Does Regulation and Institutional Design Matter for Infrastructure Sector Performance?

1. Introduction

As part of structural reforms in infrastructure industries during the 1990s, more than US$ 750 billion was invested in 2,500 private infrastructure projects in developing economies. Nearly half went to the Latin American region, mainly through the divestiture of public assets in telecommunications and electricity sectors and transport concessions. Six countries – Argentina, Brazil, Chile, Colombia, Mexico and Peru – absorbed more than 90 percent of all private investments. Overall, the region was the most important beneficiary of the huge flow of private investments for infrastructure worldwide with private investment peaking at around US$ 130 billion in 1997. Since then, investors' appetites have waned, public support to privatization decreased and the role of public investments in the provision of infrastructure services has gained momentum again[1]. While the increase of public investments is welcomed, given the magnitude of infrastructure needs in the region – roughly 4 to 6 percent of GDP per year to catch up or keep up with countries that once trailed it, such as China and Korea – and the fiscal limitations of the

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* World Bank, 1818- H Street, Washington DC. Findings, interpretation and conclusions expressed herein do not necessarily reflect the views of the Board of Executive Directors of the World Bank or the governments they represent.

public sector, private sector financing for infrastructure will always be important in Latin America.

While in Latin American countries, state-owned enterprises continue to account for more than 10 percent of gross domestic product, 20 percent of investment, and about 5 percent of formal employment (Kikeri, 1999), the infrastructure sector has dramatically changed. Specifically, while at the beginning of the 90s only 3%, 3% and almost 0% of the subscribers of fixed telecommunications, electricity and water distribution, respectively, were in private hands, in 2003 these ratios were 86%, 60% and 11%. The setting of regulatory frameworks has accompanied that increase of private sector participation in infrastructure.

There is strong evidence supporting the generally positive economic results of these policies. Some examples include Boardman and Vining (1989) and Megginson, Nash, and van Randenborgh (1994) (see Megginson and Netter, 2001, and Chong and Lopez-de-Silanes, 2003, for more recent reviews). Yet, public perceptions of the outcome are not very positive. Chong and Lopez-de-Silanes (2003) have, among others, summarized and addressed the most voiced criticism.

In the case of Latin American countries (LACs) and for the infrastructure sector, beyond case studies, there is little empirical literature analyzing impact and determinants. Most of it has focused all sectors and on the performance of financial indicators (see Megginson, Nash, and van Randenborgh, 1994, and D'Sousa and Megginson, 1999). Recently Andres, Guasch, and Foster (2006) evaluate the impact of private sector participation on of output, efficiency, labor productivity, quality, coverage and prices, using a large cross country data set for Latin America. Also, the impact of competition is analyzed in Andres, Guasch, and Foster, 2006), the issue of renegotiation of the concessions in Guasch, 2003, Guasch, Laffont and Straub, 2003, 2004, the profitability of private infrastructure firms in Sirtaine, Pinglo, Guasch, and Foster, 2005.

Yet, there is little work that has focused on the determinants of outcome and particularly on the impact of regulation on those outcomes. While the theory tells that regulation matters, there is a shortage of empirical work analyzing that issue. Some exceptions are Wallsten 2001, Jamasb 2005 and Cubbin and Stern 2005 and Stern and Cubbin 2004.

The objective of this paper is to add to that scarce literature, testing the impact of regulation from three different angles: (a) on aligning costs with tariffs- firms profitability, (b) on reducing/deterring opportunistic renegotiation, and (c) on its effects on productivity, quality of service, coverage and prices. That is done respectively in Sections 2,3 and 4 respectively.

For this, we used and extensive data set on about 1000 concessions granted in Latin America from the late 1980s to the early 2000s compiled by (Guasch, 2003).

2. Testing the Impact of Regulation on Aligning Costs with Tariffs-firms Profitability

Unlike normal competitive business sectors, the profitability of concessions is not simply a reflection of market conditions and managerial competence, but is to a considerable extent determined—or at least circumscribed—by regulatory decisions. Infrastructure companies operate mostly under a monopoly regime and thus are subject to regulation of tariffs and other aspects of enterprise performance. Thus, the observed profitability of these concessions in part should reflects the quality of the regulatory framework and the performance of the regulators that oversee them.

2.1 Theoretical framework

Regulation aims to protect consumers from abuse of monopoly power and investors from opportunistic behavior by the government, given the politically sensitive nature of infrastructure tariffs and the large sunk cost characteristics of the companies' investments. In consequence, regulatory decisions have a substantial impact on the profitability of companies. Ideally, the regulator's objective should be to maintain alignment between a company's rate of return and its cost of capital. (which is the key objective of economic regulation-the other being inducing the operator to operate at minimum efficient costs (given quality standards for service) This is because a rate of return in excess of the cost of capital inappropriately penalizes consumers, while a rate of return beneath the cost of capital inappropriately discourages further investment. The closeness of that alignment will depend, among other things, on the quality of regulation.

In theory, the closeness with which the rate of return tracks the cost of capital will also depend on the chosen regulatory regime. Under rate of return regulation, the regulator has the possibility of making frequent price adjustments to keep realigning the company's rate of return with its cost of capital. Under price cap regulation, on the other hand, the regulator sets tariffs so that expected returns match the cost of capital *ex ante*, but allows these returns to diverge *ex post* during the periods between regulatory reviews. However, in practice, in Latin America, the distinction between price cap and rate of return regulation is somewhat blurred due to frequent renegotiation of infrastructure contracts (Guasch, 2004; Guasch and Spiller, 1999; Gomez-Ibanez, 2003) [2], and to the fact that review methodologies sometimes take into account historic divergences between the rate of return and the cost of capital in adjusting future prices, which

goes against the forward looking principles of price cap regulation. Thus, the practice in the region would best be described as a hybrid regime.

Therefore, instead of focusing on the dichotomy between price cap and rate of return regulation, the approach taken is to develop a measure of the overall quality of the regulator that oversees each of the companies in the sample. The purpose of this section, then, is to empirically evaluate the impact of the quality of regulation on the profitability of the firms. The hypothesis is that the better the quality of regulation, the closer is likely to be the correspondence between the firm's rate of return and the firm's cost of capital.

2.2 Measuring regulatory quality

In order to test this hypothesis a quantitative measure of regulatory quality is needed. Good regulation is defined by clear, stable and predictable rules, a purely professional and technical interpretation of the law and contract, ability to withstand influences and pressures from the stakeholders such as government and operators, and the establishment of a predictable and adequate allocation of resources. In consequence, the index developed here considers three key dimensions of regulatory quality: legal solidity, financial strength, and decision-making autonomy. The construction of each of these indices and associated scoring method are detailed in Table 1 below.

Legal solidity refers to the stability, and thus predictability, of the regulatory regime. The strongest legal foundation is when the regulatory framework is embedded into a law, as opposed to a less strong legal instrument-less difficult to change (such as a decree or a contract if the judiciary is not reliable).

Financial strength refers to the resources the regulatory agency has to undertake its functions. This dimension has two aspects. The first aspect is financial independence, which is achieved when a regulatory entity has its own source of revenue (for example via a sectoral surcharge) that does not depend on the government budget. The second aspect is financial strength, which is a function of the size of the agency's budget.

Decision-making autonomy measures the likelihood that regulatory decisions are based on technical as opposed to political criteria. This dimension has three aspects. The first aspect is independence of appointment, which measures the extent to which the appointment process avoids a purely political appointee without adequate technical knowledge of the sector. The second aspect is duration of appointment, which indicates whether a regulator can be reappointed and hence might be less likely to act independently and issue professionally and technically based decisions. The third aspect is collegiality of decisions, which measures the relative difficulty of regulatory capture, thought to be lower when multiple regulators act jointly within a board structure. The data was collected by the authors from regulatory agencies in Latin America.

Table 1: Regulatory quality index: components and construction

	Weight	Scoring
Legal solidity	0.33	1 if regulatory framework established by law, 0 otherwise.
Financial capacity	0.34	Sum of scores on factors detailed below.
• Financial independence	0.17	• 1 if funded from regulatory levy, 0 if funded from public budget
• Financial strength	0.17	• Regulatory budget as % sectoral GDP normalized on [0,1] scale
Decision-making autonomy	0.33	Sum of scores on factors detailed below.
• Independence of appointment	0.11	• 0 if appointed directly by Executive, 1 if screening by legislature
• Duration of appointment	0.11	• 1 for a single fixed term, 0 for indefinite appointment
• Collegiality of decisions	0.11	• 1 if headed by regulatory commission, 0 if by individual regulator

Note: Scores between 0 and 1 are given for intermediate cases.

