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Do Infrastructure Reforms Reduce the Effect of Corruption?

Theory and Evidence from Latin America and the Caribbean

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Abstract

This paper investigates the interaction between corruption and governance at the sector level. A simple model illustrates how both an increase in regulatory autonomy and privatization may influence the effect of corruption. The interaction is analyzed empirically using a fixed-effects estimator on a panel of 153 electricity distribution firms across 18 countries in Latin America and the Caribbean from 1995–2007. Greater corruption is associated with lower firm labor productivity, but this association is reduced when an independent regulatory agency is present. These results survive a range of robustness checks, including instrumenting for regulatory governance, controlling for a large range of observables, and using several different corruption measures. The association between corruption and productivity also appears weaker for privately owned firms compared to publicly owned firms, though this result is somewhat less robust.

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Do infrastructure reforms reduce the effect of corruption? Theory and evidence from Latin America and the Caribbean

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Corruption is a major problem that can reduce growth and worsen productivity (Bardhan 1997; Lambsdorff 2005). One type of activity that is particularly vulnerable to corruption is the operation of network infrastructure (Bergara, Henisz, and Spiller 1998; Dal Bó 2006; Estache and Trujillo 2009). As a result, practitioners and researchers have become increasingly interested in ways to reduce the impact of corruption on infrastructure performance (Estache and Wren-Lewis 2011). However, little evidence exists on whether the major sectoral reforms that have been implemented have had a significant influence on the effects of corruption. Two important components of reform have been privatization and the creation of independent regulatory agencies (IRAs). This paper analyzes the impact of these reforms with regard to their interaction with national corruption levels. A simple model demonstrates how ownership and regulatory autonomy may influence the effects of corrupt behavior. The resulting propositions are analyzed empirically by considering the productivity of electricity distribution firms in Latin America and the Caribbean (LAC) over the period 1995–2007.

A number of previous studies have focused on the effect of corruption on infrastructure performance. The study closest to the work of this paper is that of Dal Bó and Rossi (2007), who find that corruption is associated with inefficiency among electricity distribution firms in Latin America. However, these authors do not focus on how this association interacts with regulation and privatization, partly due to a lack of data on regulatory governance.[1] Another set of papers have used recently collected data on regulatory governance to consider the impact of regulatory reforms in more detail, including Gutiérrez (2003a), Montoya and Trillas (2007), Cubbin and Stern (2006), and Zhang, Parker, and Kirkpatrick (2008). In particular, Andres, Azumendi, and Guasch (2008) produce evidence that better regulatory governance and privatization increase

[1]Other studies include Guasch and Straub (2009), who examine the effect of corruption on renegotiation, and Estache, Goicoechea, and Trujillo (2009), who consider the impact of corruption on country-level measures of access, affordability, and quality. Clarke and Xu (2004) take a different approach by considering the effect of reforms on petty bribery to utility firms.

the productivity of electricity distribution firms in LAC.[2] However, they do not consider the role of corruption.

The main contribution of this paper is its evaluation of how the impacts of regulatory autonomy and privatization are related to corruption. The question is empirically interesting because theoretically, the interaction of corruption with these reforms is ambiguous (Boehm 2009; Martimort and Straub 2009).

Overall, the empirical analysis suggests that regulation by an IRA significantly reduces the association between corruption and inefficiency. Indeed, variations in countries' corruption levels appear to explain a substantial proportion of the heterogeneity in the effects of both regulatory independence and privatization.

The analysis uses annual firm-level data on 153 electricity distribution firms across 18 countries along with detailed measures of their respective IRA's governance. To control for time-invariant omitted variables, the regressions use a firm fixed effects model. The main results are robust to a range of permutations, allowing for firm-specific corruption effects and including a large range of additional control variables. Moreover, the results are robust to instrumenting for the reform variables and corruption. The negative association of corruption and its interaction with independent regulation also remain when two alternative corruption measures are used, one of which is based on firm surveys and the other on observed corruption in Brazil. In contrast, the interaction between corruption and private ownership appears somewhat less robust, with the relevant coefficient losing significance when other corruption measures are used.

