of firm risk, averaged 16.8 from 1985-89, compared to 15 for Mexico and 16.8 for Korea during the same period (p. 208, World Bank 1995).

command a high price (field interviews). The administration feared it could harm public support for the military backed candidate (field interviews).

Table 4. Polling Results before the December 1989 Presidential Elections

	<i>March</i>	<i>October</i>	<i>December</i>
Attractive Personality:			
Büchi	37.6	30.2	20.5
Aylwin	31.9	36.6	44.5
Inspires Confidence:			
Büchi	35.8	30.7	23.1
Aylwin	36.0	44.1	52.2

Source: Mendez 1990.

Another explanation for why the Pinochet administration did not sell EMOS before the elections was worker opposition. As we discussed, worker opposition would not normally have been a barrier to privatization. In this case, however, the unions' threat of an illegal national strike of water workers raised the political risks of selling EMOS so close to the election. Water union leaders were able to convince two members of the Chilean military junta that privatization of water in 1989 would be a mistake.²³

In the event, the Pinochet government decided not to sell EMOS until after the election. This proved to be too late. The opposition candidate, Patricio Aylwin, a Christian Democrat who headed a 17 party coalition (Partidos Concertados por la Democracia, or Concertación) won a decisive victory

²³ According to field interviews, the representatives of the Navy and police force opposed water privatization after meeting with EMOS' workers and swayed the rest of the junta.

over the candidate supported by the military, Hernan Büchi (Unión por el Progreso, or UPP), and the new government took office on March 11, 1990.²⁴

The Aylwin government faced a different political equation: the political cost from selling EMOS did not outweigh the political benefits. The first cost was ideological: President Aylwin's stated view before the elections was that state enterprises which provide basic services should "stay in public hands" (Gonzalez Parra, 1990, p. 36). His party's position had been that any privatizations after the 1988 plebiscite should be reversed (EIU, December 1, 1989) and sales of all SOEs came to a virtual halt after he took power (EIU, January 1, 1993). A second cost was that the opponents of privatization of water were important constituents of the Aylwin administration. Besides the workers in EMOS and other state-owned water companies, the sale was opposed by members of the winning coalition who now headed regional and local governments and wanted to appoint their supporters to posts in the water companies.²⁵ Third, the main supporters of a sale, the building and construction industry, were not constituents of the new regime.

(ii) *Why Was EMOS Reformed?* A central question in this case is why Chile introduced a reform designed for a privatized company under state ownership despite the election of a government that opposed EMOS' privatization. The new regulation would have been very difficult to reverse because of Chile's unusual political institutions, as cogently described by Baldez and Cary 1997. The Chilean constitution, which was written by the Pinochet government and ratified in a plebiscite in 1987,

²⁴ Aylwin got 53.8 percent of the popular vote; Büchi got 28.7; and a centrist Independent candidate (Errazuriz) got 15 percent.

²⁵ The sale of one water company was (and is) widely regarded as the precursor to the sale of the remaining companies according to field interviews.

is an example of deck stacking as defined in McCubbins, Noll and Weingast, 1987, 1989. It ensured that the preferences of Pinochet's constituents were likely to prevail even after the military regime had lost power. The constitution required an absolute majority in Congress to change laws, and at the same time made it almost impossible for a new opposition regime to control such a majority (see Baldez and Carey, 1997). Reversal was difficult first because of the "designated non-elected Senators", of which four were appointed by the Military Junta, three by the Supreme Court, and two by the President, while the rest were ex-Presidents who had served six years. Since in 1990 most of these senators were appointees of the Pinochet government, they would have opposed changes to the water legislation.²⁶ A second factor making reversal hard was an electoral system with two member districts that gave preference to the top candidates on whatever two of the different party lists received the most votes. This system encouraged parties to form coalitions and split most districts' votes between the two coalitions that represented the left and the right.²⁷ By "systematically over-representing the parties of the right," the electoral system made it unlikely that a left-leaning government such as Aylwin's could win enough seats to change existing legislation (Ibid p. 188).

²⁶ Pinochet replaced many of the Supreme Court justices before leaving office with younger men. Supreme Court justices serve until they are 75 (except the president of the court, who serves for life), although the President can remove them "for bad conduct" with the Court's agreement. Republic of Chile, Constitution, 1980.

²⁷ Baldez and Cary, 1997. Briefly, each district elects two members of congress from lists of two candidates presented by the parties or coalitions. The total votes for both candidates on each party's list are totaled first and the first seat is awarded to the more preferred candidate from the list with the most votes. Votes for that list are then divided by two and if the quotient is higher than any other list's total votes, the second candidate gets the second seat; otherwise the seat goes to the first candidate on the list with the next highest total votes. As the authors note, this system assures that the candidates of the top two coalitions will each get a seat unless the top coalition's list gets more than double the vote of the second place coalition's list. Parties which are not part of the two largest coalitions are virtually disenfranchised.

Thus, even though Aylwin's coalition, Concertación, won a majority in the lower chamber of Congress in the 1989 elections, the distribution of seats meant that it could not overturn the water legislation without the -- highly unlikely -- agreement of some of the opposition or appointed senators (Table 5).

Table 5. Distribution of Congressional Seats, 1989

<i>Coalition</i>	<i>Chamber of Deputies</i>	<i>Senate</i>
Concertación	58%	47%
UPP	40%	33%
Independents	2%	
Appointed Senators		19%

Source: Baldez and Carey, 1997

Even if the new government couldn't reverse the reform, it could have dragged its feet in implementing it. Instead Aylwin chose to implement the changes expeditiously and vigorously. The reform was politically desirable because the political costs were low. The workers opposed reform under public ownership because they feared it would lay the groundwork for future privatization, but this opposition was mild compared to their views about privatization (field interviews with unions).²⁸ Workers would receive compensation for going along with the reform, since they could keep their protections as public workers yet collectively bargain. Moreover, the workers were not veto players because they could not credibly threaten to leave the coalition over something as mild as the water reform (Cox and McCubbins 1997).

²⁸ Bureaucrats responsible for supervising EMOS and the other water companies were also opposed to the creation of a new regulatory structure that would cost them jobs and power, but they were probably not an important constituency of the new government. Their fears were well founded. EMOS and the other water companies were supervised by the National Sanitary Works Service (SENDOS, Servicio Nacional de Obras Sanitarias) of the Ministry of Public Works. With reform, supervision was transferred to the state enterprise holding company (CORFO), while the new Superintendence for Sanitary Services took over the regulatory function. Most of the 200 bureaucrats in

Another reason why net political benefits were positive was that the main beneficiaries, the urban poor, were an important part of the coalition's constituency. The Concertación's platform, characterized by the slogan "growth with equity," called for retaining many of the prior administration's market oriented/fiscally responsible policies, but combining these with greater social spending and poverty reduction, (Weyland, 1997). One objective was to reduce the housing shortage of the urban poor, which would require EMOS to increase further its rate of expansion. Santiago's poor could credibly threaten to withdraw support for the coalition if the Aylwin government did not deliver on its social promises.²⁹ The reform would benefit them directly through increased coverage and indirectly by generating funds for government spending.

Institutional factors were important in creating another motivation for the reform. Constitutional constraints on increasing government expenditures and shifting funds among ministries made it hard for the new administration to reduce its large debt overhang and keep its commitment to expand social spending. The administration was mindful that voters in general and private businesses in particular were concerned that the new government would fuel inflation through deficit spending.³⁰ By moving ahead with the reform they could raise tariffs enough to allow EMOS to pay dividends that the Aylwin

SENDOS were no longer needed and were offered early retirement or other, less desirable, jobs (field interviews).

²⁹ For example, in the 1989 congressional elections the two poorest voting districts in the Metropolitan Region cast 19 and 24 percent of their ballots for the socialist party or other candidates outside the two main coalitions, compared to 11 percent in the metropolitan region as a whole (El Mercurio, Dec. 16, 1989).

³⁰ In polls just before the election voters rated inflation and price increases as their number 4 fear of an Aylwin presidency (27.5 percent rated it number one) and economic recession ranked 6th (11.9 percent rated it first). In contrast inflation and price increases was the 6th ranked fear for a Büchi presidency (15 percent rated it first), and economic recession was 8th (9.7 percent rated it first). Méndez 1990. Polls also suggested strong popular support against substantial changes in the free market economic model of the Pinochet administration (Economist Intelligence Unit 1990). Sáez 1996 found that any increase in voter pessimism about the economy favored the center-right parties and hurt the Christian Democrats in the 1993 elections.

government could use to expand spending in areas important to its constituent base without spurring inflation. At the same time the subsidy to poorer consumers could effectively defuse the adverse political consequences of steep rises in water rates by reducing the cost to a broad range of poor and middle income constituents (see Annex A).

The amount of additional revenues the administration got from EMOS' dividends totaled \$75 million from 1990 to 1994. This amount would not have been large enough to motivate the Pinochet administration to prefer reform to privatization, since the sale of EMOS would generate both the \$150 million purchase price and tax revenues. But these additional discretionary funds were important to the Aylwin government since they helped it overcome the inflexibility created by the constitutional rules while avoiding the politically distasteful step of privatization.³¹

II. Characteristics of the Reform

One characteristic of particular interest in the EMOS case is that the reform was designed for a private firm but implemented in a state owned enterprise. Evidence from similar efforts in other developing countries suggest that contracts between government and an SOE designed to

mimic private agreements typically fail (Shirley and Xu, 1998, 1999). Regardless of ownership, a contract can be expected to improve operating efficiency and investment only if it: (i) reduces government's information asymmetry vis-a-vis management; (ii) provides management with greater

³¹ Many of the state enterprises which had been sold since 1983 were heavily indebted and had been privatized without their debts. As a result, by 1990 the state enterprise holding company (Corporación Nacional de Foment, CORFO) held US\$ 500 million in debt. In contrast, EMOS had a very small debt; in 1990 its debt:equity ratio was only 10 percent. See Boldez and Cary 1997 for details on the constitution imposed constraints on raising spending or shifting funds.

incentives to comply with the contract; and (iii) provides more credible signals that government is committed to enforce the contract and adhere to any promises it has made.³² These necessary conditions are usually not met in contracts with SOEs, first the failure to auction the contract or otherwise simulate competition robs government of a tool to reduce information asymmetries and motivate performance. Second, government incentives tend to make for weak monitoring. Monitors are typically low paid civil servants who cannot effectively demand information from more powerful SOE managers and who may not be rewarded for finding politically embarrassing failures. Third, incentives to SOE managers are usually low-powered. It may be politically difficult to provide substantial bonuses to government employees or government may prefer low-powered rewards out of a fear that renegeing by the SOE will go undetected. Threats of takeover, bankruptcy or firing for poor performance are seldom credible in SOEs. Fourth, commitment is a problem in any contract with a sovereign authority. The problem is exacerbated in contracts with SOEs because state enterprise is an involuntary partner to the agreement and cannot demand safeguards against government renegeing as a condition for signing. Moreover, state enterprises are not usually granted access to neutral enforcement mechanisms, such as courts. Finally, institutions to support an effective contract, such as strong budget constraints on the SOE or norms of efficient conduct in bureaucracy, are usually absent in developing countries.