While each of these elements are individually relevant, it is also of interest to aggregate them into a single quality index that gives equal weight to each of the three dimensions that have been identified. For the sample of companies covered in this study, the average score on this index of overall regulatory quality is 0.51 as against a potential maximum of 1.0, suggesting that the quality of regulation is not overall very high. However, there is significant variation in quality across countries and sectors, with scores ranging widely between 0.12 and 0.85. The highest average score is obtained on legal solidity, 0.65, as against decision-making autonomy, 0.56, and financial strength, 0.34. Pair-wise correlations between each of the regulatory quality measures are typically low at around 0.20, and in no case greater than 0.57. In some cases, pair-wise correlations even take negative values, suggesting that high regulatory quality along one dimension is correlated with low regulatory quality along another dimension. This result illustrates that few countries have consistently applied all of the design principles needed to ensure good quality regulation.

These indices of regulatory quality are used to try to explain differences in the divergence between rate of return and cost of capital across the different companies in the sample[1]. This is done by regressing the difference between the Project Internal Rate of Return and the Weighted Average Cost of Capital (IRR-WACC) against this set of explanatory variables. The hypothesis is that the greater the quality of regulation, as measured by the described index, the smaller the differential should be, suggesting that the regulatory quality sub-indexes would enter the regression with negative signs.

[1] From that universe of private contracts, we used a sample of 34 concessions built by Sirtaine, Pinglo, Guasch, and Foster (2005), using the following criteria: (i) to include most Latin American countries with meaningful privatization programs; (ii) to include companies from all main infrastructure sectors; (iii) to focus on companies with at least 5 years of operations (in order to have a time series of data of adequate duration for the analysis); and (iv) to focus on companies publishing good quality financial statements.

Two separate measures of the IRR-WACC differential are considered. The first measure is the simple IRR-WACC differential. This captures the quality of regulation purely from a short-term consumer's perspective, since the smaller the IRR-WACC differential (including negative values), the lower the resulting tariffs for consumers. However, this constitutes a myopic view since a negative IRR-WACC undermines investment incentives and therefore ultimately penalizes consumers through declining service quality, decelerating service expansion, and potential flight of investors. Therefore, the absolute IRR-WACC differential is taken as a second relevant measure. According to this indicator, what matters is minimizing the distance between IRR and WACC, with positive and negative differentials regarded as equally reflective of poor regulatory decisions.

2.3 Simple differential (myopic consumer protection)

The results for the first set of regressions are reported in Table 2, using each of the four measures of IRR-WACC differential.[3] Despite small sample sizes, three out of the four models show that the regulatory quality variables are significant in overall terms, and are on their own capable of explaining 20-25% of the IRR-WACC differential. Moreover, some of the regulatory quality variables are also individually significant. Thus, the financial strength variable is significant at the 5% level in most of the regressions with the expected negative sign, indicating that regulators with larger budgets tend to have greater success in minimizing the IRR-WACC differential. In addition, the collegiality of decision variable is also significant at the 5% level, but takes a positive sign. This suggests that, arguably contrary to expectations, regulatory entities

headed by a single superintendent do a better job at reducing the IRR-WACC differential than do broader based regulatory commissions.[4]

Table 2: Summary of regression results

Dependent variable	Simple differential 1	Simple differential 2	Simple differential 3	Simple differential 4
Financial independence	-0.340	-0.174	-0.151	-0.135
Financial strength	-0.372	-0.332**	-0.355**	-0.370**
Legal solidity	-0.026	0.077	0.070	0.080
Independence of appointment	-0.109	-0.068	-0.101	-0.109
Duration of appointment	-0.125	-0.011	-0.038	-0.030
Collegiality of decisions	0.455**	0.256**	0.271**	0.267**
Constant	-0.341	-0.047	-0.022	0.002
P-value	0.156	0.072*	0.052**	0.045**
Adjusted R-squared	0.124	0.208	0.237	0.248
No. of observations	32	30	30	30

Notes: Regressions based on 30 observations; *, **, *** indicate significance at 10%, 5%, and 1% level respectively

2.4 Absolute differential (protecting both consumers and investors)

The results of the second set of regressions are reported in Table 3. Given that taking the absolute value of the IRR-WACC differential reduces the spread across observations in an already small sample, a log-linear specification is used to ensure that there is adequate variation for the purposes of the regression. Overall, this second set of regressions does not perform as well as the first. Nevertheless, two of the models show overall significance at the 5-10% level and are able to explain around 20% of the variation in the IRR-WACC differential. As before, the financial strength variable proves to be significant in some specifications, though not always with the expected sign. On the other hand, the collegiality of decisions is no longer statistically significant. The lower level of significance and explanatory power associated with this second

set of regressions may simply be reflecting the fact that regulatory efforts are more strongly motivated by short-term considerations of keeping prices as low as possible for current consumers, than by long term considerations of keeping returns as close as possible to hurdle rates for investors.

Table 3: Summary of regression results

Dependent variable	Absolute differential 1	Absolute differential 2	Absolute differential 3	Absolute differential 4
Financial independence	1.071	-0.653	-0.001	0.071
Financial strength	2.619**	-2.478	-2.488**	-2.140**
Legal solidity	-0.697	0.928	0.412	0.844**
Independence of appointment	1.147	0.974	0.577	-0.050
Duration of appointment	-0.478	1.412	1.053	0.767
Collegiality of decisions	-1.771	-0.810	-0.456	-0.243
Constant	-1.104	-2.618**	-2.365**	-2.487**
P-value	0.094*	0.273	0.125	0.049**
R-squared	0.171	0.069	0.156	0.242
No. of observations	32	30	30	30

Notes: Regressions based on 30 observations; *, **, *** indicate significance at 10%, 5%, and 1% level respectively

The conclusion of this analysis is that regulation matters in aligning cost of capital and rate of return, as variations in quality across regulatory regimes are significant and material in determining the size of the IRR-WACC differential. However, regulatory efforts seem to be more closely associated with minimizing the simple IRR-WACC differential (and thereby keeping tariffs as low as possible for current consumers), than with minimizing the absolute IRR-WACC differential (and thereby keeping profitability well aligned with hurdle rates of return). Another striking feature of the results is that regulatory quality variables seem to have overall significance, more than individual significance, in determining IRR-WACC differentials. This is in fact consistent with the fact that performance along different dimensions of regulatory

quality is not highly correlated, and that the benefits of high regulatory quality along one dimension can be completely offset by low regulatory quality along another dimension. Thus for regulation to be effective, one needs the whole package of regulatory characteristics. If some of the key ingredients are missing the effectiveness of regulation is highly diminished.

2.5 Summary

We have analyzed the differences between returns and costs of capital and shown that the variation of net returns across concessions can be partially explained by the quality of regulation. We have shown that the better the quality of regulation the closer the alignment between financial returns and costs of capital as is desirable. Quality of regulation is found to be a significant determinant of the divergence between the overall profitability of the concession and its corresponding hurdle rate, explaining around 20% of the variation. Thus we have shown that regulation indeed matters**.** However, regulatory efforts seem to be more closely associated with keeping tariffs as low as possible for current consumers, than keeping profitability well aligned with hurdle rates of return.

The policy implications are clear. Significant efforts should continue to be placed to improve the quality of regulation.

3. Testing the Impact of Regulation on Reducing/deterring Opportunistic Renegotiation

3.1 Concessions contracts in Latin America

In Latin America, a majority of the privatization cases took the form of concession contracts. This was mostly to avoid political, legal and sometimes constitutional impediments to the outright sale of state assets to private operators that were often foreign firms. A concession contract grants a private firm or consortium the right to operate a given infrastructure in exchange for the revenues generated by users' payments, and lasts for a limited period of time (in general between 15 and 30 years), after which the underlying assets are devolved to the state.

However, concession contracts have suffered from a number of problems, the most serious of which has been renegotiation. Considering an exhaustive sample of more than 1,000 concessions in Latin America and the Caribbean during the period 1985-2000, and excluding telecommunications where most projects were real privatizations with transfer of assets, 41% of the total projects in the three remaining sectors were renegotiated at some point. In water and transport, renegotiations have affected 74% and 55% of the projects respectively, and have occurred 1.6 years and 3.1 years on average after the award (Guasch, 2004).

Such renegotiations have had a negative impact on users, including the need for additional risk premium ex ante (Guasch and Spiller, 1999), and ex post service disruption, non-compliance with expansion targets and excessive prices due to cost pass-through charged to customers, among others. For example, the Mexican toll road program, which consisted of 52 highways built in the early 1990s, was finally bailed out by the government in 1997. The

estimated cost was between 1 and 1.7% of GDP (Guasch, Laffont and Straub, 2005). It therefore becomes important to understand the reasons for these failures and in particular the role that regulation has in determining those outcomes. That is the aim of this section.

3.2 Renegotiations of concession contracts and their determinants

Renegotiations may be of two types: renegotiations initiated by operators (Guasch, Laffont and Straub, 2003) or those at the initiative of local or national governments (Guasch, Laffont and Straub, 2005). Firm-led renegotiations might be related to economic shocks such as a devaluation or a recession, or might be opportunistic, when a firm that was previously awarded a concession seeks a bilateral negotiation with the government or the regulatory agency to strike a better deal than the initially agreed one. This may significantly reduce the benefit of the competitive pressure introduced by the ex ante auction procedure, first simply because the agreed parameters (tariffs, transfers) are modified and second because firms that anticipate this may be tempted to strategically undercut rivals at the bidding stage.