The paper proceeds as follows. In the following section, a simple model illustrates how corruption, privatization, and the regulatory structure may interact in their effect on labor productivity. In this model, regulatory autonomy decreases the ability of corruptible politicians

[2]For surveys of the empirical literature on privatization in developing countries, see Parker and Kirkpatrick (2005); Megginson and Sutter (2006); Boubakri, Cosset, and Guedhami (2008).

to interfere in the regulatory process. Privatization works through a different mechanism: it reduces the proportion of corrupt proceeds that are used to over-employ. Section II describes the data and outlines the empirical methodology used, which is based on estimating a labor demand function. The results are analyzed in Section III, both graphically and econometrically. Details of several robustness checks are provided in Section IV, including the addition of a large range of control variables, instrumentation for key variables, and the use of alternative corruption measures. The section also explores the effect of the relevant variables on measures of quality and prices. Finally, Section V concludes and suggests policy lessons.

I Theoretical Model

To provide a framework for the empirical analysis, a simple model is constructed that outlines a potential mechanism through which corruption may interact with regulatory autonomy and ownership in its impact on productivity. The model is intended to provide one potential framework for thinking about the link between corruption, labor productivity, regulatory independence, and privatization. It is not meant to suggest that this is the only way in which these variables interact; in reality, the relationship is likely to be multifaceted.

The model is a static game among four actors: society, a regulated firm, and two intermediaries whose role is to supervise and regulate the firm on behalf of society - a politician and a regulator. In this model, corruption is defined as occurring when one or more of the intermediaries collude with the firm in a way that is detrimental to society. Such corruption is made possible by an asymmetry of information between society and the other actors regarding the firm's costs.[3]

[3]The model therefore follows a tradition of modeling corruption in a three-tier hierarchy, as in Spiller (1990) and Laffont and Tirole (1991). Within this literature, other models also consider a situation with multiple supervisors (see, for example, Laffont and Martimort (1999)), and Estache and Wren-Lewis (2009) argue that it is important to consider the multiplicity of actors involved in the regulatory process.

The model focuses on the amount of labor employed by the firm, L, to produce a required level of output, Q. The focus on labor is reasonable because capital inputs are closely related to both the number of connections and the geographical area of distribution and are therefore treated in the literature on electricity distribution as exogenous in the short run (Neuberg 1977; Kumbhakar and Hjalmarsson 1998; Dal Bó and Rossi 2007). The required output level Q can also be treated as exogenous because it represents the obligation to provide electricity as demanded to a given set of consumers, which is the mandate of the firms in the sample (Dal Bó and Rossi 2007). Therefore, I consider productivity to be labor productivity in both the model and the subsequent empirical analysis because this is the variable most likely to be under the firms' direct control.

To produce the output Q, the firm must employ at least $L(Q)$ people. From the point of view of society, there is some uncertainty over the number of people the firm needs to employ. With probability ν, the firm only needs to employ $L(Q)$ workers to produce Q, but with probability $1-\nu$, the firm must employ $(1+\gamma)L(Q)$ workers. Assuming an exogenous wage rate w, the firm's total costs are thus either $wL(Q)$ or $w(1+\gamma)L(Q)$. The firm receives revenue from society to cover its costs; this revenue may arise fromcharging consumers or receiving a transfer from the government. Society wishes to minimize the revenue that the firm receives on the condition that the firm has enough revenue to cover its costs.

Society has two agents in charge of deciding the firm's revenue, a regulator and a politician, both of whom are aware of the firm's true costs. It is assumed that society can strongly punish agents who set a firm's revenue above $(1+\gamma)wL(Q)$ because such behavior is against society's interests in all situations. The range between $wL(Q)$ and $(1+\gamma)wL(Q)$ therefore represents the discretion given to the supervisors. It is assumed that, to a certain extent, the politician is motivated to act in the interests of society but may also be motivated by promises of personal gain. In particular, I consider a situation in which the firm can make an offer to the politician that

involves sharing part of any excess revenue that the firm receives.[4] The politician may either be honest or dishonest, with the probability of dishonesty being $\phi(c)$, where c is a measure of the overall level of corruption in the country. It is assumed that the probability that the politician is dishonest is increasing in the national corruption level in the country, i.e., $\phi'(c) > 0$. If the politician is honest, then he or she will never accept a bribe. If the politician is dishonest, then he or she would rather accept the bribe and attempt to set the firm's revenue at the maximum that he or she can get away with. We assume that information on bribes paid and the firm's true costs are unverifiable "soft" information and hence cannot be credibly transmitted to society.

If the regulator is not independent of the politician (e.g., the regulator is located in a government ministry), then we assume that the politician has de facto control of the firm's revenue and that the regulator does not play a significant role. However, if the regulator is independent, then with probability α, the regulator will block any attempt by the politician to set the revenue above the firm's true costs.[5] Consider, for instance, a case in which the firm is over-paying for some input and is purchasing this input from a company owned by the politician. If the regulator is within the politician's ministry, then the regulator is more likely to bow to the politician's will to allow the purchase than if the regulator is in an independent organization.