³² Although this hypothesis was originally formulated for cases of PSP and privatization, the same conditions have been shown to apply to contracts with SOEs (see World Bank 1995). See also Sappington (1991), Lafont and Tirole (1986, 1993) and Williamson (1976 and 1985).

This section examines how Santiago's "regulatory contract", in the sense of the implicit and explicit agreements between government and enterprise, overcame the agency problems and improved information, incentives and commitment under state ownership.

A. Information

The new contract with EMOS had the potential to increase government's information through more and better accounting, greater competition, and better supervision. Although the opportunities for increased competition were not fully exploited, accounting and supervision were improved. All the water companies were now required to produce audited annual accounts according to generally accepted standards. Although EMOS had produced extensive statistics on its operations before incorporation, it did not have a balance sheet or income statement until its first annual report after its incorporation in 1988.³³

The reform greatly strengthened monitoring, by replacing a hands-on government agency with an independent, arms-length regulator. Before reform, EMOS was under the supervision of SENDOS (Servicio Nacional de Obras Sanitarias), an arm of the Ministry of Public Works. Since SENDOS was preoccupied with managing the regional water companies, EMOS was largely autonomous. The reform created an independent regulatory agency, the Superintendency of Sanitary Services (SSS), designed to signal government's commitment to potential private investors and assure that privatization

³³ The World Bank had produced estimated accounts for EMOS prior to 1988 for use in its project documents and supervision reports, but these could not serve the same monitoring purpose as an annual report. They were not produced on a regular basis, did not track clearly with EMOS' statistics, involved judgments by outsiders, and were not always accepted by EMOS management or the government. In the preparation of this case we were unable to match the World Bank's version of EMOS accounts with those produced by the company for the same years.

of a monopoly would not lead to consumer exploitation. The organizational design of the SSS was detailed in a law that mandated a small, professional staff with above average civil service salaries.³⁴ Unlike SENDOS, the SSS had no management responsibilities. Its focus was on tariff setting and monitoring compliance with investment plans and standards. The SSS' maximum professional staff cannot exceed 45 according to the law, (although through short-term contracts it had grown to 61 professionals in 1997); in contrast SENDOS had over 300 staff when it was dissolved in 1990.³⁵ Although the staff of both agencies were civil servants, the salaries for SSS professionals were similar to those of bank or stock market regulators (*fiscalizadoras*), and hence higher than those which SENDOS could pay. All SSS professional staff had at least a B.A., which was not true in SENDOS, and most were engineers. (There is still room for improvement, since few of the SSS staff are civil engineers or economists, and most do not have a background in water and sanitation (field interviews, former and current Superintendency staff).)

The SSS monitors EMOS to assure compliance with quality standards and investment plans, and to measure costs and efficiency in the context of tariff adjustments.³⁶ Information on quality and investment was always good; the main improvement was in accounting information. Companies must submit regular information on costs and service to the SSS and can be fined if they fail to do so. As we explain in the next section on incentives, tariff policy was designed to

³⁴ Its responsibilities are to: (i) set tariffs; (ii) set and enforce technical standards; (iii) monitor, award and revoke water and sewerage concessions; and (iv) control liquid industrial effluent.

³⁵ As can be seen in figure 1 of the statistical appendix, the SSS is organized by function, with most staff assigned to setting and regulating standards (22, of which 15 are engineers) and setting tariffs (15, of which 9 are engineers). The term engineers includes commercial engineers who have the equivalent of an economics/business degree.

³⁶ Quality is also monitored by the Ministry of Health.

minimize the effects of information asymmetries by reducing the regulator's dependence on company information and the company's ability to manipulate the computations. Nevertheless, the information demands for tariff revision are still large, but less frequent since tariffs are revised only every five years.

The reform created the potential to use competition to extract more information, but this opportunity has not been exploited. The new legislation transformed all water and sewerage services into concessions. Since existing service operators were granted indefinite rights to their current concession areas at the time the legislation was approved, much potential for competition was lost. However, there can still be competition for new concessions, as well as for older concessions that had been revoked because the company failed to meet regulatory standards. Thus far, the regulator has been loath to revoke concessions that failed to meet standards, and has seldom used competition to award new concessions either.³⁷ None of the concessions in Santiago have been bid.³⁸

Since the reform introduced standardized accounting, the regulator could also compare among firms to determine best practice. Yardstick competition among the Chilean water companies would be least effective for EMOS since it is larger and better managed than the other water companies in Chile. EMOS could be compared with international standards, but as we shall show, the particular international and national standards used for tariff setting for each company were secret and hence less

³⁷ The law allows new concessions to be awarded without competition at the regulator's discretion unless a competitor mounts a challenge. An interested provider produces a concession proposal, which is then published in the official paper, and if no competitor chooses to challenge it within 60 days, it can be awarded without bids (although a call for bids can still be issued at the discretion of the government). Ley General de Servicios Sanitarios No. 382.

³⁸ Although the private water company in Santiago was sold (to a private electricity company), the Superintendency did not consider that grounds for rebidding the concession. Concessions have been bid in other parts of Chile.

useful for yardstick competition. This secrecy makes it hard for company management to perceive how they would be rewarded for, e.g., bringing water losses down.

A third way to reduce government's information asymmetry was to give interest groups with an incentive to inform government about abuses of EMOS' monopoly position, such as water consumers, positions on the board or standing in regulatory decision making. However, as is typical in SOEs everywhere, directors were chosen so as to reward political factions rather than to increase government's information. Regulatory decisions are not open, and no interests are represented besides government and enterprise.

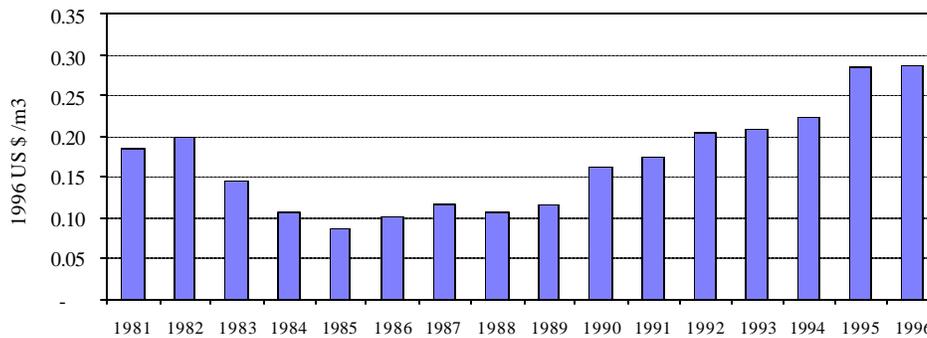
B. Incentives

The most important change in incentives was the result of the new tariff policy, which we discuss first. Several supportive institutions were key to the incentive effects of tariffs, as we also explain.

(i) Tariff Policy. Before the reform, tariff decisions were internal to the bureaucracy, ad hoc, and vulnerable to political manipulation. As we have already seen, tariffs were increased only infrequently, when the political liability of unmet demand and deteriorating service exceeded the political cost of raising tariffs. The reform not only led to higher tariffs, it also increased transparency, consistency and public accountability.

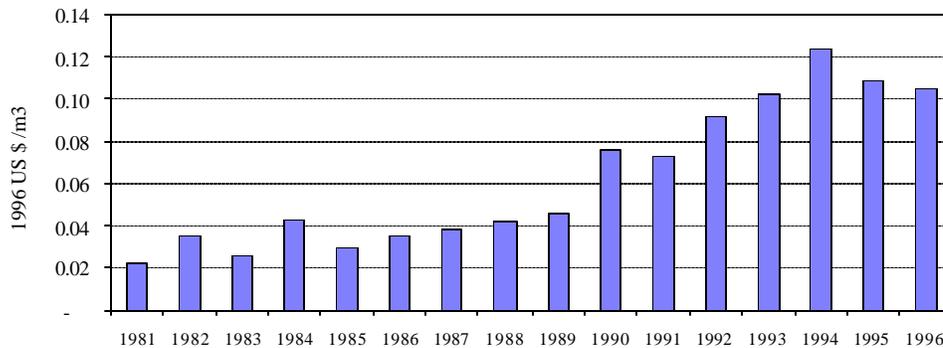
All of the formulas and definitions of the variables to be used for tariff setting are spelled out in great detail in the legislation, down to how to calculate peak and off peak monthly tariffs. As we shall see, this legalism and lack of regulatory discretion have proved a good fit with Chile's institutions. Tariff increases became automatic and the effect was a sharp rise in water and sewerage prices phased in over five years, see Figure 1 and Figure 2.

Figure 1. Average Price of Water



Source: Author's calculations based on EMOS Annual Report (Water Revenue/Water Distributed)

Figure 2. Average Price of Sewerage



Source: Author's calculations based on EMOS Annual Report (Sew. Revenue/Water Collected)

Tariff policy had been designed both to signal to a private investor that government was committed to not expropriating their return-on-capital through under-pricing and to curtail the chance of monopoly rents. Tariffs are calculated every five years to cover the long run marginal cost of a “model” or benchmark company, and then readjusted to permit a “reasonable” return on assets, i.e. to cover long run average costs and allow at least a seven percent return on capital. To reduce the risk of monopoly rents the construction of the model company was a black box, which was expected to make it harder for the company to manipulate information.