Government-led renegotiations may sometimes be of a Pareto improving nature (related to unforeseen contingencies), but most of them are opportunistic, with politicians during or after an election campaign reneging on previous contracts to please their constituencies. Recent cancellations of water concessions in 2005 in Bolivia and the ongoing renegotiations of most concessions in Argentina after the 2001 crisis, in which the government refuses any significant adjustment of the rates converted to devalued pesos despite contract clauses that contemplated indexation to the dollar and US inflation, and are examples in case.

A look at the data in Table 4 shows that regional volatility seems to play an important role in the timing of these renegotiations. For example, a number of them occurred around the hyperinflation at the end of the 80s in Argentina, during and after the Tequila crisis in 1995 in Mexico and at the time of the Real devaluation in 1999 in Brazil. It is therefore interesting to find out if economic shocks were the only determinants of renegotiations, or if there were other flaws, in contract or regulatory framework design, that were pivotal in explaining the high incidence of renegotiation.

Table 4: Renegotiation by Type of Initiator and Year

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
All countries													
outstanding concessions	10	38	38	50	78	103	123	132	156	187	187	165	
Number of renegotiations	0	13	3	9	12	14	23	15	15	11	27	20	162
Firm-led reneg.	0	12	2	2	0	1	3	3	11	4	1	14	53
Govt-led reneg.	0	0	0	0	10	13	19	11	3	7	25	6	94
Joint-led reneg.	0	1	1	7	2	0	1	1	1	0	1	0	15

Source: Guasch, Laffont and Straub (2005)

Guasch, Laffont and Straub (2003, 2005) results are based on a sample comprising 307 projects in the water and transport sectors, in five countries (Argentina, Brazil, Chile, Colombia and Mexico), across 12 years, for a total of 1287 observations (see Guasch, 2004). For each contract, there is information on the general characteristics of the projects (sector, year of award, duration), on the award process, the investment and financing conditions, the institutional and regulatory context and the type of price regulation in place (price cap versus rate of return), and other contract clauses (arbitration, income guarantees, take-over clauses, etc.). These are completed by macroeconomic data (growth rate, exchange rate evolution), dummies for national

and local elections and a full set of institutional indicators (corruption, quality of the bureaucracy, rule of law).

The initial estimations are based on a random effect probit, which is a linearized version of the equations giving the probabilities of firm-led and government-led renegotiations in the respective theoretical models:

$$y_{int} = I\,[y^*_{int} = x_i\alpha_1 + \alpha_2\, z_{int} + E_{nt}\alpha_3 + e_{int} < 0],$$

For concession i, in country n, at time t, y_{int} is the binary variable indicating whether there was a renegotiation by the firm (resp. by the government), x is a vector of time-invariant characteristics of the contract, z is the time elapsed since the award, and E is a vector of environmental characteristics, including economic shocks, elections and quality of institutions.

Alternatively, Guasch, Laffont and Straub (2003) present a competing risk duration model, which allows for both type of renegotiations hazard simultaneously. The specific model used follows Han and Hausman's (1990) semi-parametric competing risk model, with a non-parametric baseline hazard consisting of a set of dummy variables for each period. This model is estimated using a bivariate probit with the complete set of period dummies.

One major econometric issue is the fact that most contract clauses, such as the type of price regulation or specific guarantees included, must be considered to be endogenous. Indeed, we expect the contracting parties to choose them according to their observable and unobservable characteristics and those of the projects. For example, the type of tariff regulation chosen is likely to be affected by the potential efficiency of the concessionaire (more efficient firms would prefer price cap regulation, which is more risky but makes them residual claimant for their cost savings) and also by the fact that riskier projects would call for lower-powered (rate of return)

regulation. Similarly, most types of guarantees have in general been included to convince private agents to take on more risky concessions, as in the case of toll road programs for which demand proves very difficult to predict accurately. The challenge is thus to control for this ex ante self-selection effect in order to assess correctly the ex post specific incentive effect of the variables under study.

To tackle this, we implement in the two models mentioned above a two-stage instrumental variable procedure using as instrument a number of exogenous characteristics of the environment such as institutional quality, sectors of activity and the existence of a regulator. For the variables found to be endogenous according to the Rivers and Vuong (1988) test, we take the predicted values from the first stage estimations, insert them in the second stage model and adjust the standard errors with a bootstrapping procedure. Unsurprisingly, the variables for which exogeneity is rejected are price cap regulation, the investment and financing variables, and clauses such as minimum income guarantee and existence of an arbitration body.

The results arising from both models are strongly consistent. Table 5 presents the results on both types of renegotiations. It shows that contract characteristics, political and economic variables, and regulation all matter in explaining the frequency of renegotiations.

Table 5: Estimates of the determinants of renegotiations

	Firm-led Renegotiations	**Government-led Renegotiations**
Existence of regulatory body	-1.09*** (0.22)	-1.40*** (0.34)
Price cap	0.68* (0.38)	-0.46* (0.40)
Investment requirements	0.96** (0.40)	-0.70*** (0.24)
Private financing	0.35 (0.28)	-1.23*** (0.24)
Bureaucratic quality	-0.35** (0.15)	-0.57*** (0.16)
Elections -1	0.31 (0.20)	0.21 (0.19)
Growth -1	-0.06*** (0.02)	-0.05** (0.03)
Growth -2	-0.14*** (0.02)	-0.08**(0.03)
Transport dummy	0.53 (0.36)	-0.38 (0.36)
Log likelihood	-251.1	
Number of observations	1132	

Source: Guasch, Laffont and Straub (2003, 2005). Significance at the 1%, 5% and 10% level is noted by ***,**,* respectively.

3.3 Regulation and renegotiations

First, the existence of a regulator at the time the concession contract is signed appears to be crucial in avoiding failures during the early life of concession projects. This aspect has the strongest marginal effect of all variables found to be statistically significant. Comparing three specific contracts out of the initial sample-randomly selected as examples to illustrate the effects-, and using the probabilities predicted by the empirical model, Guasch, Laffont and Straub (2003) show that had a regulator been in place at the time of awarding the contract, the

respective probabilities of renegotiation in the last year of existence of the contract would have been reduced from 29.7%, 9.9% and 3.1%, to 5.3%, 0.3% and 0.2% respectively.

Depending on the type of renegotiation that is considered, at least two complementary lines of explanation are relevant here. On the one hand, regulators seem to allow for better contracts from the start, which reduces the necessity of posterior adjustments for unforeseen contingencies (this is particularly relevant for firm-led renegotiations). In the Latin American context, characterized by frequent, and difficult to predict, economic shocks and by the imperfect enforcement of contracts, drafting complete contracts is bound to fail. Moreover, long and complex contracts are often inefficient, because they lack transparency and lend themselves to contradictory interpretations and therefore opportunistic revision claims. As a consequence, most contracts are short concession-specific documents that rely on complementary rules contained in the relevant jurisprudence. This approach makes previous regulatory experience in dealing with the design of concessions contracts pivotal in limiting the occurrence of later renegotiations.

On the other hand, regulators are even more effective in weak governance environments and appear to constitute a barrier against opportunistic behavior by governments (Guasch, Laffont and Straub, 2005). This conclusion is supported by several significant interactions showing for example that the previous existence of a regulator has a stronger marginal effect in a context characterized by more corruption, or that a good quality bureaucracy is more effective in limiting the incidence of renegotiations after elections. Finally, Guasch, Laffont and Straub (2005) also show that the fact that the regulator does not belong to a ministry significantly reduces the probability of government-led renegotiation. In that regard, these firm-level results confirm some cross-country studies results that show the importance of experienced and

independent regulators in the telecommunication and electricity sectors (Wallsten, 2001; Cubbin and Stern, 2005).

Second, the choice of price regulation, between a price cap and a rate of return scheme, is of utmost importance. Beside well-known concerns with price cap regulation, in particular regarding the impact on quality and the implied risk transfer from consumers to the firm, Guasch, Laffont and Straub (2003, 2005) show that the main consequence of choosing a price cap regulatory scheme is the increased probability of renegotiation. Looking again at the marginal effect, they show for example that had the three sample contracts been under a rate of return scheme, the respective probabilities of firm-led renegotiation in the last year of existence of the contract would have been reduced from 29.7%, 9.9% and 3.1%, to 13.8%, 3.3% and 0.8% respectively.

Given that in the sample under study, above 70% of the concessions are regulated by price cap, this is clearly a major concern. Moreover, price cap schemes increase the riskiness of projects, which is reflected in an increase of the cost of capital and implies that firms end up facing higher interest. In contexts where institutions are weak, inexperienced and often unable to resist political pressures, the consequence is that most regulated firms (or the government and interest groups related to the firms) appropriate the gains when the conjuncture is favorable, but are able to transfer the losses to consumers during bad times.

