

Regulation, Renegotiation and Capital Structure

Theory and Evidence from Latin American Transport Concessions

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Abstract

The paper examines the capital structure of regulated infrastructure firms. The authors develop a model showing that leverage, the ratio of liabilities to assets, is lower under high-powered regulation and that firms operating under high-powered regulation make

proportionally larger reductions in leverage when the cost of debt increases. They test the predictions of the model using an original panel dataset of 124 transport concessions in Brazil, Chile, Colombia and Peru over 1992–2011, finding broad support for their predictions.

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Regulation, Renegotiation and Capital Structure: Theory and Evidence from Latin American Transport Concessions

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1. Introduction

Since the 1990s public private partnerships (PPPs) and concession contracts have been widely used to develop major infrastructure projects. Although the mechanics of financing such projects are now well understood, less clear is the motivation behind these financing choices. A significant barrier to progress has been the scarcity of available data. Indeed, the development of project finance – and the creation of special purpose vehicles (SPVs) or “project companies” – has meant that the firms of interest are almost always unlisted and so assembling data is a challenge. In many countries regulatory agencies do not regularly monitor the accounts of such firms, and when they do they often remain confidential. There are political motives behind this decision; given the continued controversy over the use of private capital to provide public goods, details regarding firm profitability, debt and other indicators may not be well received by the public.

Researchers interested in the financing of PPPs and concessions have typically relied on the snapshot information available at “financial close”. Given the high leverage of project companies, the predominant view is that debt is preferred to equity.¹ Indeed, the World Bank’s (2012) PPP Reference Guide states that “because equity is regarded as more expensive than debt, project sponsors often try to use a high proportion of debt to finance the project” (p.46). Yescombe (2007) echoes this view but notes that “leverage is dictated largely by the lenders’ requirements for a cash-flow cushion” (p.120). In essence then, investors prefer as much debt as possible but an upper limit is imposed by the increasing threat of bankruptcy.² Such arguments are clearly analogous to the static trade-off theory of capital structure. All else equal, less risky projects will have higher proportions of debt in the capital structure.

In the context of the United States in particular (Spiegel & Spulber 1994, Dasgupta & Nanda 1993, Taggart 1981) and Europe more recently (Bortolotti et al 2011, Cambini & Spiegel 2011), there is a view that infrastructure providers use leverage to influence regulatory outcomes. If the regulator is averse to bankruptcy, it may announce higher prices when leverage is high. The regulator may fear service disruption for example (Ehrhardt & Irwin 2004), or wish to avoid sending negative signals to potential investors. Knowing this, firms can extract higher prices and maximise profits by increasing leverage.

In this paper we extend such models to an emerging market context. We show that the firm’s ability to influence regulated prices is determined by the design of regulation. Under high-powered regulation, such as price cap, prices are unresponsive to the probability of bankruptcy; this reduces the firm’s incentive to use leverage. Our model therefore predicts that firms operating under high-powered regulation will have lower leverage than others, all else equal.

¹ We define leverage as the ratio of liabilities to assets.

² Similar arguments have been made by others in the field. Klein (2012, p.27) states that “without market risk, investors are often willing to provide high levels of debt... when there is market risk, financiers tend to require significantly higher equity cushions”. Engel et al (2010, p.49) argue that “leverage depends on the volatility of revenues and when these are very volatile, the project may not be bankable. Governments sometimes provide revenue insurance to improve the bankability of a project. Better alternatives allowing for high levels of leverage are, for example, PVR and availability contracts”.

In this model, firms find high level of debt attractive if the share of cost reimbursed is high enough to compensate for the higher probability of bankruptcy. As the cost of debt increases, the threshold of cost reimbursement for which this holds goes up and as a result firms operating under high-powered regulation make proportionally larger reductions in leverage.

To test these predictions we have created an original panel dataset of 124 transport concessions in Brazil, Chile, Colombia and Peru covering the period 1992-2011. Regulatory information is sourced from project contracts, sector legislation and renegotiation agreements (which we have for every project). Financial data is sourced directly from regulatory agencies and from commercial databases.

To capture the power of the regulation we include a dummy equal to 1 if the firm is regulated by price cap. It has previously been claimed however that the high incidence of renegotiation in Latin America leads to a convergence of regulatory regimes (e.g. Sirtaine et al 2004). For our purposes, if firms can renegotiate whenever they are in financial difficulty, then the incentive to use leverage will not vary across different types of regulation. That is, even under high-powered regulation firms can increase prices by using high leverage. By examining contract renegotiations, we show that this is not the case: being in financial difficulty is not a significant determinant of renegotiation.

To investigate the effect of regulatory design on leverage, we begin by running pooled OLS regressions. We find that the price cap dummy is positive but insignificant. To deal with the likely endogeneity of regulation, we next analyse how leverage responds *within* projects to changes in the cost of debt. As predicted by the model, we find that price cap firms make proportionally larger reductions in leverage when the cost of debt increases.

Our empirical work has implications for other capital structure theories. In particular, we find little evidence to support the trade-off view widely held in the infrastructure literature: return on assets (ROA) is negatively correlated with leverage and firms significantly reduce leverage as stock markets become more developed. Overall, our control variables are broadly consistent with findings from listed firms both in developed (Frank & Goyal 2009, Rajan & Zingales 1995) and developing (Booth et al 2001) countries.

2. Theory

The objective of the model is to provide comparative statics regarding the effect of price regulation incentives on the capital structure of the regulated firm. We start by doing so in the simplest possible model, which describes the debt-issuing decision of a firm reacting to a pre-announced price setting rule, in a framework inspired by Spiegel and Spulber (1994) and Cambini and Spiegel (2011). We first highlight our main point in the absence of either moral hazard or strategic considerations such as renegotiation of the price setting rule. We then sketch how our results extend under these considerations.

Our principal divergence from Spiegel and Spulber (1994) and Cambini and Spiegel (2011) is in the formulation of the price setting mechanism. Both of the above papers assume that the regulator maximizes the Nash product of firm profits and consumer surplus. This is justified on the basis that “in practice, because negotiations take place between the firm, consumers, and the regulator concerning each step in the calculation, regulators can exercise considerable discretion in the rate-setting process” (Spiegel

& Spulber 1994, p.427).³ In the context of our empirical application, the relevance of this assumption is questionable. Because details on the mechanisms for adjusting and revising tariffs are typically specified in project contracts, regulatory discretion is in many cases very limited.

2.1 The Model

Consider a setting in which the regulator commits ex ante to set the price p according to a price setting rule of the form $p = a + (1 - b)C$, where C is expected cost and the parameter $b \in [0,1]$ represents the power of incentives. When b is close to 1, the rule comes close to a fixed price contract, i.e. a high-powered regulatory rule, while the smaller b , the bigger the fraction of expected cost that is reimbursed by the regulator, as in a cost plus contract.