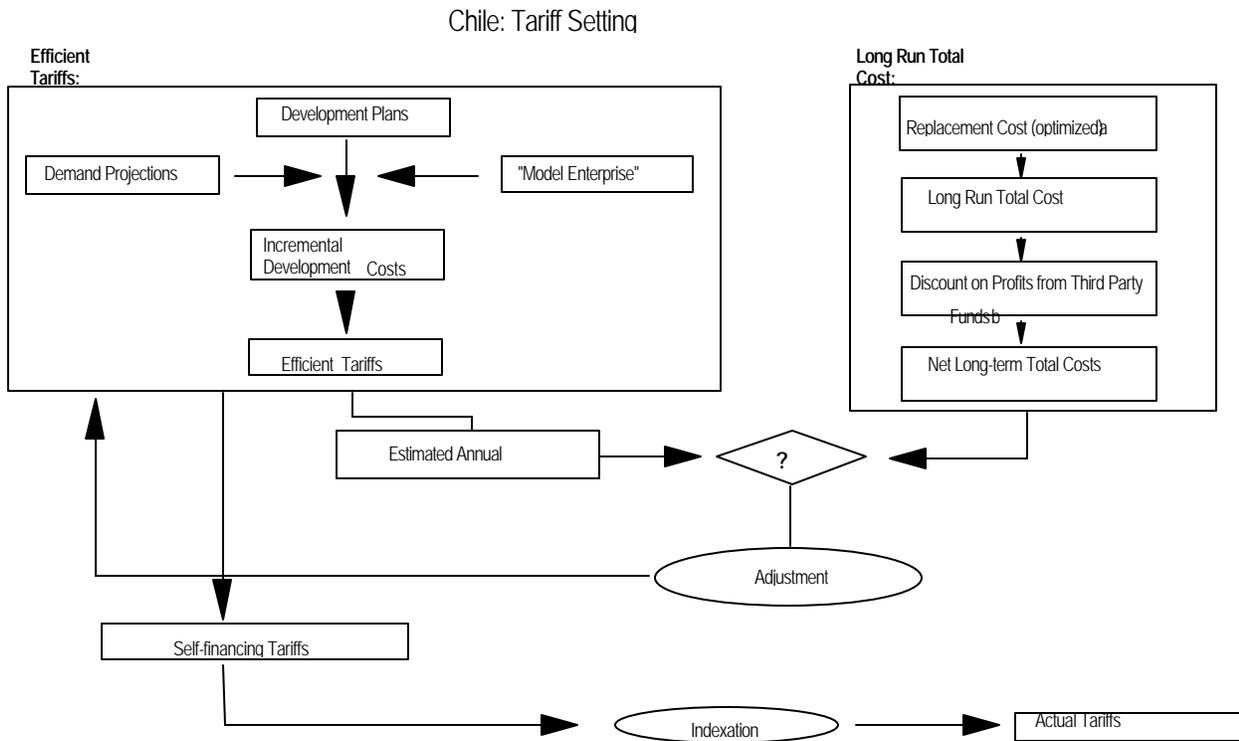
The result was a complex process, see Figure 3. First, a benchmark efficient firm is estimated for each water company, based on the company’s actual geographic, demographic and technological

conditions, but setting certain parameters (such as unaccounted-for-water, collection rates and capital costs) at “efficient” levels.³⁹ This “model” company is derived from a computer program that uses a mix of international and local standards adapted to the circumstances of the individual company. In the second step, the tariff is set to cover new investment plus operation and maintenance costs associated with meeting forecast demand growth, and to allow the benchmark firm to earn a minimum annual return on assets of at least 7 percent. Third, the tariff calculated in the first step is adjusted by a factor derived by comparing projected average long run costs with projected revenues from step two for the next five years to assure that the company can break even over the five years. Finally, the water tariff is indexed to a price index.

The tariff has incentive properties similar to a price cap since it is set on the basis of an efficient model company for five years and indexed for inflation. If EMOS can be more efficient than the model, it earns additional profits, giving the company an incentive to maximize its efficiency. At the end of the period tariffs may be adjusted downward to force the company to share its gains with consumers.

³⁹ These parameters were set through a survey of five companies in Chile plus international standards. For example, the billing collection rate is set at 100 percent, unaccounted-for-water at 20 percent. Capital costs are set using a CAPM model where the risk free rate is set equal to the state bank deposit rate and the risk premium is based on international rates.

Figure 3. Tariff Setting Process



^a Replacement cost of a plant large enough to meet demand for the five year period of the tariff.
^b Discounts on profits from funds from outside the enterprise.

Source: SSS

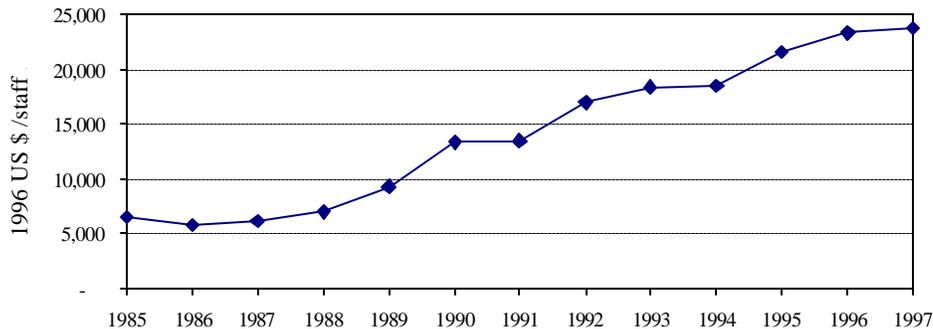
The incentive properties of the price cap was reduced somewhat because government demanded most of the returns be paid as dividends. For the first three years after tariff reform the government required EMOS to pay 100 percent of its net earnings for the previous year as dividends. Subsequently EMOS had to remit 65 percent of the prior years profits as dividends; the remainder could be retained for investment.⁴⁰ Because the dividend payment is estimated at the beginning of the year based on the previous year's profits and profits were increasing rapidly, there was sufficient surplus for investment and other uses. EMOS management and staff had an incentive to increase returns, since they got profit sharing bonuses equivalent to 10 percent of profits for the first five years of the reform, and higher real wages throughout (Figure 4). Although these wages increases might seem to suggest a soft budget, they apparently just brought EMOS salaries in line with the market; a recent consultant study suggests that EMOS wages in 1996 were close to market standards.⁴¹

⁴⁰ In 1998 the government announced a plan to return to 100 percent dividends.

⁴¹ The study (by Langton Clarke Consultants) has the following comparison of 1996 annual salaries:

	EMOS	MARKET
Professionals, managers	US\$ 30,854	US\$ 30,883
Technicians	US\$ 13,954	US\$ 15,098
Administrative	US\$ 11,701	US\$ 14,743
Service (guards, drivers, etc.)	US\$ 11,003	US\$ 9,576

Figure 4. Average Salary



Source: Author's calculations based on EMOS data.

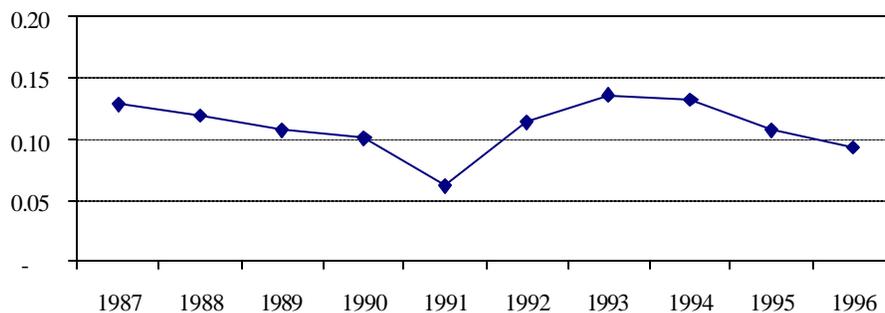
(ii) *Supportive Institutions.* The incentive effects of higher revenues were supported by several strong institutions that help explain why the increased funds generated from the tariff led to performance improvements, despite agency problems and continued information asymmetry. Among these were Chile's civil service norms and traditions of professionalism and honesty in public service. These norms were strong in EMOS. Field interviews suggest that its reputation of being one of the best performing water companies in the region for many decades before the 1988-89 reform motivated EMOS' management to strive to improve performance before and after reform. This tradition of professionalism also explains why the Aylwin government selected an experienced, well qualified and competent manager to run EMOS and allowed her to select an equally competent team.⁴²

Also important was the regulation introduced by the Pinochet government in the late 1970's that had created hard budget constraints in the government and state enterprises.

⁴² Since most EMOS staff were supporters of the new government and democracy, they had a further incentive to increase effort to try to make reform under state ownership succeed (field interviews).

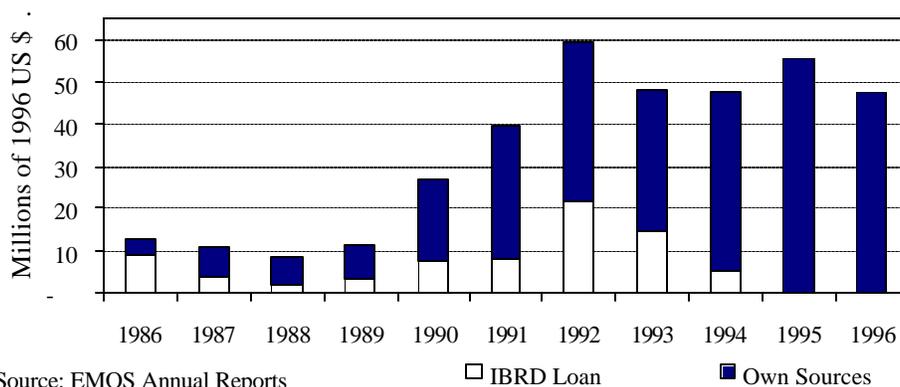
Borrowing was strictly curtailed, most transfers and subsidies were eliminated, and state enterprises were required to pay dividends. As part of this effort, the staff of EMOS had been reduced in 1977 and most services, procured through outsourcing. SOEs were not allowed to exceed a debt-equity ratio of 15 percent and EMOS maintained a very low debt: equity ratio throughout the 1980's and in the post reform period of the 1990's (Figure 5). Investment increased during this period, as we discuss in the Section III, and was financed almost entirely by internal funds (Figure 6).

Figure 5. EMOS Debt to Equity Ratio (%)



Source: Author's calculations based on EMOS Annual Reports

Figure 6. Sources of Investment Funds



Source: EMOS Annual Reports

□ IBRD Loan ■ Own Sources

Finally, EMOS continued to face the prospect of privatization. The debate over privatizing EMOS continued after Aylwin's election and a bill to authorize privatization of 65 percent of shares has been pending in Congress since 1993. (EMOS was sold in 1999.)