As a consequence, there is a growing pragmatic tendency to advocate the abandonment of price cap regulation, a synonym for the higher risk of renegotiation and higher cost of capital, and the return to an hybrid type of regulation, including some elements of rate of return (see for example Estache, Guasch and Trujillo, 2003). Such a move would imply recognizing that the shift to a hybrid regulatory scheme is imposed de facto by ex post renegotiations, which carry

high associated social costs, because they tend to endogenize the regulatory review lags. In this situation, it could prove less costly to adapt regulatory rules from the start by adopting lower-powered price regulation schemes.

3.4 Summary

In summary, two related dimensions of regulation matter when it comes to avoiding disruptive renegotiations. The first one is the regulatory environment, including the very existence of a regulator from the start, but also its independence from potential political pressures. The second one is the type of price regulation itself. It should be noted that these two aspects can hardly be separated. Indeed, price cap regulation has often been the salient choice of governments lacking previous experience with regulation, because it appeared to be less informationally demanding. The absence of a regulator when initiating transfers of infrastructure to the private sector and the choice of price cap therefore often went in tandem. The results mentioned above show that a better strategic approach would be for governments to consider a sequence including first the development of a correctly endowed and reasonably independent regulatory agency, which would subsequently be in charge of the definition of the contract and the appropriate price regulation.

4. Testing the Impact of Regulation on its Effects on Productivity, Quality of Service, Coverage and Prices

4.1 Overview

This section uses the framework developed in Andres, Guasch, and Foster (2006). As we have already described, their analysis splits the data into three periods: "pre-privatization", transition, and post-privatization periods, where the transitional period commences after the concession announcement and lasts until one year after the concession award. The motivation for this segmentation is that some of the more important changes start simultaneously with the privatization announcement and lasts one year after the change in ownership. In addition, some of these indicators are driven by firm specific time trends and not privatization itself; therefore, the authors also control for this effect. Their main results are summarized as follows:

(i) After controlling for a positive firm-specific time trend, data for service coverage suggests that privatization has a upward impact on telecommunications, but no effect on electricity and water and sanitation;

(ii) Indicators for technical losses are positively affected by privatization. While most of the improvement for electricity happens during the transition period, those for telecommunications, water, and sanitation occur later on;

(iii) Prices also significantly increased for the sectors during and after the transition except in telecommunications as the average cost of installation of a residential line decreased in every period (the monthly charge for residential service, however, increased substantially); and,

(iv) Labor productivity significantly changed in all the three sectors, mainly during the transition period, and fundamentally caused an important reduction in labor redundancy: in the electricity and water and sanitation sectors, employment decreased on average 10 percent per year during the transition period.

(v) The outcomes' results are significantly heterogeneous across firms.

The current analysis is based on the last conclusion that shows the heterogeneity across firms. Our proposal attempts to better understand the determinants for this heterogeneity across utilities. The hypothesis is that some procedural and regulatory differences might explain some of these variances.

Here we focus on four basic regulatory characteristics: (1) budget autonomy; (2) the legal autonomy of the regulatory body; (3) tariff regulation (price cap, rate of return, among others); and (4) duration of the regulatory board. Additionally, we will control for some additional features such as the award process (direct selection vs. auction process), the award criterion (highest price; lower tariff or investment plan), and the nationality of the concessionaire. The premise is that these divergences may significantly affect the incentives involved in the managerial decision process, which, in turn, affects firm performance on efficiency, quality, and price.

4.2 Procedure

Ideally, to assess the impact of privatization, the performance of utilities under private operation should be evaluated against comparable publicly operated firms from similar

environments, assuming these firms are the contra-factual of the privatized ones. In most cases, it is hard to identify an analogous firm; hence, most of the literature compares the evolution of selected indicators before and after the change in ownership.

Most of the literature employs two different strategies to estimate the effect of the privatization. First, since Megginson, Nash, and van Randenborgh (1994), there have been several studies using means and medians of the periods before and after the event of privatization, as there has also testing on the significance of the change. Some research considers different samples of SOEs among countries and evaluates indicators. Another branch of literature assumes these policies to be treatments and follows the literature of program evaluation (see Heckman and Robb, 1985) by proposing a dummy for those periods where the SOE was privately owned, and checks its significance, as well as other interactions with characteristics specific to each paper (for example, Boardman and Vining, 1989; Ros, 1999).

In this section we propose to do a modification of Andres, Guasch, and Foster (2006) where we introduce interactions between the privatization dummies and the characteristics described previously. More specifically, we define a dummy for the transition and another for the after-transition period:

$$\ln\left(y_{ijt}\right) = \delta^{T} DUMMY\_TRAN_{ijt} + \delta^{P} DUMMY\_POST_{ijt} + \sum_{ij} \phi_{ij} D_{ij} + \upsilon_{ijt} \qquad (1)$$

where

$$DUMMY\_TRAN_{ijt} \begin{cases} 1 & \text{if } -2 \le s_{ijt} \le +1 \\ 0 & \text{otherwise} \end{cases}$$

and

$$DUMMY\_POST_{ijt} \begin{cases} 1 & \text{if } s_{ijt} \geq 2 \\ 0 & \text{otherwise} \end{cases}$$

where y_{ijt} are the variables of interest (outputs, inputs, labor productivity, efficiency, quality, coverage and prices). The main coefficients in this model are the dummies $DUMMY\_TRAN_{ijt}$ and $DUMMY\_POST_{ijt}$ that are equal to one, if the firm i of country j were in a transitional or port-transitional year at time t. Given the fact that there are several variables not observable to the econometrician, fixed effects are included to capture the characteristics of the firm, such as, management, initial conditions, size, density of the network, as well as other aspects, which we assume to be constant for each firm across time. This fixed effect is captured by D_{ij}. Additionally, s_{ijt} is a time trend that has a value equal to zero for the privatization award year. Thus, the first dummy identifies the average change in the dependent variable during the transition with respect to the average level previous to those years. The second dummy identifies the average change of the dependent variable after the transition with respect to the first period. Therefore, δ^T and δ^P capture the effect on the outcome of interest, during the transition and after that, given by the change in ownership.

A second version of the equation (1) will also be estimated here with the introduction of a firm-specific time trend:

$$\ln(y_{ijt}) = \delta^T DUMMY\_TRAN_{ijt} + \delta^P DUMMY\_POST_{ijt} + \sum_{ij} \phi_{ij} D_{ij} + \sum_{ij} \theta_{ij} t_{ij} + \upsilon_{ijt} \qquad (2)$$

Equation (2) will use the same dependent variables as well as the dummies used in the static model. However, the fourth coefficient captures the time trend of the variable of interest. Several factors may affect this, like the initial conditions. Hence, it is important to control for the firm's specific value.

To identify the different characterization effects of the privatization process as well as the regulation, we test the variables with the two main dummies. More precisely:

$$\ln(y_{ijt}) = \delta^T DUM\_TRAN_{ijt} * X_{ijt} + \delta^P DUM\_POST_{ijt} * X_{ijt} + \sum_{ij} \phi_{ij} D_{ij} + \upsilon_{ijt} \quad (3)$$

$$\ln(y_{ijt}) = \delta^T DUM\_TRAN_{ijt} * X_{ijt} + \delta^P DUM\_POST_{ijt} * X_{ijt} + \sum_{ij} \phi_{ij} D_{ij} + \sum_{ij} \theta_{ij} t_{ij} + \upsilon_{ijt} \quad (4)$$

Now δ^T, which was used as a scalar number in our previous specifications, becomes a vector with the coefficients for each characteristic of the vector X_{ijt} that is of the form $(1, x_{ijt}^1, ..., x_{ijt}^N)$ with N as the total number of characteristics evaluated. The first coefficient of the vector δ^T will became the average effect of change in ownership during the transitional period on a given indicator for a firm without the characteristics evaluated in the other elements of the vector X_{ijt}. Equivalently, the vector δ^P contains the coefficients for the different characteristics of vector X_{ijt}, but for the post-transitional years.

Since we are using a semi-logarithmic functional form of these models for each of the indicators, when interpreting the coefficient estimates of the dummy, it should be remembered that the percentage impact in each indicator is given by $e^{\delta} - 1$.

Correcting for potential nonspherical errors requires a more adequate approach, such as, the Generalized Least Square (GLS); however, this estimation requires the knowledge of the unconditional variance matrix of υ_{ijt}, Ω, up to scale. Hence, we must be able to write $\Omega = \sigma^2 C$, where C is a known GxG positive definite matrix. As this matrix is unknown, we will follow a Feasible GLS (FGLS) approach that replaces the unidentified matrix Ω with a consistent estimator. Hence, our models specify heteroskedastic error structure with no cross-sectional correlation.