The firm faces a unit demand function and its cost is affected by a random shock c uniformly distributed over $[0, \bar{c}]$, capturing either cost (input prices) or technology contingencies. The firm must invest an amount K , for which it issues a level of debt D and equity E . Hence the firm's investment constraint is given by:

$$K = E + D \quad (1)$$

Ex post, D must be repaid using the net payoff $p - c$. If this falls short of D , the firm suffers a cost of financial distress T , assumed fixed for simplicity. As in Cambini & Spiegel (2011) we assume that external investors (debt holders and new shareholders) are eventually paid in full, and so existing shareholders are responsible for bankruptcy costs T in the case of financial distress. Denote by $\varphi(p, D)$ the probability that the firm finds itself in such a situation, so that its expected cost is $C = \frac{\bar{c}}{2} + \varphi(p, D)T$. Accordingly, this implies that:

$$C = \begin{cases} \frac{\bar{c}}{2} & \text{if } D + \bar{c} < p, \\ \frac{\bar{c}}{2} + \left(1 - \frac{p - D}{\bar{c}}\right)T & \text{if } D \leq p \leq \bar{c} + D, \\ \frac{\bar{c}}{2} + T & \text{if } p < D \end{cases} \quad (2)$$

The timing is as follows. An exogenous price setting rule of the form $p = a + (1 - b)C$ is announced at stage 0. In stage 1, the regulated firm invests K and chooses its capital structure by issuing an amount of debt D and equity E . At stage 2, given the pre-announced price rule, the firm's cost is revealed, and output and payoffs are realized.

As in Spiegel and Spulber (1994) and Cambini and Spiegel (2011) we assume that the firm's management acts so as to maximize the payoff of existing shareholders. Hence, the management's objective is to choose the mix of debt D and equity E so as to maximize:

³ Cambini and Spiegel (2011) provide examples from US electricity and UK water regulation to support this view.

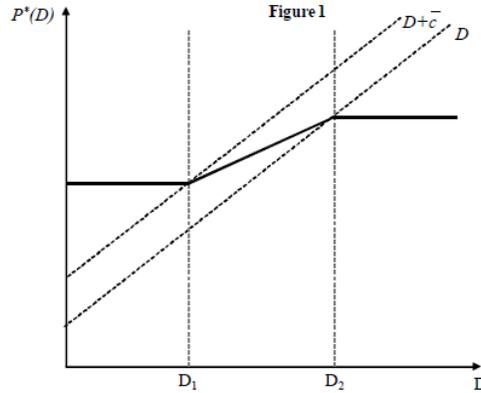
$$Y(D) = p(D) - C - R_E E - R_D D \quad \text{s.t.} \quad K = E + D \quad (3)$$

where $R_E \equiv 1 + r_E$ is the cost of equity and $R_D \equiv 1 + r_D$ is the cost of debt. Due to our assumption that existing shareholders remain the residual claimants in the case of financial distress, perfect capital markets and risk neutral investors imply that $R_E = R_D$. We relax this below.

From (2), we can infer that:

$$p^*(D) = \begin{cases} p_1 = a + (1-b)\frac{\bar{c}}{2} & \text{if } D < D_1, \\ p_2 = a + (1-b)\left[\frac{\bar{c}}{2} + \left(1 - \frac{p-D}{\bar{c}}\right)T\right] & \text{if } D_1 \leq D \leq D_2, \\ p_3 = a + (1-b)\frac{\bar{c}}{2} + T & \text{if } D_2 < D \end{cases} \quad (4)$$

where $D_1 = p_1 - \bar{c}$, $D_2 = p_3$, $D_1 < D_2$, and $p_1 < p_2 < p_3$. Figure 1 shows how $p^*(D)$ varies with D .



In this setting, we can prove the following result (for derivations see the Appendix):

Proposition 1. There exists a threshold level of incentives b^* such that $D = D_2$ if $b \leq b^*$ and $D = D_1$ if $b > b^*$.

This bang-bang result derives from the fact that over the range $[D_1, D_2]$, the firm's profit is decreasing in the level of debt it issues as long as the power of incentives is strong enough (i.e. b is large enough). Intuitively, the firm wants to issue debt to extract higher regulated prices.⁴ However, these higher prices only compensate the increased probability of bankruptcy if the share $1 - b$ of cost reimbursed is large enough, leading the firm to choose a level of debt equal to the higher end of the range. The power of incentives here is a simple measure of the responsiveness of the price channel to financial distress. When $1 - b$ is small (as in a high-powered regulation scheme), this responsiveness is low and the equilibrium

⁴ See a detailed discussion of this mechanism in Tirole (2006), pp. 296-298.

level of debt chosen is instead equal to the lower end of the range. As such, Proposition 1 tells us that higher powered regulation is likely to translate into a lower level of leverage.

When we allow R_D to deviate from R_E we can show the following (see proof in Appendix):

Proposition 2. An increase in R_D lowers the threshold level of incentives b^* .

Intuitively, as the price of debt increases, the share $1 - b$ of the firm's cost reimbursed must be sufficiently high to ensure that higher prices still compensate for the increased probability of bankruptcy. That is, only firms operating under sufficiently low-powered regulation continue to find high levels of debt profitable as debt becomes more expensive. This comes from the bang-bang nature of Proposition 1. As R_D increases, the lower threshold b^* implies that among firms with high leverage, the fraction facing the highest-powered incentive will reduce their leverage. Empirically, we therefore expect larger reductions in leverage amongst highly leveraged firms subject to higher-powered regulation as the price of debt increases.

2.2 Discussion

The model predicts that leverage will be lower under higher-powered regulation as the ability to use debt to achieve higher regulated prices is more limited. Conditional on leverage being high, we also expect that firms subject to higher-powered regulation will be more likely to reduce leverage when the price of debt increases. We use Proposition 2 to motivate our empirical strategy in Section 5.

The model assumes that the regulator is committed to the ex ante price setting rule. In practice, regulatory commitment might be difficult to sustain (see e.g. Moszoro 2013, Esty 2003). Importantly, the firm may be able to force a price revision whenever the probability of bankruptcy is high. It is easy to see that the possibility of such a revision pushes the regulation towards a lower-powered scheme. The probability that it then exceeds the threshold b^* increases, making it more likely that leverage is high.⁵

Imperfect commitment presents an empirical challenge. If seemingly high-powered contracts are renegotiated whenever the firm faces financial difficulty, then the importance of the ex ante regulation is undermined. To deal with this problem, we therefore examine the determinants of contract renegotiations in Section 4. We find no evidence that renegotiations are caused by the likelihood of financial distress. This is reassuring as it suggests that the responsiveness of the price channel to financial distress is indeed weaker under high-powered regulation.

Although the model focuses on the channel from leverage to regulated prices, there are other possible mechanisms through which the design of regulation could affect capital structure. Firstly, by transferring greater risk to the firm, high-powered regulation may directly increase the probability of bankruptcy. Under the static trade-off theory of capital structure, this would reduce leverage (all else equal). Our model partially captures this effect, as the probability of bankruptcy increases in b ; it does not drive our

⁵ In a model that would incorporate a moral hazard component to the firm's cost function, a similar debt-increasing effect would arise from moral hazard biting stronger. This can be seen simply in Tirole (2006, Chapter 7), if Δp , the probability gap of success between the high and low effort states, increases.

results as $\frac{\partial \varphi^*}{\partial D}$ is independent of b . Our empirical findings cast doubt on the importance of this mechanism however: volatility is a positive (generally insignificant) determinant of leverage and more profitable firms have lower leverage.