Studies have found that SOE performance improves with the prospect of privatization, especially when staff expect to receive shares in the company.

C. Credible Commitment

A weak point in most contracts between government and SOEs is the lack of credible commitment, especially on the part of government actors (Shirley and Xu 1998). If a contract specifies

no enforcement mechanism or other recourse against government renegeing, management will not expect to receive the promised incentives or to be penalized for poor performance. Managers will not increase effort, instead they will try to exploit their information advantage to bargain down their targets ex post. Once again the design of a contract intended for a private operator led to a different outcome from the usual in Chile.

The regulatory contract for EMOS signals government commitment by specifying neutral and automatic enforcement. Any water company can appeal a dispute over tariffs to the SSS within 30 days. If the SSS and the company fail to reach agreement, a panel of three arbitrators -- one appointed by the company, one by the government and one jointly agreed -- has 37 days to reach a decision that both sides must accept. Decisions can also be appealed to the courts, which are regarded as honest and independent, although slow, but an SOE would be less likely to be able to use this route.

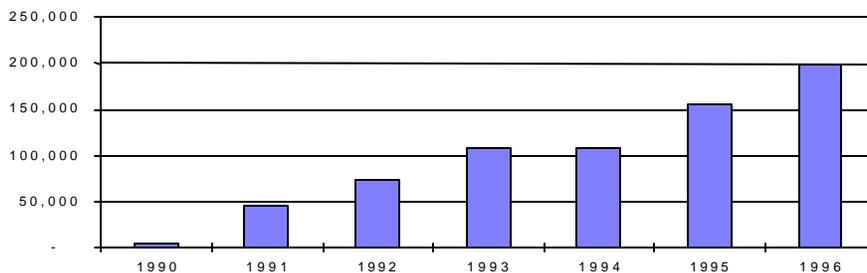
The fact that state owned companies can appeal the decision of a government regulator increases the credibility of the contract. Moreover, this ability to arbitrate a tariff decision has not been a theoretical privilege. So far water tariffs have been set twice under the reformed procedures; once in 1990 when the system was first implemented and again in 1995. The first tariffs were gradually phased in over five years and did not generate appeals since they led to an average real increase in tariffs in the first year alone of almost 25 percent for all water companies, 20 percent for EMOS. The second round of tariff setting led to much lower increases: on average the real annual increase awarded companies was 5.9 percent, while EMOS' tariffs were reduced by 1.2 percent a year in real terms for 93 percent of its customer base and raised by 6.8 percent for the remainder (SSS 1995). Five companies took disputes over tariffs to arbitration, including EMOS, two other SOEs and the two largest of the six private companies (one of which operates in Santiago). EMOS' dispute was on the capital costs, which

SSS had set at 7.5 percent and EMOS argued should be 10 percent. The arbitrators decided on 9.16 percent.

A second source of credibility is the lack of regulatory discretion. The tariff calculations are detailed in laws that, as we have seen, are hard to change. The SSS relies on a computer model designed by external consultants to comply with this law, which could not be easily manipulated for political purposes.

Credibility was also enhanced by a third tool, a means tested subsidy, which reduced the political pressure against tariff increases. On average 60 percent of the bill for the first 20 cubic meters of consumption of qualified low-income households is paid by taxpayers; government transfers the funds directly to the water companies (see Annex 1 for details). The number of recipients has grown with tariff increases (Figure 7), an easing of the subsidy's limits and requirements, and a public information campaign by the water companies. In 1996 about a third of recipient households were in the lowest income quartile and another third in the second lowest. This spillover of benefits to middle income groups added to political constituency affected by the subsidy.

Figure 7. Number of Subsidy Recipients



A number of the institutional safeguards described above supported the government's credible commitment to the regulatory contract. These included: the set of laws and regulations that underlay the

contract plus the political institutions that made it difficult to overturn this legislation, and norms of behavior and legal strictures supporting efficiency and competitiveness in state owned enterprises. The new government signaled that it would support these norms by, for example, moving quickly to implement the tariff system and appointing a well-qualified insider to run the company. Although there were violations of the implicit contract, such as political appointments to the board and ministerial interference in some internal decisions, these did not threaten the tariff, which was the most important change from the previous regulation.

Finally, factor endowments offered safeguards. Cost of usage was low since Santiago's principal water sources were sustainable at current and projected rates of extraction, and the system is gravity fed. As a result, even with the 25 percent increase in tariffs between 1990 and 1996, water tariffs in Santiago were still relatively low compared to a sample of six water companies.⁴³ THE TARIFF INCREASE WAS MUCH HIGHER THAN 25%. THE FIXED CHARGE INCREASE 125%, METRIC TARIFF WITH SUBSIDY 261% AND REGULAR METRIC CHARGE 64% IN CONSTANT 1996 DOLLARS.

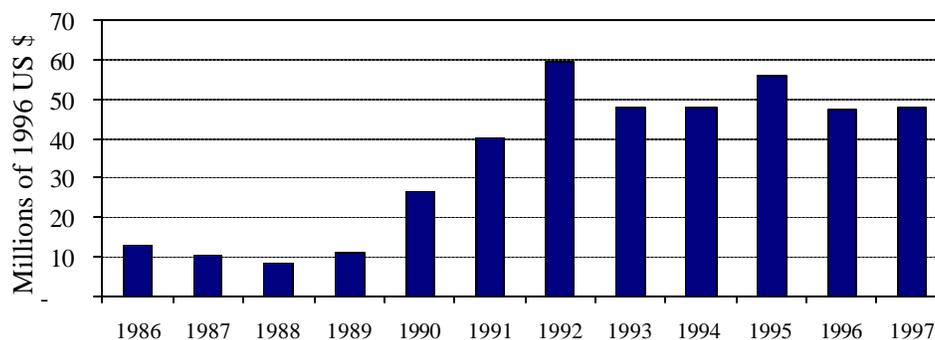
III. Effects of the Reform on Performance and Welfare

We present evidence in this section that, despite relatively good initial conditions, the reform led to improvements in performance and welfare that were important in magnitude. This section first presents partial performance indicators and then describes net economic benefits.

A. *Performance Effects*

The new tariff policy allowed an increase in real investment (see Figure 8) that enabled EMOS to extend water and sewerage connections while maintaining an aging system.

Figure 8. Investment



Source: EMOS Annual Reports

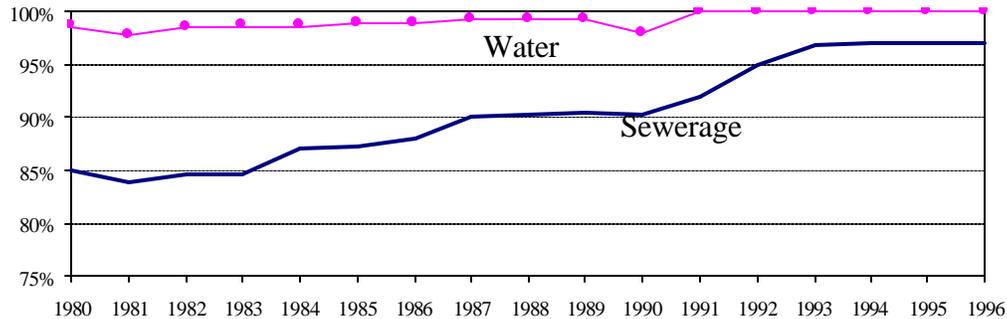
Market coverage for water reached 100 percent soon after the reform and stayed there, while sewerage coverage increased from 88 percent at the start of the reform to 97 percent from 1994 onwards (Figure 9). Since demand for connections accelerated as the Alywin government increased the pace of public housing construction while private construction rose with rising incomes during this boom period, EMOS had to increase the number of new connections to keep coverage constant (Figure 10). EMOS also expanded its concession area to include poor municipalities on the periphery of Santiago,

⁴³ Santiago's average revenues collected per M³ distributed (minus UFW) was US\$0.29 in 1996, higher than Buenos Aires or Mexico City (at US\$0.23/M³), but lower than Lima (US\$0.32), Abidjan (US\$0.51) or Conakry (US\$0.74). Unlike Santiago and Buenos Aires, Mexico City's tariffs do not cover marginal cost and return on investments.

subsidizing customers who could not afford to pay their requisite share of the cost of connecting (Alfaro, 1996).⁴⁴

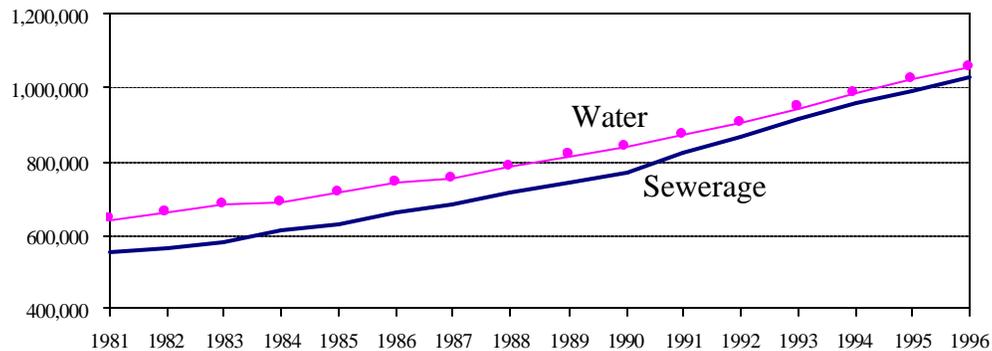
⁴⁴ EMOS also allowed middle income consumers to pay the cost of connection in 12 to 20 installments; low income families (those certified for subsidies, see Annex A) to pay in 60 installments; and the very poor (again with certification) to pay a fraction of the cost US\$5 to \$10 in ten installments. Alfaro 1996.

Figure 9. Market Coverage
(% of clients served)



Source: EMOS Annual Reports & Statistical Bulletins.