4.3 Data

For our research we use an official data set provided by public and private sectors, as well as a novel one built by the World Bank. First, by using the official data reported by the firms to their investors and statistical reports of the regulator agencies of each country, we build an unbalanced panel data set of key indicators on outputs, inputs, labor productivity, efficiency, quality, coverage, and prices. Furthermore, we requested information from each of the companies and international organizations like the ITU (International Telecommunication Union), the OLADE (Latin American Organization of Energy), as well as information provided by each regulatory office. We make a particular effort in corroborating the company data with several public sources and with data from the firms provided by different governmental offices. We are also particularly cautious about the consistency and comparability of the data across time and countries (see Andres, Guasch, and Foster, 2006).

Secondly, the novel dataset built by the World Bank describes the characteristics of nearly 1,000 infrastructure projects awarded in Latin American and Caribbean countries from 1989 to 2002, in the sectors of telecommunications, energy, transportation and water. (see Guasch, 2003).

The analysis focuses on several indicators of outcomes, inputs, labor productivity, efficiency, quality, coverage and prices. Some of these variables are used by other authors with other samples, such as, Ros (1999), who employs equivalent indicators for *coverage*, *labor productivity*, *quality* and *prices* for the telecommunications sector. Ramamurti (1996) uses analogous indicators in *output*, *coverage,* and *labor productivity* for the four Latin American telecommunications firms of his study. Saal and Parker

(2001) use similar indicators for *output*, *employment*, *quality,* and *prices* for water and sewerage companies in England and Wales.

Table 6 shows the summary statistics of these variables in each sector.

Table 6: Summary statistics

Variable	N	Mean	Median	SD	Min	Max
Electricity Distribution						
Number of subscribers	98	497,776	225,230	681,698	2,700	3,884,579
Output [thousand of KWHs]	100	2,850	789.5	5,282	13.8	34,300
Number of employees	87	1,421	625	2,115	18	13,642
Subscribers per employee	84	558.81	506.67	244.20	210.45	1,523.27
Output per employee	84	2,343.48	2,116.46	1,298.60	663.86	7,323.09
Distributional losses	90	15.3%	13.6%	6.6%	2.0%	33.9%
Duration of interruptions per subscriber	65	25.26	20.36	21.01	1.75	100.00
Frequency of interruptions per subscriber	67	22.63	16.03	21.24	1.07	100.00
Subscribers per 100 HHs	86	74.6%	81.3%	20.7%	7.0%	100.0%
Avg price per KWH [in u$s]	92	88.70	85.34	35.43	7.47	323.61
Fixed Telecommunications						
Number of subscribers	16	2,423,040	824,594	3,150,005	28,048	9,642,200
Output (million of minutes)	13	20,500	6,200	28,800	774	83,100
Number of employees	16	12,268	9,732	12,097	966	47,949
Subscribers per employee	16	209.30	109.27	241.96	33.81	736.65
Output per employee	13	1,627.35	844.29	1,790.44	257.10	6,419.45
P% of digital lines	16	67.0%	70.3%	26.4%	14.6%	100.0%
% of completed calls	12	67.0%	64.8%	20.4%	20.0%	98.8%
Subscribers per 100 inhabitants	16	9.84	8.40	5.83	2.96	22.01
Price of 3-minute call [in u$s]	14	0.13	0.07	0.25	0.01	0.99
Monthly charge for a resid. Sv. [in u$s]	15	6.16	6.01	4.52	0.36	19.97
Price for the installation of a line [in u$s]	15	343.75	309.51	339.35	1.20	1,102.26
Water and Sewerage						
Total Subscribers for water	48	147,119	78,864	223,803	1,894	1,282,074
Total Subscribers for sewerage	43	107,286	42,991	173,795	435	799,994
Water Production	47	91,400	28,900	2,110	145.6	13,700,000
Number of employees	42	528	258	997	9	6,346
Water subscribers per employee	42	312.23	283.10	153.56	43.34	772.36
Water production per employee	33	39.1%	37.3%	12.7%	15.3%	62.8%
Continuity [hours per day]	21	19.40	22.97	6.57	-	24.00
Potability [%]	29	88.5%	98.9%	26.1%	0.0%	100.0%
Water subscribers per 100 HHs	44	74.83	88.29	34.30	0.01	100.00
Sewerage subscribers per 100 HHs	34	64.61	71.99	27.83	0.30	97.70
Avg price for water [u$s/m3]	27	0.48	0.44	0.16	0.17	0.84
Avg price for sewerage [u$s/m3]	12	0.40	0.39	0.22	0.07	0.97

Note: each observation is the average for the available information since 5 years before the change in ownership and 5 years after that.

The countries analyzed include: Argentina, Bolivia, Brazil, Chile, Colombia, El Salvador, Guatemala, Guyana, Jamaica, Mexico, Nicaragua, Panama, Peru, Trinidad and Tobago, and Venezuela. The sample consists of unbalanced panel data that includes 181 firms and 1,885 firm-year observations. Each of the sample firms contain at least one year of pre-privatization data, while 150 of the 181 firms have information for at least the previous 3 years.

We matched our previous data set with a novel dataset built by the World Bank that describes the characteristics of nearly 1,000 infrastructure projects awarded in Latin American and Caribbean countries from 1989 to 2002, in the sectors of telecommunications, energy, transportation and water. (See Guasch, 2004). This dataset contains information with respect to the privatization process we know how many bidders participated, the contract process[5], the award criterion[6], and the type of concession[7]. With respect to the regulatory framework, we know how the establishment of the legal framework[8], the regulation of tariffs[9], if there were a possibility of contractual renegotiation, and (if this was the case) who would initiate it[10].

The data also contains additional contractual clauses, such as, if it considered a termination clause, about the arbitration process, claim solving institution, obligation to provide universal service, duration of the contract, contract renewal, government's guaranties, if the government granted subsidies, frequency of the tariff review, and how the exchange and commercial risk were born. If the contract was renegotiated, we know when it was, the reason given for it, and its outcome.

Some characteristics of the regulator include: an index of its autonomy, its budget source, the duration of the regulatory board member mandate, as well as the year of the regulatory board's inceptions.

Among these variables we selected those with enough variation across firms that allow us to better identify the effect of the differences in each outcome. Hence, the following Table indicates the variables that we were able to use in this analysis, while Table 8 shows the summary statistics of the characteristics across the sectors.

Table 7: Description of the characteristics used in the analysis

Variable	Description
Regulatory Board	
AUTON_YES	Dummy with value 1 if the Regulatory Board was fully autonomous.
AUTON_PART	Dummy with value 1 if the Regulatory Board was partially autonomous.
DURATION	Dummy with value 1 if the duration of the Regulatory Board was 5 or more years (CHECK)
Tariff Regulation	
TARIFF_RR	Dummy with value 1 if the tariffs were regulated according to the Rate of Return
TARIFF_PC	Dummy with value 1 if the tariffs were regulated according to Price Cap.

Table 8: Summary statistics of the characteristics used in the analysis

	Fixed Telecommunic.		Electricity Distribution		Water and Sanitation	
Variable	# firms	Mean	# firms	Mean	# firms	Mean
Regulatory Board						
AUTON_YES	11	36.4%	84	39.3%	33	0.0%
AUTON_PART	11	9.1%	84	38.1%	33	27.3%
DURATION	4	75.0%	56	41.1%	9	100.0%
Tariff Regulation						
TARIFF_RR	8	25.0%	106	20.8%	38	23.7%
TARIFF_PC	8	62.5%	106	91.5%	38	89.5%

4.4 Main Results

Tables 9 through 11 present the results. There are four different specifications for each indicator. As may be intuitive, there are some indicators that follows a firm-specific time trend. This is the case of the output, labor productivity, and coverage indicators; therefore, for these variables we include firm-specific time trends. For these cases, we include this trend in order to provide a better intuition on the impact of change in ownership for these variables. The table clarifies when this trends were included.

The results in this chapter suggest that most of these characteristics significantly affect the outcomes on each of the indicators; however, while some characteristics have positive effects on certain indicators, the same characteristics have negative outcomes in other instances. The set of available choices is important to consider and analyze to focus on specific targets. If the target is the expansion of the network, the strategy will focus on certain characteristics; however, if the target is an efficiency increase, other sets of characteristics may be analyzed. We have also found that in these same cases, not all the sectors react evenly to an identical set of characteristics.

This section describes the more robust results across the different specifications.