An alternative possibility is that high-powered regulation increases the cost of equity, leading such firms to choose higher leverage. In the Capital Asset Pricing Model (CAPM), the cost of equity is determined by the covariance of the company's returns with the market portfolio. Alexander et al (1996) find that this covariance is higher in price cap contracts than rate-of-return contracts in regulated infrastructure projects, implying a higher cost of equity.⁶ Unlike the previous mechanism, this offsets the predictions of the model. The magnitude of this effect in our sample may not be significant however as almost all contracts include annual tariff adjustments for inflation, and many allow adjustments for exchange rate shocks. Such clauses reduce the extent to which the project's returns are dictated by economy-wide cost shocks. Furthermore, Gaggero (2007) replicates the methodology of Alexander et al (1996) and does not find that the cost of equity is higher under higher-powered regulation.

3. Data

We construct an original dataset of 124 transport concessions in Brazil, Chile, Colombia and Peru over the period 1992-2011. The complete panel – tracking all projects since the year of contract signing – covers 1,360 observations and financial data covers 1,037 observations. Details on the design of price regulation come from project contracts, sector legislation and renegotiation agreements. In addition we have information on the specifics of the projects (investment size, duration, etc.), on the institutional and regulatory environment, the timing and content of renegotiation agreements, as well as the evolution of key economic variables. Table 1 provides summary statistics of the main variables. Table A1 in the Appendix provides a full list of variables and sources.

Our principal measure of leverage is the ratio of total liabilities to total assets. The unit of observation is the project company, as opposed to the project sponsor(s). As argued by Esty (2004), project companies are “strategic research sites” and “provide a new and, potentially, very powerful laboratory to analyse structural decisions and to show why they matter”. The fact that project companies are created for a specific and well-defined purpose is greatly beneficial from a research perspective.

Firm-level financial data comes directly from regulatory agencies and from commercial databases. OSITRAN, the Peruvian federal regulator, provided the data for all Peruvian projects and ANI, the Agencia Nacional de Infraestructura provided data for Colombian road projects. The two commercial databases we use are the ISI Emerging Markets Database of Euromoney Institutional Investor and the Orbis Database of Bureau van Dijk.

In Chile, Colombia and Peru all concessions are regulated at the federal level. In Colombia the federal regulator varies across subsectors and across time, whereas in Chile all projects are regulated by the Ministerio de Obras Publicas (MOP) and all Peruvian projects are regulated by Ositran. In Brazil

⁶ Their results show higher equity betas amongst price cap firms. In the standard CAPM model this implies a higher cost of equity, all else equal.

concessions are regulated at both the federal and state level. In addition to federal road and rail projects we have data on state-level road projects from Parana and Rio Grande do Sul and rail projects from Rio de Janeiro.

Table 1: Summary Statistics

	All	Brazil	Chile	Colombia	Peru	Roads	Rail	Airports	Ports	Price cap=1	Price cap=0
Observations (Full)	1360	452	441	311	156	918	197	165	80	1174	186
Observations (Financial)	1037	351	398	147	141	718	144	136	39	917	120
Projects	124	37	40	23	24	84	15	18	7	107	17
Leverage	0.69	0.81	0.66	0.52	0.62	0.67	0.96	0.57	0.47	0.69	0.62
LT Leverage	0.44	0.43	0.54	0.26	0.31	0.43	0.58	0.41	0.29	0.45	0.34
Net Leverage	0.64	0.76	0.63	0.49	0.51	0.64	0.90	0.48	0.35	0.65	0.57
Price cap (% obs)	0.86	0.71	1.00	0.82	1.00	0.86	1.00	1.00	0.29	1.00	0.00
MIG (% obs) ⁷	0.48	0.00	0.80	0.64	0.67	0.58	0.04	0.61	0.11	0.56	0.00
Flexible contract (% obs)	0.11	0.00	0.24	0.16	0.00	0.14	0.00	0.15	0.00	0.13	0.00
Investment Size (\$m, 2000)	268.84	459.56	211.81	140.27	133.79	252.16	527.09	77.56	218.86	244.97	419.51
Contract Duration (yrs)	22.57	23.23	22.19	20.38	26.10	22.60	28.53	15.13	22.88	22.59	22.44
Return on Assets ⁸	0.10	0.10	0.10	0.08	0.10	0.08	0.00	0.24	0.21	0.09	0.17
Volatility ⁹	0.11	0.13	0.08	0.11	0.11	0.09	0.11	0.22	0.12	0.11	0.11
GDP Growth	0.04	0.03	0.04	0.04	0.06	0.04	0.03	0.04	0.04	0.04	0.03
Inflation	0.11	0.19	0.06	0.10	0.04	0.13	0.08	0.06	0.10	0.07	0.36
Stock Market Value	12.84	22.23	13.45	2.80	3.39	13.34	16.52	10.56	2.61	12.17	17.10
Pr. Bond Market Capitalization	11.10	13.67	18.46	0.43	3.78	11.59	10.29	14.08	1.34	11.28	9.96
Renegotiations per Project	3.22	1.46	2.73	7.57	2.58	3.37	4.60	1.44	3.00	3.57	1.00
Renegotiations per Project-Year	0.29	0.12	0.25	0.56	0.40	0.31	0.35	0.16	0.26	0.33	0.09

Mean values reported.

3.1 Renegotiations

A renegotiation is considered to have occurred “if a concession contract underwent a significant change or amendment not envisioned or driven by stated contingencies” (Guasch 2004, p.80). There are a total of 399 renegotiations across the sample, with an average of 3.22 per project. The most significant

⁷ Minimum income guarantee.

⁸ Earnings Before Interest and Tax (EBIT) divided by total assets.

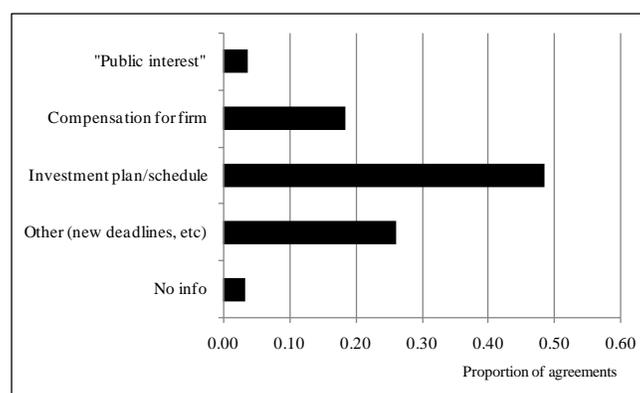
⁹ Standard deviation of ROA by project.

renegotiations occurred in the Brazilian states of Parana and Rio Grande do Sul. In Parana the state government significantly reduced tariffs in 1998, less than a year after the projects had become operational. This was followed by further renegotiations in 2000 and 2002, which revised tariffs and investment obligations in an attempt to restore the economic-financial equilibrium of the contracts. A similar situation occurred in Rio Grande do Sul, where the state government blocked contractual tariff adjustments and attempted to cut tariffs within a year of the contracts being signed. Again this was followed by multiple renegotiations compensating the firm and attempting to restore economic-financial equilibrium.

Another major set of renegotiations occurred in Chile in 2003/04 with the introduction of the Income Distribution Mechanism (IDM).¹⁰ The IDM guaranteed firms the toll revenue they would have received had traffic grown at an annual rate of $x\%$ throughout the contract (where $x = 4, 4.5$ or 5% and was chosen by the firm). If the guaranteed revenue was not met, the concession could be extended by up to 10 years, and ultimately the government would be liable for any remaining difference. In exchange for the guarantee, firms were required to carry out additional investments (see Engel et al 2006 and Vassallo 2006 for further details).