The firm's payoff function is such that it wishes to maximize its revenue. If its revenue is greater than its costs, the excess will be split among any bribed agents and parties within the firm. A proportion $0 < \pi < 1$ of the excess revenue that the firm receives is distributed among various actors as "profits", bribes, or greater income for employees. The remaining proportion $1 - \pi$ is spent on employing a greater number of workers than necessary. This remainder represents the part of the pie given to employees whose wages are relatively inflexible

[4]For the purposes of the model, it is not necessary to specify the size of this share. We simply require that the share needed to persuade the politician is sufficiently small that there is always enough money to bribe.

[5]We assume that the regulator cannot overrule the politician in the other direction - that is, set revenue high when the politician is not corrupted. In a more general model where this is possible, the creation of an independent regulator would have ambiguous effects with regard to corruption.

and who would otherwise be unemployed and essentially provides the link between the firm receiving excess revenue (through corruption) and over-employment. To keep the model general, I abstract from the exact mechanism through which this split occurs. One possibility is that managers who successfully pursue corrupt activities expend less effort on ensuring efficient employment levels, as in Dal Bó and Rossi (2007). Alternatively, if the the workers are aware of the firm's true costs, they may need to receive a share of the corruption proceeds to be persuaded not to blow the whistle.

The timing of the game is then as follows:

1. The firm's true labor needs and the supervisor's corruptibility is made known to all actors except society.

2. The firm may offer a (revenue-contingent) bribe to the politician.

3. The firm's revenue is set.

4. Any excess revenue received by the firm is shared among the relevant parties.

Let us now solve the model for the expected level of labor employed in equilibrium. With probability $1 - \nu$, the firm is high cost, and hence the labor employed will be $(1 + \gamma)L(Q)$. In contrast, with probability ν, the firm is low cost. In this case, we need to evaluate the probability that the firm is allowed to receive excess revenue. If the politician is honest, then he or she will not accept a bribe, and the firm will receive no more revenue than necessary. In contrast, if the politician is dishonest, then he or she will accept a bribe and attempt to set revenue at the higher level. If the regulator is not independent, then the politician will succeed with certainty, whereas if the regulator is independent, the politician will succeed only with probability $1 - \alpha$. Hence, conditional on the firm being low cost, the overall probability of the firm being allowed

excess revenue is therefore $\phi(c)(1-\alpha 1_{IRA})$, where 1_{IRA} is an indicator function that takes the value 1 when the regulator is independent and zero otherwise.

Given this situation, the expected amount of labor employed is

$$L = L(Q)\left[1+(1-\nu)\gamma+\nu\gamma(1-\pi)\phi(c)(1-\alpha 1_{IRA})\right]. \quad (1)$$

In this equation, we can see that the "excess" labor employed is proportional to the average revenue received corruptly. Taking logs and then approximating gives the following equation:

$$ln(L) \approx ln(L(Q))+(1-\nu)\gamma+(1-\pi)\phi(c)(1-\alpha 1_{IRA})\gamma. \quad (2)$$

The effect of a change in corruption levels on the log of labor employed can therefore be gathered by differentiating this equation:

$$\frac{dln(L)}{dc} \approx (1-\pi)\phi'(c)(1-\alpha 1_{IRA})\gamma. \quad (3)$$

Having derived a relationship between corruption and employment, let us now consider the role of policy reforms.[6]

Privatization typically involves transferring firm ownership from the state to an organization that is focused on maximizing profits. The change in ownership is likely to create an extra outlet for the firm's excess revenue: owners' profits. In the context of the model, privatization can therefore be viewed as an increase in π.[7]

[6]For the purposes of this model, we abstract from the reasons why these reforms are implemented. Because corrupt politicians may lose out from the reforms, one potential explanation is that these reforms are a response to pressure from outside actors, including citizens and international bodies. See Section IV for a brief discussion of such motivations.

[7]This effect is similar to the effects of privatization in Shleifer and Vishny (1994), where privatization decreases the relative influence of those pushing for excess labor compared to profit-motivated managers. Bai et al. (2000) also discusses why state-owned firms may be required to use their funds to over-employ.