Table 9: Regression analysis – output, number of employees and labor productivity

	(ln) connections				(ln) flow units				(ln) number of employees				(ln) connection per employee			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
dum_priv_tr	0.024**	0.014***	0.024	0.020*	0.180***	0.078***	0.216***	0.099***	0.394***	0.067**	0.450***	0.162**	-0.243**	-0.047	-0.194*	0.141**
	(0.011)	(0.005)	(0.015)	(0.012)	(0.039)	(0.017)	(0.054)	(0.036)	(0.105)	(0.034)	(0.113)	(0.074)	(0.101)	(0.041)	(0.112)	(0.066)
dum_priv_post	0.040***	0.014***	0.029	0.004	-0.060	0.019	-0.040	0.003	-0.046	-0.178***	-0.148	-0.070*	-0.019	0.131***	0.069	0.018
	(0.015)	(0.005)	(0.018)	(0.008)	(0.053)	(0.017)	(0.061)	(0.032)	(0.090)	(0.031)	(0.097)	(0.039)	(0.099)	(0.040)	(0.112)	(0.040)
tr_bid	-0.070***	-0.060***			-0.012	-0.016			-0.222***	-0.196***			-0.081	-0.025		
	(0.023)	(0.012)			(0.038)	(0.026)			(0.073)	(0.056)			(0.080)	(0.053)		
pt_bid	0.006	-0.009			0.010	-0.010			-0.182***	-0.095**			0.117	-0.064		
	(0.022)	(0.007)			(0.037)	(0.022)			(0.067)	(0.044)			(0.080)	(0.047)		
tr_auton_part	-0.039	-0.031***	-0.072***	-0.035***	-0.076**	-0.070***	-0.086***	-0.061***	-0.449***	-0.100**	-0.651***	-0.137***	0.066	0.194***	-0.018	0.041
	(0.027)	(0.010)	(0.020)	(0.012)	(0.038)	(0.023)	(0.032)	(0.023)	(0.132)	(0.050)	(0.119)	(0.053)	(0.225)	(0.054)	(0.219)	(0.061)
pt_auton_part	-0.013	-0.001	0.001	-0.005	-0.029	-0.001	-0.036	0.000	0.154*	0.085**	0.034	0.063	-0.301***	-0.162***	-0.284**	-0.072*
	(0.022)	(0.007)	(0.013)	(0.008)	(0.033)	(0.018)	(0.029)	(0.019)	(0.085)	(0.038)	(0.068)	(0.039)	(0.111)	(0.042)	(0.111)	(0.041)
tr_auton_yes	0.035	0.030**	-0.010	0.009	-0.090**	-0.004	-0.087	-0.054**	-0.596***	-0.315***	-0.769***	-0.532***	0.345***	0.082*	0.471***	0.202***
	(0.024)	(0.012)	(0.015)	(0.011)	(0.040)	(0.021)	(0.055)	(0.027)	(0.110)	(0.055)	(0.148)	(0.083)	(0.109)	(0.045)	(0.151)	(0.071)
pt_auton_yes	-0.030	0.010	-0.010	0.005	0.013	-0.045**	-0.038	-0.046*	-0.041	-0.058	-0.104	0.097	-0.167	-0.050	-0.127	-0.320***
	(0.026)	(0.008)	(0.019)	(0.009)	(0.056)	(0.019)	(0.062)	(0.027)	(0.094)	(0.044)	(0.129)	(0.073)	(0.107)	(0.040)	(0.129)	(0.065)
tr_rb_dur	-0.009		-0.004		-0.102***		-0.123**		-0.365***		-0.295***		0.236**		0.268***	
	(0.010)		(0.011)		(0.035)		(0.049)		(0.098)		(0.106)		(0.093)		(0.101)	
pt_rb_dur	-0.028**		-0.021		0.071		0.039		-0.150*		-0.143		0.109		0.155	
	(0.014)		(0.016)		(0.050)		(0.058)		(0.083)		(0.091)		(0.091)		(0.096)	
tr_nation_f	0.012	0.017**	-0.018*	-0.010	-0.046*	-0.045**	-0.029	-0.115***	0.005	-0.122**	-0.317***	-0.375***	-0.011	0.036	0.038	-0.005
	(0.008)	(0.007)	(0.010)	(0.008)	(0.026)	(0.019)	(0.051)	(0.033)	(0.066)	(0.053)	(0.108)	(0.086)	(0.053)	(0.044)	(0.116)	(0.067)
pt_nation_f	-0.006	-0.007	0.003	-0.003	-0.041*	-0.026	-0.054	-0.016	-0.004	0.047	-0.071	-0.061	0.072	-0.026	0.017	-0.079*
	(0.008)	(0.006)	(0.011)	(0.008)	(0.025)	(0.016)	(0.037)	(0.033)	(0.057)	(0.041)	(0.091)	(0.055)	(0.054)	(0.037)	(0.095)	(0.046)
tr_nation_b			-0.016	-0.022**			-0.015	-0.038			-0.151*	-0.139**			-0.111	-0.209***
			(0.011)	(0.010)			(0.043)	(0.033)			(0.082)	(0.071)			(0.083)	(0.063)
pt_nation_b			0.004	0.008			0.019	0.018			0.040	-0.147***			-0.099	0.040
			(0.011)	(0.008)			(0.038)	(0.031)			(0.071)	(0.042)			(0.079)	(0.044)
tr_award_prc			-0.011	-0.026**			-0.034	0.044			-0.023	0.002			-0.176	-0.176**
			(0.017)	(0.012)			(0.056)	(0.032)			(0.121)	(0.084)			(0.133)	(0.075)
pt_award_prc			-0.010	-0.000			0.038	-0.010			-0.064	-0.294***			0.047	0.305***
			(0.013)	(0.008)			(0.038)	(0.025)			(0.110)	(0.072)			(0.111)	(0.060)
tr_tar_rret	0.061***	0.055***	0.034*	0.024**	0.045	0.036	0.028	0.028	-0.920***	-0.027	-0.923***	-0.051				
	(0.024)	(0.014)	(0.018)	(0.011)	(0.081)	(0.026)	(0.078)	(0.032)	(0.131)	(0.061)	(0.131)	(0.066)				
pt_tar_rret	0.014	0.020**	0.024	0.019*	0.027	0.018	0.018	0.006	0.309**	-0.028	0.354***	-0.087*				
	(0.023)	(0.010)	(0.017)	(0.010)	(0.088)	(0.022)	(0.084)	(0.026)	(0.122)	(0.051)	(0.124)	(0.046)				
Constant	11.448***	10.119***	12.652***	10.080***	12.592***	19.851***	13.552***	16.211***	7.040***	6.618***	7.342***	6.220***	6.987***	5.329***	4.686***	4.558***
	(0.029)	(0.014)	(0.022)	(0.013)	(0.088)	(0.039)	(0.058)	(0.026)	(0.257)	(0.239)	(0.111)	(0.130)	(0.152)	(0.100)	(0.232)	(0.083)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Specif trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes
Observations	450	715	428	693	430	639	408	617	357	586	335	564	350	610	328	588
Log-likelihood	1136.9	1675.0	1079.9	1606.5	644.5	997.9	586.8	948.2	127.2	156.4	131.7	185.1	365.7	542.7	328.5	528.6
Number of firms	45	74	43	72	44	68	42	66	37	63	35	61	37	66	35	64

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

1.1.1 Number of connections

Table 9 indicates that those concessions with partially autonomous regulatory board, we observe that those with partial autonomy report a reduction of between 3.1% and 7.2% below the firm-specific time trend. Later changes are not significantly different from the transitions, nor are they unusual as compared to those with total autonomy.

The duration of the regulatory boards seem to have no significant effect on number of connections.

The two main award criteria include the highest price as well as the best investment plan. Reductions between 1.1% and 2.6% are observed during the transition, which are below the firm specific time trend when the concession awards are according to the highest bidder. Any following changes result in no significant difference during the transitional period.

In identifying the effects of tariff regulations on network expansion, we analyze the effects of rate of return and price cap regulation on the number of connections. We found that those firms regulated by rate of return increased the number of connections between 2.4% and 6.1% above the firm specific time trends during the transition. We observe additional increases after the transition. No significant results are evidenced in the reduction on regulation levels in regulations through price caps.

We split the sample by sectors to identify particular effects different from those described above[11]. We found that autonomy had positive effects on telecommunications.

1.1.2 Output

During the transitionary period, partial autonomy reduces the output flow of measures between 6.1% and 8.6%, which are below the firm-specific time trend. Any following changes are not significantly different from the transition. Total autonomy results in negative outcomes, however, the size of the effects are smaller than the partial autonomy coefficients.

Also during the transition, the duration of the Regulatory Board, firms regulated by board with longer duration resulted with a reduction between 10.2% and 12.3%, which is below the firm specific time trend. All of the following changes are not significantly different from the transition period because…

When exploring the sectorial specifications, we observe that in the case of electricity, the total autonomy had higher decreases than partial autonomy; whereas, for water distribution, firms under price cap regulation experience level decrease.

1.1.3 Number of employees

We observe that during transitional periods partial autonomy of the regulatory board results in a reduction between 10% and 48% below the pre-transition levels. Increases in the number of employees subsequent to that are not always significant. Total autonomy experiences higher drops than in partial autonomy. These changes total between 27% and 54%, while following ones did not result in significantly different levels than those present during the transition.

Higher durations of the Regulatory Board show significant positive changes in transitional levels, but as more controls are added, the coefficients become highly negative.

Firms regulating tariffs by using a rate of return system, present higher reductions in the number of employees than those regulating under price cap tariffs. For periods when under a price cap system, we observe some reductions during the transition period; however, after controlling for other factors, these changes did not result in any significance.