The reasons for renegotiation are shown in Figure 2. Almost half are to alter the project’s investment plan or schedule.¹¹ Compensation for the firm may be sought due to exogenous changes in demand or costs, or due to previous government action (“in the public interest”). Such “public interest” renegotiations include the reduction of tariffs in Parana and Rio Grande do Sul, plus a number of renegotiations in Colombia which lowered road tolls for local residents. The “Other” category consists largely of changes to deadlines of various kinds. The category also includes changes to environmental legislation, changes in the assets of the firm (in lease agreements) and disagreements over taxes and other costs.

Figure 2: Reasons for renegotiation

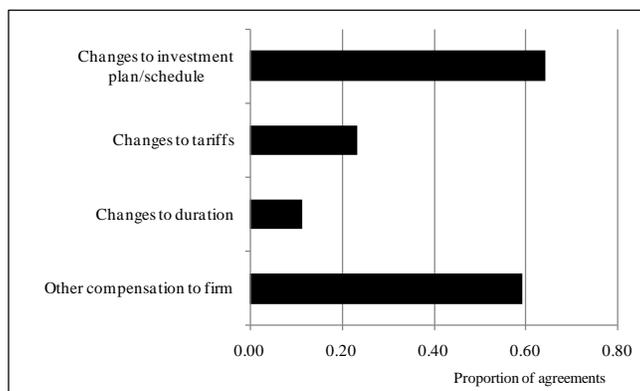


¹⁰ Officially known as the Mecanismo de Distribución de Ingresos (MDI). This renegotiation did not affect all Chilean projects.

¹¹ This category also includes renegotiations to change the maintenance works/schedule.

Figure 3 shows the outcomes of renegotiations.¹² Again, the most common outcome is a change to the investment plan or schedule. Typically, the firm will agree to increase the volume of investment in exchange for a direct payment from the regulator, an increase in tariffs or an extension of the contract. Indeed, this particular scenario accounts for 38 percent of all renegotiations in the sample. Tariffs themselves are affected by just over 20 percent of renegotiations.

Figure 3: Outcomes of renegotiation



4. Regulation and renegotiations

As discussed in Section 2, the de facto regulatory regime is a function of both (i) the project contract, (ii) the commitment of the regulator to that contract. If the firm can force a renegotiation when the probability of financial distress is high, the regulatory regime becomes less high-powered. Ultimately, the distinction between very high-powered contracts (e.g. price cap) and much lower-powered contracts (e.g. rate of return) could become meaningless. Given the high rate of renegotiation in Latin American infrastructure projects, this is potentially a serious issue. Sirtaine et al (2004, p.37) argue that in Latin America:

“The short interval between the granting of a concession and its renegotiation, about two years, and the outcome of the renegotiation process, makes the resulting regime a hybrid of price caps and rate of return...Thus in practice both types of regulatory regime tend to converge to a hybrid.”

For our purposes, the key distinction between high- and low-powered regulation is the regulator’s responsiveness to the risk of financial distress. In this Section we therefore first outline our classification of regulatory regimes, and then investigate whether renegotiations fundamentally change the incentive structure of the original contracts. In particular, we ask whether high levels of debt or poor financial

¹² Values no longer sum to 1 as most renegotiations have numerous outcomes.

performance are strong predictors of renegotiation. We show that this is not the case. This means that in our core empirical specification (Section 5), we can rely primarily on the project contract for our measurement of regulatory design.

4.1 Ex ante regulation

To capture the (ex ante) incentive structure of the contract, we include a dummy variable equal to 1 if the project is subject to price cap regulation. We define a contract as price cap if there is an automatic tariff revision at most every 5 years. Table A2 in the Appendix provides summary details on the rules for revising and adjusting tariffs across projects.¹³

In the context of the sample, this simple classification appears reasonable. In a large number of projects, there are no automatic tariff revisions in the contract. Although some of these projects allow for discretionary reviews, they are essentially pure fixed price contracts. In Peru, a number of projects are RPI-X with revisions every 5 years.¹⁴ As standard therefore, we also classify RPI-X projects as price cap. Our non-price cap sample consists of federal road projects in Brazil and port projects in Colombia. The Brazilian projects have tariff reviews every year. The aim of the regulation is to re-establish the ex ante (contracted) internal rate of return (IRR) of the project whenever an event occurs for which the regulator bears the risk (see Veron & Cellier 2010 for details). Most notably, the contracts allow tariffs to change whenever there is an alteration to the detailed investment programme (Programa de Exploracao da Rodovia), which is reviewed each year. As noted by Carpintero and Barcham (2012, p.101), “some observers claim that this mechanism has been abused to provide relief to concessionaires suffering from traffic shortfalls”.

In the Colombian port projects, tariffs are revised every 2 years. The firm submits a tariff proposal to the regulator, which the regulator can approve or reject. If the proposal is rejected the regulator imposes a “competitive tariff” which ensures an “acceptable” rate of return for the firm.

4.2 Determinants of renegotiation

Having established an ex ante classification of regulatory regimes, we now ask whether renegotiations fundamentally alter this classification. In particular, we are interested in whether renegotiations are a response to poor financial performance. If the firm can renegotiate whenever there is a risk of financial distress, then the incentive to use leverage to gain higher prices may be just as strong (or even stronger) under high-powered regimes as low-powered regimes.

¹³ We distinguish between tariff revisions and adjustments. Revisions determine the type of price regulation in effect (price cap, cost-plus, etc.). Tariff adjustments typically occur annually to adjust for inflation and sometimes exchange rate movements.

¹⁴ RPI-X regulation consists of periodic price reviews (typically every 5 years) in which a tariff is set that increases at the rate of inflation (RPI) minus a factor X to account for productivity gains.

Following Guasch, Laffont and Straub (2007) we investigate the determinants of renegotiation by performing random probit estimations. Our dependent variable is a dummy equal to 1 if there is a renegotiation in project i with regulator j in country n at time t . The probit model is given by:

$$R_{ijnt} = I [R_{ijnt}^* = \gamma_1 X_{it} + \gamma_2 M_{nt} + \gamma_3 IRA_j + \gamma_4 F_{it} + e_{ijnt} < 0] \quad (4)$$

where $I [.]$ is the indicator function, taking value 1 whenever the statement in brackets is true, and 0 otherwise; R_{ijnt} is the dummy variable indicating whether concession i with regulator j in country n at time t is renegotiated; X_{it} is a vector of project variables (regulatory regime, subsector, duration, investment, project age, government guarantee dummy); M_{nt} is a vector of environmental characteristics (GDP growth, government corruption); IRA_j is a binary variable taking value 1 if regulator j is an independent regulatory agency; F_{it} are financial performance variables for project i in year t (discussed below); and e_{ijnt} is the error term.

We want to test whether the financial performance variables F_{it} are significant predictors of renegotiation. We experiment with a number of alternatives, corresponding to the different columns of Table 2: (i) Leverage: total liabilities divided by total assets, (ii) Distress 1: binary variable taking value 1 if the firm has leverage greater than 1 standard deviation above the mean for its country, (iii) Distress 2: binary variable taking value 1 if the firm has a working capital ratio less than 0.5,¹⁵ (iv) ROA: earnings before interest and tax (EBIT) divided by total assets, (v) Performance 1: binary variable taking value 1 if the firm has ROA more than 1 standard deviation below the mean for its country. (vi) Performance 2: binary variable taking value 1 if the firm had negative ROA in both of the previous two years.