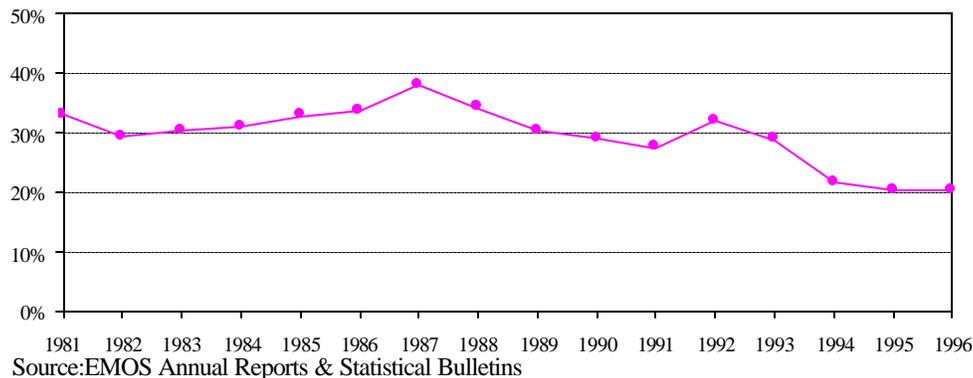
Figure 10. Number of Connections



Source: EMOS & Statistical Bulletins

Another benefit came from EMOS' ability to finance investments in maintenance, which allowed it to upgrade pipes and thus reduce water losses and improve pressure. The number of pipe breaks per kilometer dropped from over 0.52 in 1988 to 0.31 by 1994. As a result, the trend in unaccounted-for-water (UFW) which had been largely caused by physical losses, was reversed and UFW was brought close to international standards of 20 percent of production (Figure 11).

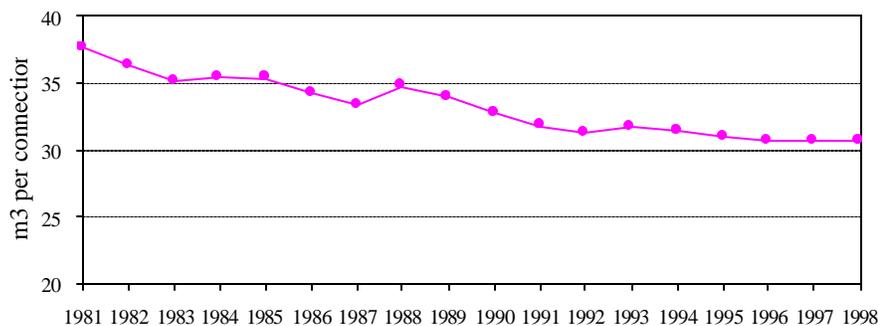
Figure 11. Unaccounted for Water
(% of production)



The main cost to consumers from the reform was higher prices. Since all connections were metered and billing was efficient, price increases had a direct effect on consumer welfare, although this was partly offset by the subsidies described earlier. Nevertheless, Figure 1212 points to a continuously declining trend in average monthly water consumption per connection, which suggests that consumers responded to rising prices by cubing consumption. EMOS launched a campaign during this period to educate consumers on reducing water wastage. It could also be that the rise in housing construction reduced the extent of shared housing.⁴⁵

⁴⁵ An estimated 16 percent of housing was shared in some way in 1982. This probably increased with the destruction of much rental housing in the 1985 earthquake and a faster rate of removal of squatter settlements than of construction of new subsidized housing during the Pinochet administration. Gilbert 1993.

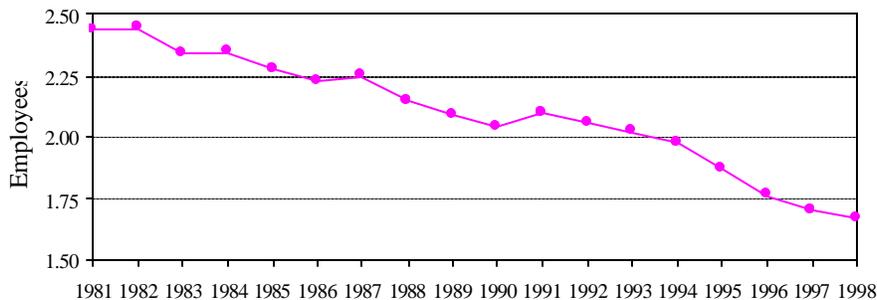
Figure 12. Average Monthly Water Consumption per Connection



Source: Author's calculations based on EMOS Annual Reports

Partial indicators suggest that the reform increased EMOS' already high productivity even though total factor productivity did not change much. Although the number of employees increased slightly, the workers per thousand connections declined to 1.76 in 1996 (Figure 13).

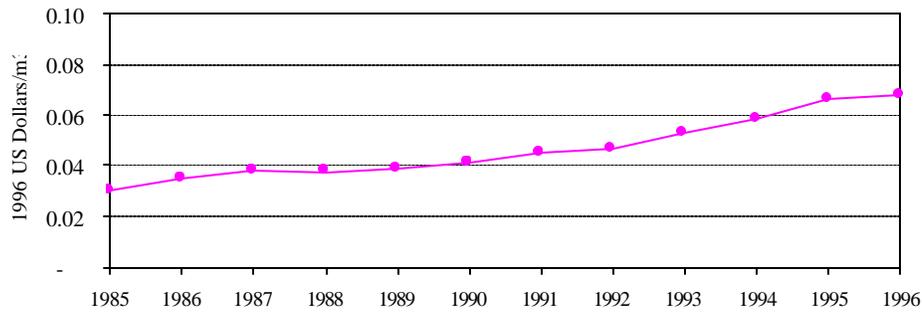
Figure 13. Employees Per 1000 Water Connections



Source: Author's calculations based on EMOS Annual Reports

The growth in intermediate inputs also suggests productivity was improving. Real growth in the value of intermediate inputs per cubic meter of water production declined from an average of 9.1 percent a year to less than 4 percent a year after the reforms (Figure 14).

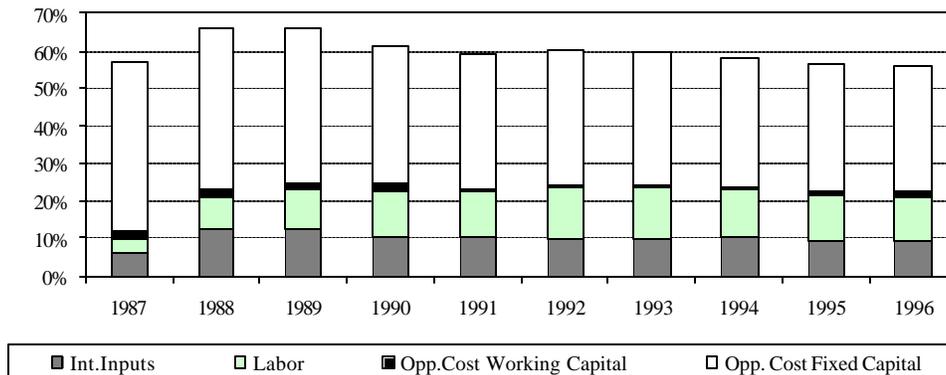
Figure 14. Intermediate Inputs/ M^3



Source: Author's calculations based on EMOS Annual Reports

Despite these improvements in partial productivity indicators, EMOS' total factor productivity (TFP) showed little change, with inputs hovering at around 60 percent of outputs from 1988 to 1996 (Figure 15). These numbers are misleading, however, since they count the cost of EMOS' increased investment in maintenance, but fail to take into account the value of the improved quality of service, including better pressure and fewer interruptions.

Figure 15. Total Factor Productivity



B. Welfare Consequences of the Reform

We calculated the welfare effects of the reform by comparing the net benefits from the actual reform with a counterfactual assuming no reform.⁴⁶ As we shall show the net gains are important, even when compared with Buenos Aires, a city with much less favorable initial conditions. This section begins with a brief summary of the methodology; it then describes the welfare gains; it concludes with some sensitivity analysis.

(i) *Methodology.* To construct the counterfactual for 1989 to 1998, we projected the key parameters --including price and quantity of water and sewerage, unit costs of labor and intermediate inputs—on the basis of their linear trends from 1981 to 1988.⁴⁷ We projected the counterfactual EMOS' investment based on two assumptions: (1) that the ratio of output to fixed capital would stay at 1988 levels; and (2) that any additional investment needed to maintain that ratio would be financed by retained earnings.

In order to have a “factual” time period of at least ten years we also projected the factual scenario for two years beyond the end of our observations: 1997 and 1998.⁴⁸ We projected investment using the same two assumptions as for the counterfactual, and fixed the other key ratios equal to those of the last year of the observed period, 1996.

⁴⁶ We used a partial equilibrium cost-benefit methodology developed by Jones, Tandon and Vogelsang (1990).

⁴⁷ Labor productivity is assumed to be constant in both scenarios, although salaries are assumed to be higher under the “factual”.

⁴⁸ Although another study using this methodology (Galal et al 1994) used a much longer projection period, we concluded that further projection would entail too much prediction error, and the large discounting factors beyond the year 1998 would make this omission largely unimportant to our results.

We calculated consumer surplus using an elasticity of -0.26 and assuming that the shape of the demand curve was the same shape for the factual and the counterfactual.⁴⁹ We also assumed that at the start of the reforms in 1988 total demand was equal to all potential demand in the EMOS service area, so that unconnected customers were treated as excess demand, which seems reasonable given the low price for water that year (US\$ 0.14). We further assumed that new connections have been rationed by willingness to pay, in other words that most wealthy people who would be willing to pay more than the price of connecting were already connected at the time of the reform. This seems reasonable given that the government was building subsidized housing and EMOS was now subsidizing the costs of connection for poorer people in new sites and services areas. For more on methodology see Appendix A.

This cost-benefit methodology has its limitations. Although we tried to take into account as many relevant details as possible in constructing our factual and counterfactual scenarios, we necessarily had to leave out many unquantifiable factors. Thus, the analysis does not take into account benefits from improvements in quality mentioned above or social costs and benefits, which we discuss in the section below on privatization. In addition, our assumption that without reform EMOS would have followed its pre-reform trends may bias the welfare gains upward. We therefore consider some alternative assumptions in our sensitivity analysis below.