1.1.4 Labor productivity

Most differences in characteristics seem not to particularly affect the indicators related to labor productivity. Among those with similar differences is the autonomy of the board. Those firms with a regulator exercising partial autonomy reported some mixed effects the transitional phase. Total autonomy shows significant changes during the transition which measured between 9% and 60% above the firm-specific time trend. After transitioning, partial autonomy presents significant reductions in labor productivity after the time trend correction. In addition, evidence of deceleration in the improvements of labor productivity is also present.

Table 10: Regression analysis – labor productivity, distributional losses, quality and coverage

	(ln) flow units per employee				(ln) distributional losses				(ln) quality index				(ln) coverage			
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
dum_priv_tr	-0.024	-0.000	0.009	0.054	-0.234***	-0.069**	-0.218**	-0.080	-1.078***	-0.018	0.266	-0.159**	0.037**	0.019	0.015	0.033***
	(0.133)	(0.052)	(0.143)	(0.083)	(0.055)	(0.032)	(0.087)	(0.052)	(0.214)	(0.019)	(2,469.903	(0.065)	(0.016)	(0.013)	(0.020)	(0.012)
dum_priv_post	0.056	0.157***	0.159	-0.018	0.488***	-0.071**	0.488***	0.080***	0.004	0.017	0.213**	0.069*	0.031*	0.008	0.029	0.001
	(0.118)	(0.052)	(0.132)	(0.040)	(0.088)	(0.029)	(0.090)	(0.015)	(0.041)	(0.016)	(0.089)	(0.036)	(0.018)	(0.012)	(0.021)	(0.008)
tr_bid	0.007	-0.044			-0.016	-0.076			0.040	0.231***			-0.028	-0.031**		
	(0.098)	(0.064)			(0.113)	(0.050)			(0.123)	(0.073)			(0.018)	(0.014)		
pt_bid	0.112	-0.140**			-0.367***	-0.102**			0.664***	0.206***			0.010	0.002		
	(0.097)	(0.058)			(0.116)	(0.040)			(0.114)	(0.040)			(0.018)	(0.012)		
tr_auton_part	-0.106	0.176***	-0.141	-0.027	0.015	0.059	-0.058	0.010		-0.275**	-0.500	-0.197**	-0.017	-0.012	-0.022*	-0.023**
	(0.198)	(0.057)	(0.191)	(0.070)	(0.108)	(0.049)	(0.054)	(0.040)		(0.110)	(2,469.903	(0.098)	(0.016)	(0.010)	(0.013)	(0.011)
pt_auton_part	-0.500***	-0.197***	-0.542***	-0.162***	0.295**	-0.142***	0.053	-0.106***	-0.704***	-0.155***	-0.249**	-0.077*	0.008	0.000	0.010	-0.005
	(0.123)	(0.048)	(0.135)	(0.052)	(0.115)	(0.038)	(0.060)	(0.036)	(0.113)	(0.053)	(0.114)	(0.045)	(0.016)	(0.009)	(0.013)	(0.009)
tr_auton_yes	0.194	0.142***	0.381**	0.433***	0.256**	0.152***	0.160***	0.084*	1.087***	-0.014	0.063	-1.358***	-0.027*	-0.008	-0.036***	-0.028***
	(0.140)	(0.049)	(0.191)	(0.095)	(0.106)	(0.042)	(0.056)	(0.044)	(0.246)	(0.068)	(2,469.903	(0.228)	(0.014)	(0.006)	(0.008)	(0.007)
pt_auton_yes	-0.253**	-0.103**	-0.145	-0.210***	-0.250*	-0.042	-0.470***	-0.253***	-0.583***	-0.081**	-0.150	0.007	-0.019	0.013**	-0.002	-0.003
	(0.124)	(0.042)	(0.151)	(0.073)	(0.135)	(0.032)	(0.104)	(0.048)	(0.113)	(0.033)	(0.115)	(0.095)	(0.017)	(0.006)	(0.017)	(0.008)
tr_rb_dur	0.074		0.068		0.145***		0.110*		1.060***		-0.469		-0.026**		-0.009	
	(0.122)		(0.133)		(0.043)		(0.057)		(0.213)		(2,469.903)		(0.011)		(0.011)	
pt_rb_dur	0.055		0.124		-0.567***		-0.483***		0.013		-0.000		-0.028**		-0.020	
	(0.106)		(0.114)		(0.082)		(0.083)		(0.038)		(0.063)		(0.013)		(0.015)	
tr_nation_f	-0.155**	-0.003	0.007	0.133	-0.063	0.018	-0.032	-0.007	-0.086	-0.265***	-0.063	0.014	0.009	0.006	-0.034***	-0.035***
	(0.068)	(0.049)	(0.143)	(0.095)	(0.042)	(0.032)	(0.066)	(0.047)	(0.071)	(0.067)	(0.068)	(0.063)	(0.009)	(0.007)	(0.012)	(0.008)
pt_nation_f	-0.037	0.019	-0.065	0.025	0.049	-0.036	-0.127**	-0.328***	-0.030	-0.102***	-0.021	0.028	-0.000	-0.002	0.020*	-0.004
	(0.066)	(0.041)	(0.113)	(0.053)	(0.042)	(0.031)	(0.062)	(0.028)	(0.041)	(0.028)	(0.042)	(0.033)	(0.009)	(0.006)	(0.012)	(0.008)
tr_nation_b			-0.022	-0.074			-0.021	-0.043							-0.022*	-0.036***
			(0.102)	(0.078)			(0.069)	(0.048)							(0.012)	(0.011)
pt_nation_b			-0.092	0.088*			-0.165***	-0.234***							0.011	0.008
			(0.098)	(0.045)			(0.062)	(0.024)							(0.012)	(0.009)
tr_award_prc			-0.185	-0.318***			0.062	0.008			0.258**	0.266***			0.023	-0.001
			(0.163)	(0.090)			(0.087)	(0.048)			(0.116)	(0.054)			(0.018)	(0.011)
pt_award_prc			-0.073	0.088			-0.034	0.139***			0.022	0.132***			-0.018	0.017**
			(0.133)	(0.070)			(0.090)	(0.044)			(0.071)	(0.033)			(0.017)	(0.008)
tr_tar_rret											-0.293**	1.559***				
											(0.121)	(0.234)				
pt_tar_rret											0.014	-0.034				
											(0.081)	(0.092)				
Constant	8.531***	4.256***	8.520***	13.130***	-1.957***	-2.027***	-1.821***	-2.782***	-1.251***	-0.819***	0.047	-0.918***	1.374***	-0.008	4.140***	1.385***
	(0.179)	(0.104)	(0.190)	(0.126)	(0.375)	(0.400)	(0.134)	(0.200)	(0.214)	(0.239)	(2,469.903	(0.233)	(0.036)	(0.018)	(0.032)	(0.036)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Specif trend	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Observations	335	552	313	530	353	604	331	582	219	346	219	346	444	688	422	666
Log-likelihood	297.1	464.3	267.4	447.5	241.5	331.2	232.9	358.6	200.6	204.0	114.5	208.4	1172.0	1695.0	1131.5	1634.2
Number of firms	36	62	34	60	39	68	37	66	26	43	26	43	50	77	48	75

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

The duration of the regulatory board is another characteristic that seems to affect the labor productivity. Longer lasting board concessions resulted in significant improvements above the trend of between 27% and 31% in their connection-per-employee ratio during the transition; however, no significant changes are later observed with respect to the transition itself. These results are the consequence of the higher reduction in the number of employees for firms regulated by a regulatory board holding higher tenure.

Finally, when tariffs are regulated using a price cap system, we find evidence on the reduction of levels during the transition; however, when regulated with return rates of return structure system, we found a significant increase on productivity above the time trend.

1.1.5 Distributional losses

There is an absence of significant transitional effects on regulatory boards consisting of partial autonomy. Results are a bit mixed but in general find a reduction in losses. On the contrary, when the board possesses total autonomy, we find significant increases in losses during the transitional period ranging between 8% and 22%, followed by important reductions on losses. The total effects result in higher reductions than those cases with partial autonomy.

The results suggest that there are increases in losses during the transition, when the regulatory board had longer duration, which were then followed by important reductions of around 27% with respect to the level before the transition.

We further explore the differential effects across sectors and find that for electrical companies with fares regulated by a rate of return reduced their losses by 4% during the transition and an additional 33% after that.

1.1.6 Quality

We also observe how different characteristics affected the changes in quality. Total autonomy has mixed results effects increasing quality during the transition and after that, we learn that partial autonomy has negative effects in quality during the transition period between 15% and 24%. An additional reduction in these indicators is observed after the transition.

Some evidences of quality improvement are present when the board has a longer duration; however, the results are mixed. When tariffs are regulated according to a rate of return method, firms have significantly improved on quality during the transition; however, those under a price cap system have reductions in quality during the transition. However, changes after that resulted no significant different than during the transition.

1.1.7 Coverage

With respect to the autonomy of the regulatory board, we observe the partial autonomy reported a reduction of 2% below the firm specific time trend present during the transition. However, any other changes are not significantly different to the transition as well as those with total autonomy.