The results are presented in Table 2. The first row shows that price cap contracts have a higher incidence of renegotiation, which lends some weight to the view that they may in practice resemble hybrid regimes. This result is driven in part by the unique nature of the Brazilian federal road contracts however, which state that tariffs will be revised in the event of changes to the investment programme. This happens frequently, but is not considered a renegotiation as it is a clearly stated contingency of the contract (see Veron & Cellier 2010).

Importantly, the financial performance variables are not significant predictors of renegotiation. Firms with higher leverage and weaker profitability are no more likely to experience renegotiations than others.¹⁶ Moreover, this result holds for each of the country sub-samples (results not reported).

¹⁵ The working capital ratio is defined as current assets divided by current liabilities. A ratio below 1 is typically used as an indicator of liquidity problems. Given the highly leveraged nature of project finance transactions however, a ratio below 1 is extremely common. We therefore choose a more extreme ratio of 0.5. Even at this level, over a third of observations classify as being in “distress”.

¹⁶ The distress variable is significant at the 10 percent level, but if the threshold is changed from 1 standard deviation above country mean to 1.5 or 2, this significance disappears.

Table 2: Random effect probit estimations - Determinants of renegotiation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Reneg						
Price cap	1.274*** (0.364)	1.077*** (0.407)	0.938*** (0.328)	0.975*** (0.325)	1.067*** (0.404)	0.965*** (0.324)	0.955*** (0.323)
Road	-0.285 (0.329)	-0.207 (0.338)	-0.303 (0.299)	-0.224 (0.303)	-0.139 (0.341)	-0.222 (0.300)	-0.215 (0.301)
Rail	-0.217 (0.367)	-0.068 (0.372)	-0.374 (0.341)	-0.246 (0.334)	-0.028 (0.374)	-0.274 (0.338)	-0.255 (0.335)
Air	-0.776** (0.392)	-0.615 (0.397)	-0.660* (0.356)	-0.652* (0.357)	-0.489 (0.404)	-0.590 (0.361)	-0.583 (0.361)
Duration	-0.039*** (0.013)	-0.032** (0.013)	-0.038*** (0.013)	-0.042*** (0.013)	-0.024 (0.015)	-0.032** (0.014)	-0.031** (0.014)
Investment	0.000 (0.000)	0.000** (0.000)	0.000*** (0.000)	0.000** (0.000)	0.000** (0.000)	0.000** (0.000)	0.000** (0.000)
Project age	-0.036*** (0.012)	-0.066*** (0.015)	-0.052*** (0.013)	-0.054*** (0.014)	-0.064*** (0.017)	-0.055*** (0.014)	-0.057*** (0.014)
Guarantee	0.652*** (0.157)	0.795*** (0.173)	0.728*** (0.158)	0.695*** (0.174)	0.801*** (0.178)	0.661*** (0.164)	0.662*** (0.164)
IRA	0.119 (0.146)	0.173 (0.168)	-0.000 (0.152)	0.024 (0.156)	0.215 (0.175)	0.018 (0.155)	0.017 (0.155)
GDP growth (lag)	-0.055*** (0.018)	-0.037* (0.022)	-0.033 (0.020)	-0.038* (0.021)	-0.048** (0.023)	-0.039* (0.022)	-0.038* (0.022)
Corruption ¹⁷	-0.072 (0.074)	-0.155* (0.087)	-0.128 (0.082)	-0.112 (0.083)	-0.165* (0.094)	-0.131 (0.087)	-0.120 (0.090)
Leverage1 (lag)		-0.041 (0.168)					
Distress1			0.247* (0.149)				
Distress2				-0.082 (0.134)			
ROA (lag)					0.153 (0.291)		
Performance1						0.105 (0.208)	
Performance2							0.111 (0.210)
Observations	1104	748	630	727	669	830	747
Projects	102	99	91	95	97	99	97

Standard errors in parentheses.

The columns are identical with the exception of the financial variables included in the bottom rows.

*** p<0.01, ** p<0.05, * p<0.1

Such results are only indicative. They do not imply that firms cannot renegotiate when in financial difficulty; only that being in difficulty does not increase the likelihood of renegotiation. To address this, we can look in more detail at those firms that have particularly high leverage, or particularly poor profitability, and analyse the renegotiations that occur.

¹⁷ A higher value indicates less corruption.

Take the Distress 1 variable used in Table 2. This is a dummy equal to 1 if the firm has leverage more than 1 standard deviation above the relevant country mean. There are 161 year-project observations in which this variable equals 1, and in 42 of these there was a renegotiation. Tariffs were altered in only 5 of these cases however, and in 13 other cases the duration was changed or the firm received some other form of compensation. Hence, for those firms considered in distress on this measure, in 26 percent of cases there was a renegotiation. In only 11 percent of cases was there a renegotiation in which we suspect the firm may financially benefit. If we increase the threshold to two standard deviations above the country mean – hence capturing only those firms with very high leverage – there are 20 observations but only a single renegotiation. Moreover, this was “in the public interest” – disadvantaging the firm.

Across our sample therefore, it does not seem that contracts are systematically renegotiated when firms face financial difficulty. This reduces the concern that the different regulatory regimes “converge to a hybrid”, and suggests that regulators perhaps do a better job than often recognised in enforcing price caps. For our purposes, it suggests that the transmission from debt to prices is indeed weaker under high-powered contracts. For our empirical methodology we can therefore concentrate on the regulatory design as specified in the project contracts.

5. Methodology

We return now to our primary question: what is the effect of price regulation incentives on the capital structure of project companies? Building on the previous Section, we use our price cap dummy to capture the power of the regulation. Our principal specification is given by:

$$l_{int} = \beta_0 + \beta_1 pc_i + \beta_2 x_{it} + \beta_3 f_{it} + \beta_4 m_{nt} + \theta_n + \delta_t + \epsilon_{int} \quad (5)$$

where l_{int} is the ratio of liabilities to assets in project i , in country n , at time t ; pc_i is a dummy variable taking value 1 if project i is subject to price cap regulation; x_{it} is a vector of contract characteristics of project i at time t ; f_{it} is a vector of financial variables for project i at time t ; m_{nt} is a vector of macro-financial variables for country n at time t ; and θ_n and δ_t are country and year fixed effects, respectively.

The contract variables x_{it} consist of a minimum income guarantee (MIG) dummy, a flexible contract dummy and subsector dummies. The firm-level financial variables f_{it} are the natural logarithm of real assets, the ratio of EBIT to total assets (ROA) and the volatility of returns (the standard deviation of ROA). These variables are standard in the corporate finance literature (e.g. Frank & Goyal 2009, Booth et al 2001, Rajan & Zingales 1995).¹⁸ The macro-financial variables m_{nt} consist of real GDP growth and

¹⁸ We do not include taxes in our main specifications. As noted by Rajan & Zingales (1995), the tax advantage of debt is highly sensitive to assumptions regarding the tax rates of the marginal investor. Rajan & Zingales (1995) do not include taxes in their core regression and Frank & Goyal (2009) do not find taxes to be one of their “core factors” explaining capital structure. When we include the top corporate tax rate in equation (5) it is insignificant and none of the main results are affected. In equation (6) the tax variable is generally significant, although again the main results remain largely unaffected. This significance is likely to be spurious as the time-series variation in corporate tax rates is extremely limited.

inflation, the stock market value to GDP ratio and the private bond market capitalization to GDP ratio (de Jong et al 2008, Booth et al 2001).