⁴⁹ This elasticity comes from a SENDOS study of water demand in Santiago, which finds a price elasticity of -0.516 for households which consume $1-20\text{ m}^3$ of water, -0.2 for $20-30\text{ m}^3$, and -0.25 for more than 30 m^3 . We know that the consumption patterns among households in Santiago; 5% of households use $1-10\text{ m}^3$ per month, 40% use $10-30\text{ m}^3$ per month, and 55% use more than 30 m^3 per month. This suggests that the weighted average elasticity is: $0.10*(-0.516)+0.35*(-0.20)+0.55*(-0.25)=-0.259$. We did not include the demand elasticity of industrial and commercial users

(ii.) *Welfare gains, winners and losers.* The reform led to cumulative domestic gains in the ten post reform years of about US\$214 million net present value (NPV) in 1988 prices (Table 6).⁵⁰ Since these gains are really a flow of funds that goes on in perpetuity, we can get some sense of how significant they were by expressing them as a percent of another flow, namely EMOS' annual sales. The gains were large, equivalent to 52% of EMOS 1988 sales every year in perpetuity. By way of comparison, the gains in 1996 dollars were approximately US\$64 per capita (NPV). Using the same methodology, the estimated NPV of gains (in 1996 dollars) from ten years of concession contract in Buenos Aires, using the same methodology, were about US\$150 per capita (Alcazar, Abdala, and Zuluaga, 1999). We would expect the gains in Buenos Aires to be larger since Santiago's system was well run to begin with, while the Buenos Aires' concession reduced prices by almost 27 percent, expanded water coverage from 70 to 81 percent and improved efficiency under very poor initial conditions.

In contrast to Buenos Aires, however, where consumers were the big winners, the biggest winner from the EMOS' reform was the government. Thanks to increased taxes and dividends, government gained a NPV of roughly US\$ 181.5 million in 1988 prices, or the equivalent of 44% of EMOS' 1988 annual sales in perpetuity.⁵¹

because this category accounts for only 5.8% of total use according to EMOS, Annual Report 1990. This elasticity is similar to that assumed for Buenos Aires, Argentina (-0.32).

⁵⁰ Domestic gains are almost the same as total gains since foreign participation was very small.

⁵¹ The average exchange rate for 1988 was 245.01 pesos/US\$.

Table 6. Winners and Losers from Reform

(NPV, in 1988 US dollars unless stated otherwise)

	Government	Domestic Investors	Workers	Consumers	Total Domestic
Welfare gains (1988 US\$ millions)	\$181.5	\$0.7	\$29.0	\$3.07	\$214.3
Welfare gains/1988 sales (%)	44%	0.2%	7.1%	0.8%	52.3%
Annual welfare gains for each group (1988 US\$)			\$1,710/ employee	\$0.39/ connection	\$4.80 per capita

Source: authors' calculations.

Consumers did less well, reaping a gain of roughly US\$3 million (NPV in 1988 prices) or about US\$0.40 per connection. Although the consumer surplus was reduced by price increases, this was offset by the gain from the pace of increased connections. Consumers' gains are understated somewhat because we do not include the benefits of higher pressure and reliability. This gain is very sensitive to our assumption that connections were rationed by willingness to pay, as we explain below.

Employees also benefited, thanks to higher wages, by about US\$ 29 million (NPV in 1988 prices).⁵² The net present value of a typical worker's gains was about US\$ 1,710 a year in real terms. Finally, EMOS' few private shareholders also gained modestly, by US\$ 0.7 million.

(iii.) Sensitivity analysis. Although we tried to make plausible assumptions about the counterfactual scenario, we also conducted sensitivity tests to examine whether the main qualitative results remain intact when we change one key parameter from the base (Table 7). The qualitative conclusions, that there were large gains and that government is a major winner, remained robust with respect to alternative assumptions.

⁵² The gains for workers are computed as the net discounted present value of the wage differences in the factual and the counterfactual. The wage of the counterfactual is projected on the basis of the historical trend.

Consumer surplus is the most sensitive to changes in parameters. If we assume that excess demand was rationed randomly instead of by willingness-to-pay, then the consumer surplus increases from a NPV of US\$3 million to US\$ 155 million (1988 prices). This scenario is unlikely, however, since, as we have seen, most of those who were unconnected were poor. If we assume that the price elasticity is -0.2 instead of -0.259 , then consumer gains are roughly US\$ 30.31 million (NPV in 1988 prices). The former elasticity is closer to that of industrial and commercial consumers and other heavy water users. In contrast, if the price elasticity was higher, -0.3 , then the consumer surplus becomes negative -US\$ 9.49 million. This elasticity is probably the upper bound for Santiago and it seems unrealistic that it would apply to most customers.

Table 7. Welfare Gains under Alternative Assumptions
(NPV in 1988 US\$ millions and as % of 1988 EMOS Sales)

	Base	Random Rationing	Elasticity 0.20	Elasticity 0.30	Counterfactual Intermediate Inputs Equals the Actual	Counterfactual Labor = Actual
GOVERNMENT	\$181.5 44.3%	\$181.5 44.3%	\$181.5 44.3%	\$181.5 44.3%	\$164.9 40.3%	\$203.0 49.5%
DOMESTIC INVESTORS	\$0.8 0.2%	\$0.8 0.2%	\$0.8 0.2%	\$0.8 0.2%	\$0.8 0.2%	\$0.8 0.2%
WORKERS	\$29.0 7.1%	\$29.0 7.1%	\$29.0 7.1%	\$29.0 7.1%	\$29.0 7.1%	\$0.0 0.0%
CONSUMERS	\$3.1 0.8%	\$155.6 37.8%	\$30.3 7.4%	-\$9.5 -2.3%	\$3.1 0.8%	\$3.1 0.8%
TOTAL DOMESTIC	\$214.3 52.3%	\$366.9 89.5%	\$241.6 58.9%	\$201.7 49.2%	\$197.8 48.3%	\$206.9 50.5%

Note. Total (domestic and foreign) welfare gain is not presented because it is generally very close to total domestic welfare gain.

Other changes in assumptions have less effect on the results. Thus, we tested what would have happened if the counterfactual EMOS had used intermediate inputs as efficiently as the post reform EMOS did, instead of projecting their use on the basis of the company's historical trend. Under this

assumption, the efficiency gains from the reform decline only slightly compared to the base case (Table 7). We also tested what would have happened had unit labor costs under the counterfactual grown as much as in the factual instead of following historical trends. In this scenario, government's revenues in the counterfactual are less because EMOS' costs are higher, so its gains from the reform are greater, while workers gains from the reform disappear. The net total welfare gains drop slightly compared to the base.

C. What if EMOS Had Been Privatized?

In this section we speculate on how a private EMOS might have differed from the actual. Such speculation is not idle since EMOS was privatized in 1999. Imagining what would have happened had EMOS been sold in 1990 helps illustrate some ways in which incentives are likely to differ under private operation.

First, most observers consulted in Chile expected that a private EMOS would have built a sewage treatment plant five to ten years after sale. Instead, EMOS' current plan is to have 100% sewage treatment in 2024.⁵³ The argument favoring faster action by a private EMOS is based on two observations. One is that EMOS had strong incentives to build treatment facilities since tariff regulations assure at least a 7 percent a return on its investment, plus the company could sell treated wastewater to farmers. The second is that the project was delayed because of government imposed constraints on

⁵³ The wastewater collection system of Greater Santiago is made up of a network of 6,500 km of sewer mains that evacuate a current average flow of 13 m³/s. The flow is expected to increase to 25m³/s by the year 2024. The wastewater collected is discharged without treatment in more than 40 points along three major natural channels that drain the metropolitan area. Some areas are highly polluted, especially areas irrigated by the Zanjón de la Aguada and

EMOS' borrowing and slow, bureaucratic decision-making in the public sector which a private firm would not have faced. There are two main counter-arguments. The first is that a private owner would have not have acted out of fear of a strong political reaction against raising tariffs to cover sewage treatment, which is expected to double charges for water service.⁵⁴ The commitment mechanisms we have described and the presence of a water subsidy, however, make it more likely that the government would have increased tariffs as mandated by the law. The second counter argument is that private operators would have been put off by farmers' apparently low willingness-to-pay for treated water. However estimates of willingness-to-pay vary.⁵⁵ Moreover, it seems plausible that the government would outlaw irrigation of all foodstuffs with untreated sewage once a supply of treated wastewater becomes available. In any case sales to farmers are not necessary to make sewage treatment profitable as long as the tariff policy is sustained.

the central and lower Mapocho River. In 1990, the total agricultural area irrigated with the polluted water from the canals was on the order of 130,000 hectares.

⁵⁴ EMOS expects the combined water and sewerage tariff, which is currently US\$0.40 per M³ of water, to increase by US\$0.10 M³ because of wastewater treatment the first year of the project, by US\$0.16 M³ the fifth year and by US\$0.40 M³ by the tenth year.

⁵⁵ According to surveys, farmers were willing to pay about one to three Chilean pesos/m³ for untreated irrigation water from the Puclaro reservoir in 1991/92 (Aninat et al., 1993). Farmers might be willing to pay more now since prohibitions on irrigation of low-growing foodstuffs were put in place after this survey. A few recent purchases of raw water in the SMR for municipal and industrial uses suggest much higher prices, equivalent to 64 pesos/m³ (or US\$0.16/m³).

Table 8. Annual Cost and Benefits of Sewage Treatment in Santiago
(in millions of 1994 US\$)

Benefits: ^a	\$24.1-79.0	Costs: ^d	\$61.6
Avoided cases of cholera	\$ 2.9-14.7	Net total benefits:	(\$37.5)- 17.4
Avoided cases of typhoid	\$ 0.3- 1.4		
Net impact on farm profitability ^b	\$ 5.8		
Avoided losses of farm exports	\$10.0-50.0		
Reduced consumer costs ^c	\$ 4.1		
Sale of treated wastewater	\$ 1.0- 3.0		

^aLow end of range assumes emergency measures fail every one year in five, high end assumes annually.

^b Brzovic 1993 calculated the annual loss from reduced yields at US\$ 0.6 million and from the reduction in irrigated areas at US\$ 4.3 million, against the revenue gain to farmers from producing vegetables on prohibited acreage estimated at US\$ 6.4 million a year.

^cAssumes a rollback in price increases for crops which currently cannot be irrigated with wastewater.

^dAssumes an average annual sewage flow of 18 M³ and a cost per M³ treated of US\$0.109 including investment, amortization, operation and maintenance.

Source: World Bank 1994, Brzovic 1993, Fernandez 1993, Poblete, 1993 and authors' calculations.

Drawing on World Bank 1994 we estimated that full sewage treatment 25 to 30 years earlier would have led to the range of net benefits shown in Table 8.⁵⁶ In 1991 the government put into effect a number of emergency measures in the face of the threat of cholera spreading from Peru that reduced the number of cases of cholera and typhoid attributable to irrigation with untreated sewage.⁵⁷ The benefits in Table 8 are based on these reduced rates of mortality and morbidity.