Longer duration of the regulatory boards seems to have negative effects on increase coverage, after controlling for trends.

Table 11: Regression analysis – prices

	(ln) average prices in dollars				(ln) average prices in real currency			
	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
dum_priv_tr	0.213***	0.140***	0.389**	0.565***	0.165***	0.111***	0.300***	0.250***
	(0.035)	(0.021)	(0.152)	(0.098)	(0.029)	(0.019)	(0.083)	(0.048)
dum_priv_post	-0.189***	0.104***	-0.235***	-0.111*	0.198***	0.130***	0.259***	0.169***
	(0.032)	(0.019)	(0.056)	(0.059)	(0.025)	(0.017)	(0.036)	(0.033)
tr_bid	1.086***	0.191***			0.511***	0.144***		
	(0.046)	(0.065)			(0.086)	(0.055)		
pt_bid	-0.340***	-0.060**			-0.210***	-0.120***		
	(0.038)	(0.029)			(0.038)	(0.026)		
tr_auton_part	-0.601***	-0.738***	-0.224	-0.723***		-0.456***	2.009***	-0.338***
	(0.066)	(0.079)	(0.195)	(0.081)		(0.069)	(0.129)	(0.063)
pt_auton_part	0.316***	-0.108***	0.239***	-0.023	0.266***	-0.108***	0.183**	-0.223***
	(0.072)	(0.039)	(0.070)	(0.046)	(0.083)	(0.037)	(0.079)	(0.043)
tr_auton_yes	-1.142***	-0.301***	-0.137	-0.153**	-0.382***	-0.079	0.193***	-0.010
	(0.049)	(0.072)	(0.090)	(0.063)	(0.081)	(0.056)	(0.053)	(0.038)
pt_auton_yes	0.243***	-0.161***	-0.090**	-0.253***	0.133***	0.098***	0.019	0.063**
	(0.036)	(0.030)	(0.041)	(0.037)	(0.043)	(0.025)	(0.031)	(0.029)
tr_rb_dur	-0.083**		0.019		-0.096***		-0.182***	
	(0.034)		(0.105)		(0.028)		(0.066)	
pt_rb_dur	0.306***		0.126***		-0.112***		-0.175***	
	(0.029)		(0.027)		(0.022)		(0.023)	
tr_nation_f	-0.007	0.073**	-0.112	-0.182*	-0.108***	-0.059**	-0.020	-0.189***
	(0.035)	(0.036)	(0.117)	(0.093)	(0.026)	(0.025)	(0.052)	(0.038)
pt_nation_f	0.227***	0.024	0.156**	0.085	0.070***	0.046**	0.070**	0.021
	(0.030)	(0.027)	(0.064)	(0.061)	(0.025)	(0.021)	(0.031)	(0.030)
tr_nation_b			-0.255**	-0.403***				
			(0.109)	(0.096)				
pt_nation_b			0.176***	0.197***				
			(0.058)	(0.057)				
tr_award_prc			-0.060	-0.184**			-0.052	-0.157***
			(0.198)	(0.078)			(0.043)	(0.043)
pt_award_prc			0.034	0.094**			-0.010	-0.076***
			(0.047)	(0.038)			(0.027)	(0.029)
tr_tar_rret							-0.188*	0.061
							(0.113)	(0.052)
pt_tar_rret							-0.126***	-0.060*
							(0.040)	(0.033)
Constant	3.839***	-1.227***	4.435***	-1.183***	4.193***	6.614***	4.593***	6.715***
	(0.027)	(0.093)	(0.095)	(0.088)	(0.033)	(0.085)	(0.056)	(0.082)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Specif trend	No	No	No	No	No	No	No	No
Observations	372	550	350	528	370	548	348	526
Log-likelihood	316.7	281.2	288.7	280.6	381.3	400.5	373.5	388.7
Number of firms	44	65	42	63	44	65	42	63

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

1.1.8 Average prices

Table 11 indicates that concessions regulated by a board with partial autonomy, in general, show higher reductions on average prices than firms regulated with a total autonomous agency.

Agencies with longer board duration seem to have higher reductions in average prices during the transition, although after the period, prices in dollars increase significantly while those in real terms decreased.

Finally, we establish that when tariff regulations are adjusted by rate of return mechanisms, average prices show some reductions.

4.5 Conclusions and policy recommendations

After this short overview of infrastructure reforms in Latin America during the 1990s, two main results emerge. First, privatization generated important improvements, but they were neither extended beyond the transition period around the privatization event nor always transferred to consumers. Second, significant heterogeneity within and among sectors may be explained by intrinsic characteristics of the reform process, such as the privatization mechanism, the level of regulatory development, and the concession design.

The following are the remarks to the previous analysis:

(i) Generally autonomous regulatory bodies seem to be correlated with the higher reductions in the number of employees, while older (longer duration) institutions produce lower price increases;

(ii) When pricing is regulated according to the rate of return, companies have higher network expansion than in the case of price-capping regulation. Consistently, those firms under price-cap have higher reductions of their labor force, but lower increases in labor productivity. Additionally, the latter firms present less improvement in both distributional losses and quality, while also showing higher price increases than those under the rate-of-return regulation; and,

These results suggest one main policy implication: change in ownerships has significant effects in term of improving efficiency and quality. However, how regulatory quality is an important determinants in these outcomes.

Additionally, for the existing private utilities, there is a need to complete the reforms, particularly the so-called "second generation regulatory reforms." Without these reforms – that include the completion of the regulatory framework, avoiding excessive contract renegotiations, and increasing competition when feasible – post-privatization improvements are limited and probably unsustainable, whereas, private financing will be difficult to attract. Obviously, the importance of competition, regulation, and contract design is closely related to technological characteristics within an industry. For example, the reduction in the telecommunications costs and substitution by means other than fixed telephony, which increases the role of competition, with regulation as a tool to avoid

abuse of dominance and is relatively less relevant for contract design. In water and sanitation, remaining natural monopolies make the move towards market competition a more difficult task. This implies relying more on well-designed concession contracts with regulation as a tool to guarantee the appropriate contract management. In either case, regulation is a key instrument, especially if one needs to reduce regulatory risks and attract private investments to support the Latin American needs in infrastructure.

5. Final Remarks

We have tested the impact of regulation of private infrastructure operators on sector performance, from three separate angles. We have found that

- Quality of regulation is found to be a significant determinant of the divergence between the overall profitability of the concession and its corresponding hurdle rate, explaining around 20% of the variation. However, regulatory efforts seem to be more closely associated with keeping tariffs as low as possible for current consumers, than keeping profitability well aligned with hurdle rates of return.
- Price caps led a significant increase of the probability of renegotiation
- Existence of regulator at signing of contract reduces renegotiations
    - The regulators filter and dissuade opportunistic private operator led renegotiation.
    - In the case of Government-led renegotiation, the regulator acts as barrier against political opportunism.
    - Impact of regulator is stronger in weak governance environments

- Differences in the private sector participation in infrastructure outcomes are explained to some extent by differences in the design and quality of the regulatory design.
- Overall Main Message: Regulation matters.

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Notes

[1] In Brazil, for example, dissatisfaction with privatization has increased from 40 to 60 percent of the population during 1998-2004 while in smaller countries, such as Guatemala and Panama, this index reaches more than 80 percent of the population. Even in Chile, commonly seen as the champion of structural reforms, dissatisfaction is predominant (see Latinobarómetro surveys for 1998 and 2004). Indeed, public authorities and multilateral institutions, such as the IMF and the World Bank, once sponsors of privatization, are now discussing ways of increasing public investments in infrastructure without jeopardizing sound fiscal management. The policy-making pendulum is, then, back to public investments as either if infrastructure reforms and privatization had never been implemented or, even worse, if reforms were fully completed, all lessons had been taken, and adjustments had been made.

[2] Guasch (2004) shows that the incidence of renegotiation is about 42% of all concessions and about 55% and 75% for concessions in the transport and water sectors. And the incidence is even much higher for concessions regulated under a price-cap regime. Even more striking is how fast those renegotiations take place. The time interval between the granting of the concessions and renegotiation is about 2.1 years, and for water concessions is even quicker, about 1.6 years.

[3] Simple differential 1 excludes terminal value, Simple differential 2 includes terminal value, Simple differential 3 includes terminal value and adjustment for management fee, Simple Differential 4 includes terminal value and adjustments for management fee and transfer pricing.

[4] One weakness of regulatory commissions, perhaps captured here in these estimates, is the higher political intervention, since often each relevant political party gets to designate its own commissioner.

[5] Bid, Direct adjudication, invitation, petition or request.

[6] Highest cannon, highest price, tariff, lowest government subsidy, investment plan, shorter duration of the concession or multiple criteria.

[7] Operation, BOT, BOO, privatization, etc.

[8] Law, decree, contract or license.

[9] Revenue cap, price cap, rate of return or no regulation.

[10] The government, the concessionaire, both or nobody.

[11] These tables are available upon request.