There are two important weaknesses with the approach taken in equation (5). Firstly, there may be a number of relevant project characteristics that we are not able to account for with the available information (an omitted variables problem). Secondly, it is likely that the contract clauses – including the price cap variable – are endogenous. We may expect that riskier projects are less likely to be subject to high-powered regulation and more likely to include clauses such as minimum income guarantees and flexible terms. We may also expect firms and regulators to self-select according to their risk preferences. Risk averse firms for example may prefer to limit their debt exposure, and at the same time have a preference for low-powered regulation and government guarantees.

To deal with these two problems we introduce firm fixed effects and analyse the response of firms to changes in the cost of debt. We use the country’s lending interest rate and interest rate spread (lending rate minus deposit rate) as our cost measures as these are plausibly exogenous to the firm’s actions. The model presented in Section 2 predicts a greater reduction in leverage amongst firms subject to high-powered regulation when there is a cost shock. We therefore expect the interaction between price cap and the interest rate to be negative in the following regression:

$$l_{int} = \vartheta_0 + \vartheta_1 r_{nt} + \vartheta_2 pc_i * r_{nt} + \vartheta_3 x_{it} + \vartheta_4 f_{it} + \vartheta_5 m_{nt} + \alpha_i + \delta_t + \sigma_{int} \quad (6)$$

where r_{nt} is the lending interest rate or interest rate spread in country n in year t , depending on the specification; x_{it} , f_{it} , and m_{nt} are vectors of project, financial and macro-financial variables respectively as per equation (5); α_i and δ_t are project and year fixed effects respectively; and σ_{int} is the error term. We replace the subsector dummies from x_{it} with the median leverage by subsector and year, based on Frank and Goyal (2009). This helps to control for subsector-specific effects, as the project fixed effects absorb the subsector dummies.

We begin by running equation (6) using our leverage ratio, total liabilities divided by total assets, as the dependent variable l_{int} . All else equal however, an increase in the interest rate r_{nt} will increase the leverage ratio if variable rate debt is held by the firm; although a higher rate increases the cost of new debt, it also increases the burden of existing debt. The transmission from cost shock to leverage is therefore multifaceted, and equation (6) will capture not only current but also past decisions. To account for this, we therefore also run equation (6) using the natural logarithm of real liabilities as our dependent variable l_{int} .¹⁹

¹⁹ We drop the real assets variable from f_{it} as this consists of liabilities + equity.

6. Results

Table 3 presents the baseline results from equation (5), with and without country and year fixed effects. Columns (1) to (3) contain the entire sample for which we have financial data, and columns (4) to (6) exclude extreme outliers. We class an observation as an outlier if the leverage ratio is 3 standard deviations above the relevant country mean (along the lines of Booth et al 2001). Although the drop in sample size is extremely small, the fit of the model increases substantially.

The first row shows that the price cap dummy is insignificant in all specifications; when outliers are dropped the magnitude of the coefficient is also lower. The insignificance of this variable may reflect some of the endogeneity concerns discussed above, which also appear to affect the minimum income guarantee variable. The negative and significant coefficient suggests a self-selection process amongst firms. It may be that risk-averse firms prefer both limited debt and government guarantees.

Of the remaining variables, the negative coefficients on ROA and the country's stock market value are notable. These results are at odds with the common view amongst many infrastructure practitioners that firms have a strong preference for debt over equity (e.g. World Bank 2012). Instead we find that when profitability is higher, and so debt availability should be greater, firms reduce their leverage. Likewise, as stock markets develop, and so equity availability is greater, firms reduce leverage. Our results suggest that supply-side constraints are actually stronger with regards to equity than debt.

Table 3: Baseline estimations – Regulation and leverage

	(1)	(2)	(3)	(4)	(5)	(6)
	Leverage	Leverage	Leverage	Leverage	Leverage	Leverage
Price cap	0.035 (0.054)	0.047 (0.059)	0.038 (0.062)	-0.008 (0.050)	0.033 (0.052)	0.033 (0.054)
MIG	-0.192*** (0.043)	-0.131** (0.052)	-0.132** (0.053)	-0.197*** (0.051)	-0.129** (0.057)	-0.134** (0.056)
Flexible term	0.052 (0.042)	0.060 (0.038)	0.044 (0.045)	0.018 (0.034)	0.038 (0.031)	0.051 (0.036)
Road	0.250*** (0.067)	0.122* (0.065)	0.119* (0.067)	0.279*** (0.089)	0.144** (0.066)	0.153** (0.067)
Rail	0.431*** (0.116)	0.292*** (0.094)	0.300*** (0.091)	0.346*** (0.094)	0.160** (0.081)	0.172** (0.081)
Air	0.138 (0.091)	0.043 (0.093)	0.031 (0.100)	0.193* (0.099)	0.136* (0.079)	0.141* (0.083)
Ln (Assets)	0.007 (0.009)	0.024 (0.022)	0.018 (0.024)	0.024*** (0.007)	0.056*** (0.015)	0.055*** (0.015)
ROA	-0.313* (0.173)	-0.310* (0.172)	-0.325* (0.194)	-0.216*** (0.065)	-0.205*** (0.068)	-0.192*** (0.069)
Volatility	0.334 (0.230)	0.386* (0.213)	0.388* (0.216)	0.131 (0.174)	0.204 (0.150)	0.198 (0.155)
GDP growth	0.676* (0.350)	0.816** (0.378)	0.775 (0.485)	0.312 (0.253)	0.232 (0.241)	0.274 (0.238)
Inflation	-0.200 (0.313)	-0.158 (0.271)	-0.004 (0.361)	-0.330 (0.213)	-0.233 (0.213)	-0.252 (0.236)
Bond cap	0.005 (0.003)	-0.004 (0.005)	-0.005 (0.008)	0.001 (0.002)	-0.004 (0.003)	-0.002 (0.003)
Stock market	-0.006*** (0.002)	-0.005*** (0.002)	-0.007*** (0.002)	-0.004*** (0.001)	-0.004*** (0.001)	-0.006** (0.002)
Brazil		0.456*** (0.145)	0.480*** (0.142)		0.582*** (0.117)	0.602*** (0.122)
Chile		0.343*** (0.128)	0.392*** (0.150)		0.276*** (0.073)	0.279*** (0.081)
Peru		0.237 (0.146)	0.195 (0.162)		0.441*** (0.119)	0.439*** (0.128)
Constant	0.405*** (0.146)	0.018 (0.367)	0.175 (0.434)	0.230* (0.139)	-0.501* (0.287)	-0.490 (0.311)
Observations	817	817	817	805	805	805
Projects	111	111	111	111	111	111
R-squared	0.07	0.08	0.09	0.16	0.20	0.22
Year dummies	No	No	Yes	No	No	Yes

The dependent variable is the ratio of total liabilities to total assets (book values).

Robust standard errors in parentheses. Standard errors are clustered by firm.