By far the largest potential benefit comes from the reduced risk to earnings from agricultural exports should these emergency measures fail. Based on the consequences of trade restrictions on Chile's fruit exports because of a health scare in 1989, World Bank 1994 assumed that an eventual

⁵⁶ This analysis draws heavily on World Bank 1994, Chapter 2 "Water Pollution in Santiago: Health Impacts and Policy Alternatives".

⁵⁷ Specifically, the government prohibited irrigation of low growing vegetables with untreated sewage and restricted transporting irrigated vegetables and fruits outside of the SMR, intensified water quality monitoring, chlorinated irrigation water in canals, temporarily prohibited serving raw vegetables in restaurants, and intensified communication campaigns about the risks of vegetables and the need to wash and cook them.

cholera outbreak would cause huge export losses, which are calculated to be equivalent to annual losses of at least 5 percent of fruit exports or US\$50 million.

Another benefit come from the elimination of cases of typhoid and cholera attributable to irrigation of food crops with untreated sewage, which is calculated as the average cost of medical treatment plus earnings lost due to lost work time per case.⁵⁸ The table also calculates the net effects on farmers productivity. The treatment of sewage will reduce the fertilizer value in wastewater, and eliminate it in areas deprived of wastewater by interception, which has a cost to farmers. However, farmers benefit because they can grow vegetables could be grown in areas where they are currently banned because the only water available for irrigation is contaminated, which raises their profits somewhat, although it also reduces consumer prices. The calculations do not consider the effects of price increases to cover the cost of sewage treatment since the reduction in consumer surplus is offset by the increase in EMOS' revenue. Finally, the table assumes that treated water can be sold, producing additional revenues for EMOS.

Against these benefits Table 8 deducts the cost of sewage treatment, resulting in net benefits between –US\$37.5 and + US\$17.4 million in 1994 prices.⁵⁹ Although the lower range is negative, it should be kept in mind that the benefits do not include a reduction in hepatitis and

⁵⁸ Between 1985 and 1990 the average annual direct cost of, for example, typhoid cases attributable to sewage irrigation of vegetables was \$1.4 million per year.

⁵⁹ EMOS' recent studies suggest that the total lifetime cost for treating 100 percent of the SMR wastewater using conventional technology will be US\$574 million or US\$61.6 a year.

other gastroenteric diseases, benefits to tourism and fishing in coastal waters and the effects to image and trade negotiations.

Besides perhaps building the sewage treatment plant, there were other ways we might expect a private EMOS to have behaved differently.⁶⁰ In particular there were regulatory weaknesses that the public EMOS had little motivation or capacity to exploit. One such weakness resulted from SSS vulnerability to capture (Sánchez and Sanhueza 1997). SSS officials could have been influenced by prospective employment opportunities in the regulated sector if EMOS had been private. Although the SSS was better paid than its predecessor, professors of hydraulic and environmental engineering at the University of Chile reported that most of their graduates were not attracted to the SSS because salaries were low and career prospects, poor compared to the private sector. The law does not place any restrictions on who can hold top executive positions at the SSS or what they do when they leave. The risk of capture has thus far been low because most of the regulated companies are state-owned, and hence can offer few inducements.

The SSS was also vulnerable to outright misbehavior by a private EMOS since its ability to enforce its decisions was weak. If a regulated company failed to comply with SSS technical standards, requests for information, or requirements under its concession rules, the SSS could fine the company and in extreme cases revoke the concession. However, the fines are set by law and were widely regarded as too low to motivate compliance, while in most circumstances revoking the concession

⁶⁰ It could be that a private EMOS would have been motivated to increase operating efficiency faster since it could have captured more of the rents than the state owned EMOS, which had to make large dividend payments to government. But since EMOS' performance was already good, the welfare gains from this would have been small.

would have been seen as draconian and politically unacceptable.⁶¹ This lack of credible sanctions was less of a problem with state enterprises like EMOS because the SSS could appeal to other government agencies such as the Ministry of Public Works for support in forcing compliance.⁶² A private EMOS would not have been subject to orders from other government agencies, but would have had to be concerned about its international reputation.

In sum, there were some costs to not privatizing EMOS if we accept that a private firm would have built the sewerage treatment plant. However, these costs are reduced by the likelihood of opportunistic behavior on the part of a private operator.

IV. Conclusion

The reform of EMOS illustrates how a regulatory contract that addresses problems of information, incentives and commitment, combined with strong supportive institutions, can produce net benefits even in a relatively well performing water system. It also shows how institutional factors enabled Chile to overcome the agency problems that usually lead to contractual failure in SOE performance contracts.

In a situation such as Santiago's, where service was relatively good, such that the political costs of doing nothing were low, reform seemed unlikely. Yet a crisis brought in a government ideologically committed to the sale of EMOS. After the Pinochet government passed legislation designed to attract a

⁶¹ The proposed reform of the SSS would increase fines sharply. For example, the present fine for providing false information is the equivalent of US\$80,000 and would increase to US\$800,000; the fine for poor quality water would increase from US\$15,000 to US\$80,000. (Field Interviews)

⁶² Indeed, in a randomly selected week from the SSS' weekly report of fines, EMOS was cited for three infractions, apparently minor judging from the amounts of the fine. The private firm operating in Santiago, Aguas Cordillera, was

private investor, motivate efficiency gains and prevent capture, Chile's political and constitutional constraints made reversal virtually impossible. Since there were net political gains to the Aylwin government, the reform was not only tolerated but vigorously pursued. On the political benefits side, poor constituents could be connected, service could improve, and needed revenues could be generated. The existence of a subsidy that was means targeted but leaked over to middle income consumers reduced opposition to tariff increases across a broad range of voters. Although workers were initially opposed, their opposition was weak to begin with, muted by their support for the new government and lack of alternatives, and offset by the compensation of collective bargaining, bonuses and other benefits.

A regulatory framework grounded in law that gave limited discretion to the regulator on pricing was a good fit with Chile's electoral, legislative and legal institutions. Price cap pricing reinforced the existing incentives motivating efficiency in EMOS. Supportive norms and institutions mandating a hard budget reinforced the high powered incentives in the regulatory contract.

Would Chile have done better if it had privatized EMOS? If everything else remained the same, except that a private investor built the sewage treatment plant, then the health of Santiago's population would have improved, a serious risk to its food exports would have been mitigated and a source of contamination of its beaches and oceans would have been eliminated. The benefits of these externalities are hard to estimate, but our best guess suggests that the gains would have outweighed the costs.

However, the assumption that all else would have been equal with private ownership of the country's largest water company seems dubious. A private investor would have had much stronger incentives to

cited for ten infractions, three of them serious, again judging from the amounts of the fines. SSS, 1997.

exploit the vulnerabilities of the SSS. The net effect of these actions is hard to predict. Recent legislation will correct some of the weaknesses of the regulator, through higher salaries (by putting SSS staff on a higher civil service ranking), limits on how soon SSS staff can be employed by the regulated industry, and higher fines for regulatory infractions (see Sánchez and Sanhueza 1997 for an excellent discussion of these issues).

Our findings suggest that the workings of Chile's water regulation could also be improved by increasing the use of competition. Increasing yardstick competition would require the SSS to reveal more information to the companies about what standards are used in tariff setting and simplify the process so that company managers can compare their costs with the model company. The risk that the company might manipulate information could be reduced through greater competitive bidding of concessions and higher sanctions for misinformation. The incentive effects of yardstick competition could be lost, however, unless the dividend policy is changed. The incentive for companies to improve their efficiency under the benchmark tariff used in Chile is curtailed if government captures all the gains through dividends and taxes, especially for regional companies without the strong reputation effects of EMOS.

Another way to improve information and strengthen the incentive features of the regulation would be to require competition for all new concessions and for existing concessions when the current owner fails to live up to important obligations such as to invest or to maintain water quality over some prolonged period, such as five years. Greater consumer information and representation of consumers and other interests in the tariff setting process would also improve monitoring.

Those looking to Chile as a model might keep in mind three factors present in Chile that are not typical of most developing country water systems. First is the long tradition of private water rights that

meant that management of the sector was shaped by a very early recognition of water as a scarce and tradable private good. A second factor is Chile's strong bureaucratic institutions and norms governing the public sector that prevented EMOS and other SOEs from operating with the degree of corruption, inefficiency and paralysis common to many water systems. Third, Chile's electoral, constitutional and judicial institutions permitted the introduction of a contract that mimicked a private concession as well as a means-tested subsidy. Finally, Santiago's relatively low cost water sources helped make it politically possible to price at full cost recovery.

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Field Interviews

Aguas Cordillera (private water company in Santiago, formerly Lo Castillo)

Jorge Alé Yarad, General Manager

Victor de la Barra Fuenzalida, Commercial Manager

Patricia Pacheco Gómez, Manager, Finance and Administration

Catholic University, Department of Economics

Vittorio Corbo, Professor of Economics

Chamber of Construction (Camera de Construcción)

Hernan Doren

Alejandro Fuensalida

Loreto Silva

CORFO (Corporación de Fomento)

Felipe Sandoval, Minister

EMOS (Empresa Metropolitana de Obras Sanitarias)

Sergio Saavedra, President, Board of Directors

Paulina Lobos, General Manager

Victoria Ahumada, Financial Manager

Hector Franco, Commercial Manager

Amparo Nuñez, Manager, Planning and Development

Alejandro Romero, Operations Manager

Domingo Valenzuela, Chief, Network Expansion

Jose Ignacio Zaldivar, Auditor

Sergio Celedon Diaz, Chief, Public Relations

Adolfo Meyer, President, Union of Technicians and Professionals

Victor Navarrete, President, Union of Administrators

Emilio Pastenes Trabajadores, President, Employees Union

Ministry of Economy (Ministerio de Economía)

Oscar Landerretche, Undersecretary

Ministry of Health (Ministerio de Salud)

Dr. Roberto Belmar Erpel, Chief, Environmental Health

Ministry of Planning (Ministerio de Planificación)

María Teresa Hamuy P., Chief, Investment Department

Analía Morán, Potable Water Expert

Berta Teitelboim G., Chief, Social Statistics Department

Ministry of Public Works (Ministerio de Obras Publicas)

Guillermo Pickering, Undersecretary

SSS (Superintendencia de Servicios Sanitarios)