Columns (1) to (3) present the results for the full sample: (1) excludes country and year dummies, (2) includes country dummies only, (3) includes country and year dummies. Columns (4) to (6) replicate columns (1) to (3) respectively, with extreme outliers excluded.

*** p<0.01, ** p<0.05, * p<0.1

Table 4 presents the results from the fixed-effects equation (6). Columns (1) and (2) present results when leverage is the dependent variable, and columns (3) to (8) use log liabilities as the dependent variable. When using leverage, we see that the interaction term is negative for both the interest rate and the interest rate spread, although only the second is significant. When there is a shock to the cost of borrowing, price cap firms reduce leverage more than others.

This interpretation is strengthened when we use log liabilities as the dependent variable. Now, the interest rate also enters negatively as we would expect if it is capturing the cost of debt. Column (3) uses the full sample, column (4) drops outliers and column (5) uses a lag of the interest rate variable – columns (6) to (8) repeat this for the interest rate spread. Whether we use the interest rate or the spread, the interaction term is negative and highly significant, implying that price cap firms are more responsive to increases in the cost of debt than the control group.

The control variables enter similarly to Table (3). Again, it is notable that the ROA is negative in all specifications, and highly significant when log liabilities are the dependent variable. The country stock market value is again negative and highly significant, and in most cases bond capitalization is now also significant. As we might expect in an emerging market sample, these results suggest that firms face supply side barriers to achieving their desired capital structure.

Table 4: Fixed effects estimations – Cost of debt and leverage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Leverage	Leverage	Ln (liab)					
Interest	0.003 (0.003)		-0.012 (0.009)	-0.013 (0.009)	-0.035*** (0.010)			
PC*Interest	-0.005 (0.003)		-0.023*** (0.008)	-0.022*** (0.008)	-0.024*** (0.008)			
Spread		0.011** (0.004)				0.002 (0.020)	0.001 (0.020)	-0.013 (0.017)
PC*Spread		-0.010** (0.005)				-0.033*** (0.012)	-0.033*** (0.012)	-0.039*** (0.013)
MIG	0.177 (0.119)	0.176 (0.118)	-0.593 (0.463)	-0.619 (0.469)	-0.460 (0.446)	-0.578 (0.469)	-0.600 (0.475)	-0.795 (0.533)
Flexible term	0.021 (0.054)	0.012 (0.055)	0.325 (0.319)	0.339 (0.321)	0.491 (0.316)	0.288 (0.328)	0.301 (0.330)	0.403 (0.328)
Sector lev	0.489** (0.204)	0.497** (0.196)	2.657*** (0.695)	2.649*** (0.705)	2.220*** (0.635)	2.661*** (0.712)	2.648*** (0.720)	2.393*** (0.686)
Ln (Assets)	0.000 (0.047)	0.003 (0.047)						
ROA	-0.217 (0.211)	-0.218 (0.211)	-0.839** (0.329)	-0.873** (0.371)	-0.864*** (0.318)	-0.858*** (0.317)	-0.897** (0.357)	-0.863*** (0.313)
GDP growth	0.785 (0.483)	0.848* (0.482)	3.491** (1.508)	3.441** (1.533)	1.068 (1.328)	3.800** (1.642)	3.746** (1.661)	3.637** (1.532)
Inflation	0.016 (0.383)	0.026 (0.360)	-0.266 (1.461)	-0.255 (1.483)	-1.198 (1.441)	-0.622 (1.432)	-0.615 (1.453)	-1.166 (1.487)
Bond cap	-0.005 (0.008)	-0.003 (0.008)	0.021 (0.016)	0.021 (0.017)	0.034** (0.015)	0.040** (0.016)	0.040** (0.016)	0.046*** (0.015)
Stock market	-0.008*** (0.003)	-0.008*** (0.003)	-0.056*** (0.013)	-0.057*** (0.013)	-0.081*** (0.015)	-0.057*** (0.013)	-0.058*** (0.013)	-0.069*** (0.014)
Constant	0.505 (0.797)	0.355 (0.817)	14.011*** (0.616)	14.091*** (0.628)	15.441*** (0.628)	13.454*** (0.765)	13.529*** (0.771)	14.323*** (0.695)
Observations	817	817	820	808	820	820	808	820
Projects	111	111	114	114	114	114	114	114
R-squared	0.10	0.10	0.20	0.20	0.23	0.19	0.19	0.20
Year dummies	Yes							

Robust standard errors in parentheses. Standard errors are clustered by firm.

Columns (1) to (2): The dependent variable is the ratio of total liabilities to total assets (book values). Column (2) is identical to column (1) except that the lending interest rate is replaced by the interest rate spread (including the interaction term).

Columns (3) to (8): The dependent variable is the natural logarithm of real liabilities. Column (3) uses the full sample, column (4) excludes extreme outliers and column (5) is identical to column (3) except that the interest rate is lagged one period. Columns (6) to (8) replicate columns (3) to (5) respectively, with the lending interest rate replaced by the interest rate spread (including the interaction term).

*** p<0.01, ** p<0.05, * p<0.1

7. Conclusion

PPPs and concession contracts have become a popular mechanism for delivering big infrastructure projects. The understanding of how such projects are financed, and why, is still relatively limited however. It has been argued that private investors use leverage to secure higher prices. This is feasible if the regulator wants to avoid bankruptcy. Ehrhardt & Irwin (2004, p.47) argue that “probably the main reason why governments do not like to see private infrastructure providers go bankrupt is the fear of

service disruption”. In an emerging market context, in which country risk is already assumed to be high, regulators may be equally concerned about sending negative signals to potential investors. Either way, if regulators fear bankruptcy then firms may be able to extract higher prices and maximise their profits by increasing leverage.

In this paper we show that the firm’s ability to increase prices by using leverage is determined by the regulatory regime. When regulation is high-powered, such as in price cap regimes, prices are unresponsive to costs. In such a case, the incentive to use leverage is limited and so we would expect leverage to be lower under high-powered regulation.

To investigate this we construct a sample of 124 transport concessions in Brazil, Chile, Colombia and Peru. We include a price cap dummy to capture the power of the contract. In pooled OLS regressions we find that the price cap dummy is positive but insignificant. It is highly likely however that the choice of regulation and other contract clauses (such as government guarantees) are non-randomly assigned to projects. To deal with this endogeneity we analyse how leverage changes *within* projects when the cost of debt changes. We find that price cap firms make proportionally larger reductions in debt when the cost of debt increases. We conclude that for leveraged firms high-powered regulation reduces leverage, all else equal.

Our paper makes two further contributions. Firstly, we contribute to the scarce evidence base on the financing of infrastructure in developing and emerging markets. By sourcing financial statements directly from regulatory agencies we are able to create a panel of over 1,000 observations and analyse within-project variation. In doing so, we question some of the prevailing logic including the view that infrastructure investors have a strong preference for debt over equity (World Bank 2012). If this were true, we would expect leverage to increase in profitability as it is easier for firms to meet lenders’ requirements (Yescombe 2007). Instead, we find that leverage falls in profitability. We also find that leverage falls as stock markets become more developed. Secondly, we contribute to the literature on incomplete contracting and renegotiation. The high frequency of renegotiation in Latin American concessions has been identified elsewhere (Guasch et al 2007, Guasch 2004) although the role of financial performance in triggering renegotiations has not been explored. We provide what is perhaps encouraging evidence: financial performance does not appear to be a significant predictor of renegotiation. This reduces the concern that regulation varies on paper but not in practice.

Our results provide useful insights for regulators concerned about capital structure and prudent financial management. Given that PPPs represent significant investments, particularly for developing countries, even small improvements in financial management can lead to substantial cost savings. It is therefore important to understand the motivations underlying firm’s financial decisions and how they respond to changes in the policy environment. This paper provides important evidence in that direction.

Appendix

Proposition 1

The derivation follows closely Cambini and Spiegel (2011). Consider first the case $D < D_1$. Then $\varphi^*(p, D) = 0$, $\frac{\partial p^*}{\partial D} = 0$, so that $\frac{\partial Y(D)}{\partial D} = 0$, using the fact that $R_E = R_D$.

Consider now the case $D_1 < D < D_2$. Then $\varphi^*(p, D) = (1 - \frac{p^*-D}{\bar{c}})$ and $p^*(D) = a + (1 - b) \left[\frac{\bar{c}}{2} + (1 - \frac{p^*-D}{\bar{c}})T \right]$. This implies that $\frac{\partial \varphi^*}{\partial D} = \frac{1}{\bar{c}}$, $\frac{\partial \varphi^*}{\partial p} = -\frac{1}{\bar{c}}$, and $\frac{\partial p^*}{\partial D} = (1 - b)T \frac{1}{\bar{c}}$. Using the fact that

$$\frac{\partial Y(D)}{\partial D} = \frac{\partial p^*}{\partial D} - \left(\frac{\partial \varphi^*(p(D), D)}{\partial p^*} \frac{\partial p^*(D)}{\partial D} + \frac{\partial \varphi^*(p(D), D)}{\partial D} \right) T \quad (\text{A1})$$

straightforward computations lead to

$$\frac{\partial Y(D)}{\partial D} = \frac{T}{\bar{c}} \left[(1 - b) \frac{T}{\bar{c}} - b \right] \quad (\text{A2})$$

Thus $\frac{\partial Y(D)}{\partial D} > 0$ if $\frac{T}{\bar{c}} > \frac{b}{(1-b)}$. In this case, which occurs if b is small enough, the firm chooses $D = D_2$ for which its profit is maximum, while for $\frac{\partial Y(D)}{\partial D} < 0$, the firm's profit is maximized at $D = D_1$.

Finally, when $D > D_2$, $\varphi^*(p, D) = 1$, $p^*(D) = a + (1 - b) \left[\frac{\bar{c}}{2} + T \right]$, so that $\frac{\partial p^*}{\partial D} = \frac{\partial \varphi^*}{\partial D} = \frac{\partial \varphi^*}{\partial p} = \frac{\partial Y(D)}{\partial D} = 0$.

Proposition 2

If $R_E \neq R_D$ equation (A2) becomes:

$$\frac{\partial Y(D)}{\partial D} = \frac{T}{\bar{c}} \left[(1 - b) \frac{T}{\bar{c}} - b \right] + R_E - R_D \quad (\text{A3})$$

and denoting $\frac{T}{\bar{c}} \equiv z$ we have that $\frac{\partial Y(D)}{\partial D} > 0$ if $b < \frac{z - (R_D - R_E)/z}{1+z}$.

Table A1: Variable definitions and sources

Variable	Sources
<i>Leverage</i> : Total liabilities/ total assets.	“Financial sources”: Ositran; Agencia Nacional de Infraestructura (ANI); ISI Emerging Markets Database; Orbis Database.
<i>Return on Assets (ROA)</i> : EBIT/ total assets.	Financial sources.
<i>Volatility</i> : Standard deviation of ROA.	Financial sources.
<i>Price cap</i> : Dummy variable indicating whether the contract is price cap.	Project contracts, bidding documentation and renegotiation agreements available from the regulatory agencies.
<i>Renegotiation</i> : Dummy variable indicating whether there was a renegotiation of the concession contract.	Regulatory agencies, Guasch (2004), Engel et al (2009).
<i>Independent Regulatory Agency (IRA)</i> : Dummy variable indicating whether the regulator is independent of the sector Ministry.	Country legislation, Guasch (2004), Correa et al (2006), Serebrisky (2012)
<i>Investment</i> : Natural logarithm of investment commitments, in constant \$2000 (millions).	World Bank/PPIAF Private Participation in Infrastructure (PPI) database; World Bank <i>World Development Indicators</i> .
<i>Contract duration</i> : Duration of concession contract in years.	Project contracts.
<i>Minimum income guarantee</i> : Dummy variable indicating whether there is a minimum income guarantee from the government.	Project contracts, renegotiation agreements.
<i>Flexible contract</i> : Dummy variable indicating whether the contract length is flexible.	Project contracts, renegotiation agreements.
<i>Multilateral support</i> : Dummy variable indicating whether the project received financial assistance from the World Bank, Inter-American Development Bank, International Financial Corporation or Corporacion Andina de Fomento.	PPI database.
<i>GDP growth</i> : Annual GDP growth in \$2000.	World Bank <i>World Development Indicators</i> .
<i>Inflation</i> : Annual inflation (GDP deflator).	World Bank <i>World Development Indicators</i> .
<i>Interest</i> : Lending interest rate	IMF <i>International Financial Statistics</i>
<i>Spread</i> : Interest rate spread. Lending interest rate minus deposit interest rate.	IMF <i>International Financial Statistics</i>
<i>Stock market value</i> : Total shares traded on the stock market exchange/ GDP.	Beck & Demirgüç-Kunt (2009) <i>Financial Development and Structure Dataset</i> (September 2012 update).
<i>Bond capitalization</i> : Private domestic debt securities issued by financial institutions and corporations/ GDP.	Beck & Demirgüç-Kunt (2009).
<i>Corruption</i> : Government corruption. Range from 1 to 6. Higher value means less corruption.	Political Risk Service, International Country Risk Guide.

Table A2: Regulation summary

Country	Sector	Regulator	Projects	Revision < 5 years (Y/N)	Inflation/ER adjustment (Y/N)	Adjustment frequency (Years)
Brazil	Road	DNER/ ANTT	“First phase” federal projects	Y	Y	1
Brazil	Road	ANTT	“Second phase” federal projects	Y	Y	1
Brazil	Road	DER Parana	All	N	Y	1
Brazil	Road	DAER (Rio Grande do Sul)	All	N	Y	1
Brazil	Rail	RFFSA/ ANTT	Federal freight concessions	N	Y	1
Brazil	Rail	ASEP RJ/ AGE TRANSP	Rio metro	N	Y	1
Brazil	Rail	ASEP RJ/ AGE TRANSP	SuperVia	N	N	.
Chile	Road	MOP	All	N	Y	≤1
Chile	Air	MOP	All	N	Y	0.5
Col	Road	Invias/ INCO	All	N	Y	≤1
Col	Rail	Invias/ INCO	Federal freight concessions	N	Y	1
Col	Air	Aerocivil	All	N	Y	≤1
Col	Port	MOT/INCO	All	Y	N	.
Peru	Road	OSITRAN	All	N	Y	0.5
Peru	Rail	OSITRAN	All	N	Y	1
Peru	Air	OSITRAN	Co-pay contracts	N	Y	1
Peru	Air	OSITRAN	RPI-X contracts	N	Y	1
Peru	Port	OSITRAN	All	N	Y	1

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