Juan Eduardo Saldivia, Superintendent

Nancy Cepeda, Director, Department of Standards

Sergio Espinosa Riveros, Chief, Industrial Runoff Section

María Concepción Palominos, Director, Tariffs Department

Jorge Paredes, Director, Legal Department

United Nations

Terence Lee, Environment Division

University of Chile, Faculty of Economics

Ricardo Paredes, Professor, Economics

Jose Miguel Sanchez, Assistant Professor, Economics

Ricardo Sanhueza Palma, Professor, Economics

University of Chile, Faculty of Engineering

Ernesto Brown, Professor and Head, Hydraulic Engineering

Gabriela Castillo, Professor, Microbiology

Carlos Emerosa, Professor, Hydraulic Engineering

María Piamena, Professor, Civil Engineering, wastewater treatment

Individuals:

Raquel Alfaro Fernandois, consultant, former General Manager, EMOS (1990-1997)

Jorge Rosenblut, investment banker, former staff Ministry Economy

Eduardo Bitran Colodro, Director, Fundación Chile, former government advisor on water reform

Alejandro Bontes, consultant INDECON, participant in two tariff studies and design of tariff setting program

Eugenio Celedon Silva, consultant, former Supervisor (1990-1997)

Jorge Ducci Palma, consultant, Soluciones Integrales, former advisor to Ministry of Public Works

Juan Esteban Doña, author of books and research paper on regulation in Chile

Carlos Hurtado Ruiz, consultant, Soluciones Integrales, former Minister of Public Works, 1990-1994

Annex A Chile: Subsidy Program

In 1989 Chile created a system of subsidies for water and sewerage, which took effect in 1990. Anyone who holds a social classification card (CAS), has a household water connection and is not more than three months late in paying their water bill is eligible for the subsidy. The CAS has been in effect since 1980 and establishes eligibility for a number of targeted subsidies in addition to water and sewerage, including a flat-rate family allowance, minimum pensions, and housing assistance. Households applying for a CAS are visited by a municipal official who allocates points to the family based on the size and composition of the household, the occupation and education of the household head, the assets (car, refrigerator, land, etc.) and per capita income of the family, and the characteristics of the dwelling (such as location, number of rooms, exterior and interior materials used for construction, whether it has a water or electrical connection, etc.) Households with less than a maximum number of points are then issued a CAS and those with lower points receive higher priority for getting subsidies.

The yearly allotments for the water subsidy are based on bi-annual surveys of family income by region. The allotments are allocated so as to assure that no family in the region pays more than five percent of its income for water and sewerage.⁶³ Regional allotments are then divided among municipalities based on the number of CAS holders with lower points in each local area. The municipality then distributes its allotment across the list of eligible beneficiaries, starting with those with the lowest points, and puts those it cannot cover on a waiting list.⁶⁴ The subsidy is then paid directly to the water supplier, who subtracts the appropriate amount from each household's water bill and collects the remainder of the bill directly from the customer. Initially only the first 15 M³ of consumption per month could be subsidized; this was later raised to 20 M³. By comparison, average consumption for a poor urban family is 20-30 M³ per month. On average the subsidy covers 60 percent of the water bill of eligible households, although in regions with high tariffs, up to 85 percent may be covered.

The number of Chilean households covered by the subsidy has gone from 5 percent of those eligible in 1990 to 95 percent in 1996 (see table A-1). The expansion in coverage was largely the result of a public education campaign by the water companies to convince eligible consumers to apply, although an easing of the conditions for eligibility also helped. As a result of this increased coverage, the total, national cost for the water subsidy has risen from US\$ 8,000 in 1990 to US\$ 500,000 in 1991 to US\$ 30 million in 1996.

Only about a third of the households which received a water subsidy were in the lowest income quartile, and thirty percent in the second quartile, while some benefits reached even the upper income

⁶³ The five percent is a standard based on the World Health Organization's recommendation that water and sewerage expenditures should represent no more than one day of a worker's income a month.

⁶⁴ Persons can lose the subsidy if they fail to pay their share of the water bill, change dwellings, etc.

quartile (see table A-2). This distribution by number of households is somewhat misleading, since the share of the total water subsidy which was received by the upper income groups is probably much less than for the other groups (data are not available) and the number of people in a lower income household is much higher. The fact that some subsidies were paid to upper income groups is partly a result of Chile's highly unequal income distribution, where 96 percent of the households have incomes of less than \$1,260 per capita (see table A-3); Chile's per capita income in 1995 was US\$ 4, 805. In addition, the way the subsidies are distributed by regions means that even a household in the upper quintile could qualify under the "no-more-than-five-percent-of-income-for-water" rule in some regions. Only a third of the beneficiaries are in the lowest quartile, probably because the subsidy cannot reach indigent households (approximately 5 percent of all households in 1995, see table A-4). The subsidy is only available to those with a house connection (which requires a fixed dwelling) and who can afford to pay some part of their bill, which rules out the indigent. (As well as the non-indigent part of the 21 percent of Chile's population that does not have indoor plumbing, most of them in rural areas.) In addition, some poor families may be discouraged by the need to apply for the subsidy, while some municipal workers may be duped or corrupted by wealthier beneficiaries.

Table A-1
Chile: Coverage of the Subside for Water and Sewerage, 1990-96

Year	Number of Budgeted Subsidies	Number of Subsidies Used	Usage Rate (%)
1990	424,625	21,824	5.1
1991	424,625	177,719	41.9
1992	441,040	315,901	71.6
1993	443,038	351,925	79.4
1994	454,038	389,712	85.8
1995	461,508	399,205	86.5
1996	466,508	442,524	94.9

Source: MIDEPLAN, 1997.

Table A-2
Chile: Water and Sewerage Subsidy by Income Group, 1996

Income Quintile	Per Capita Household Income (US\$)	Average Subsidy (CH\$)	Number of Beneficiary Households	Percentage Distribution of Beneficiaries
I	0-250	2,419	64,594	32.7
II	250-440	2,370	59,541	29.6
III	440-680	2,392	43,045	21.6
IV	680-1,260	2,676	24,220	13.6
V	>1,260	2,507	4,920	2.6
Total		2,432	196,320	100.0

Source: MIDEPLAN, 1997.

Table A-3
Chile: Distribution of Monetary Income by Quintiles, 1987-1996*
(percentages)

Quintile	1987	1990	1992	1994	1996
I	57.2	56.9	56.3	56.9	56.7
II	19.0	18.1	18.4	18.5	19.1
III	11.7	12.3	2.2	12.0	11.9
IV	7.9	8.2	8.5	8.2	8.2
V	4.3	4.4	4.6	4.3	4.1

* Monetary income includes all income to factors of production (i.e., wages, salaries, pensions, rents, dividends, interest, etc.) plus monetary transfers from the public sector.

Source: MIDEPLAN, 1997.

Appendix B

Demand Estimation and Consumer Surplus

Since the estimation of demand curve is an integral part of the cost-benefit analysis, this annex provides more details on the assumptions used for the estimation of demand curve and consumer surplus.

In our analysis of consumer surplus we cover two goods, water and sewerage, for which the same demand elasticity is assumed.⁶⁵ (The lack of data prevented us from decomposing the revenue into finer categories.) The price elasticity we use is -0.259.⁶⁶ The connection fee is not treated explicitly, but this should not significantly affect the results because the coverage was quite high: the water market was almost 100% covered, and the sewerage market, more than 80%. Continuity for the Santiago metropolitan area was not an issue: all connections had running water for 24 hours a day. Finally, since the metering percentage has been 100%, there is no need to distinguish metered and unmetered consumers.

As we mentioned in the text the total demand curve is assumed to be:

$$TQ_t = N_t(a - bp)$$

Where TQ is total demand; N is total population; $(a - bp)$ is individual demand curve; a is the demand when marginal price is 0, and p , price of water and sewerage combined. Thus the total demand curve shifts outward with the expansion of population, while the individual demand curve remains stable over time.

The estimation of a and b involves a few assumptions. First, the demand elasticity around the observed demand point in 1988 is, as mentioned in the text, -0.26. Second, except for the population

⁶⁵ From total revenue and quantity of water and sewerage respectively--which are consistently available--we derive their implicit prices.

⁶⁶ This elasticity comes from two sources. The first is a study about water demand in Santiago (CITE), according to which the price elasticity is -0.516 for households which consume 1-20 m³ of water, -0.2 for 20-30 m³, and -0.25 for more than 30 m³. The second source is the consumption patterns among households, which suggests that there were 5% of households using 1-10 m³ per month, 40% using 10-30 m³ per month, and 55% using more than 30 m³ per month. Then the weighted average elasticity is just $0.10*(-0.516)+0.35*(-0.20)+0.55*(-0.25)=-0.259$. Although we know that the demand elasticity for water of industrial and commercial use is -0.20, we did not use this piece of information because this category of water use accounts for only 5.8% of the total use according to EMOS Annual Report 1990. This elasticity is quite similar to that is assumed in Argentina (-0.32).

shifter for each year, the demand curve remains the same, whether under the factual or the counterfactual. Third, at the price in 1988, the total demand consisted of all the residents of EMOS; the uncovered population is treated as excess demand. Given the relative low price of water and sewerage that year (roughly 0.14 US dollar), this assumption is likely justified. From these assumptions, then, one may impose the following simultaneous equation system, with two equations and two unknowns, a and b :

$$-e_d = \frac{d \ln TQ}{d \ln P} = -Nb \frac{P}{TQ}$$

$$\frac{Q}{\text{coverage}} = N(a - bP)$$

They can be solved by using the data of 1988, the last year of the pre-reform era. With the knowledge of demand function, we can then proceed to estimate consumer surplus associated with a price and quantity pair.

The estimation of consumer surplus then proceeds as follows.

- $\text{slope} = \frac{dp}{dTQ} = \frac{1}{Nb}$

- $P_{\text{intercept}} = TQ \cdot \text{slope} + P_t$,

where $P_{\text{intercept}}$ is the interception of the demand curve with the P axis, and P_t is the observed marginal price.

- $\text{Consumer surplus} = S_1 + S_2$,

where $S_1 = 0.5 \cdot Q \cdot (P_{\text{intercept}} - P_Q)$, and

$$S_2 = Q \cdot (P_Q - P).$$

Caution

The cost-benefit analysis has its limitations. While we have tried our best to take into account as many relevant details as possible in constructing our factual and counterfactual scenarios, we also had to leave out many relevant ingredients. For instance, it was hard to incorporate into the benefits of the reform the improvement of the quality of the system, even though there was evidence that it had been improving after the reform.⁶⁷ Also ignored are the benefits in terms of better ability to deal with a major drought.

⁶⁷ The number of pipe break per kilometer decreased from above 0.50 before 1990 to 0.25 in 1996, representing a significant drop.