Independent regulatory agencies are independent in the sense that they are not part of a government ministry or subject to direct executive control. Therefore, they are viewed as less sensitive to the will of political elites (Andres, Azumendi, and Guasch 2008). Their role is to implement regulatory policy, which may include setting tariffs, publishing information on firms' performance, and enforcing agreed standards of quality and supply. In the model above, it is therefore reasonable to assume that this reform creates the potential for the regulator to "block" corrupt political behavior.[8]

Modeling the two reforms in this way leads to the following proposition:

Proposition 1. *For a given output Q, labor employed by the firm is increasing in the national level of corruption. Moreover,*

- *(a) This effect is greater if the firm is public rather than private.*
- *(b) This effect is smaller if the regulator is independent.*

A rise in the national corruption level increases the probability that the firm will be able to bribe the politician. This situation then increases employment because part of the gains that the firm makes from this corruption will be shared with labor through excess employment.

Privatization reduces the effect of corruption in this model because fewer of the corrupt gains are distributed to workers through excess employment. Note, however, that privatization does not reduce the amount that the firm receives as a result of corrupt behavior; hence, consumers and taxpayers do not benefit directly from this increase in productivity. An IRA's

[8] An alternative model could consider the idea that a regulator's independence might directly impact the way in which rents are shared within the firm in a way similar to privatization. For example, more transparent regulation may reduce the rents that workers obtain from holding more information than owners or politicians. In such a model, greater independence could then reduce the impact of corruption on labor productivity without an effect on revenue. However, such a model is not investigated here because revenue setting is generally considered to be a regulator's primary role.

creation reduces the politician's power and diminishes the effect of the politician's corruption on productivity. The interaction between corruption and IRA creation is therefore negative.

Overall, the model provides a simple framework for considering the potential relationship among corruption, labor productivity, and infrastructure reforms. An important point is that the model does not generate welfare implications. Because any change in productivity also results in a redistribution of revenues, reforms may simultaneously increase productivity and decrease welfare.

II Data and Empirical Strategy

In this section, we move to the empirical analysis. After describing the data sources used, we describe the econometric methodology, followed by a discussion of the identifying assumptions and the manner in which we should interpret our results.

Data

The empirical analysis is based on the electricity distribution sector in countries in Latin America and the Caribbean from 1995–2007. The electricity distribution sector has many of the properties that are typical of network infrastructure, including close government regulation and limited direct competition. Moreover, the period includes a number of important reforms as well as substantial variation in the level of corruption, both within and between countries.

Data on firm performance are from the World Bank Latin American and Caribbean Electricity Distribution Benchmarking Database. This database contains data on 249 utilities across 25 countries between 1995–2007. Overall, the firms represent 88% of all electricity connections in the region. Each utility firm operates in only one country. The main analysis uses data on the total number of employees, the total number of connections, total electricity sold (in GWh),

Table 1: **Summary statistics**

Panel A: Firm characteristics	Mean	Std. Dev.	Minimum	Maximum
Employees	1,337	3,479	12	40,970
Connections	668,958	1,771,628	2,499	23,265,575
Electricity (GWh)	3,619	11,201	3	140,283
Interruption frequency (No. per year)	35	61	0	533
Interruption duration (hrs per year)	33	61	0	705
% of electricity lost	16	10	2	72
Avg. residential tariff ($)	84	30	11	177
Avg. industrial tariff ($)	75	25	9	147

Panel B: Corruption index				
Argentina	0.22	0.41	-0.29	0.71
Bolivia	0.14	0.51	-0.29	0.71
Brazil	0.01	0.61	-1.29	0.88
Chile	-0.97	0.64	-1.79	0.21
Colombia	0.30	0.55	-0.29	1.21
Costa Rica	-0.99	1.42	-2.29	1.21
Dominican Republic	0.19	0.90	-1.29	0.71
Ecuador	-0.23	0.43	-0.70	1.09
El Salvador	-0.51	0.67	-1.29	0.21
Guatemala	-1.23	0.10	-1.29	-1.12
Haiti	1.38	0.35	0.80	1.71
Honduras	0.61	0.21	0.21	0.80
Jamaica	1.21	0.00	1.21	1.21
Mexico	0.32	0.51	-0.70	0.71
Nicaragua	-0.25	0.68	-1.29	0.21
Panama	0.71	0.00	0.71	0.71
Peru	-0.07	0.43	-0.95	0.71
Uruguay	-0.29	0.00	-0.29	-0.29
Full sample	0.00	0.82	-2.29	1.71

Panel C: Regulators and firms	IRA		No. of Firms, by ownership		
	Start year	ERGI	Private	Public	Changed
Argentina	1996[a]	0.64[a]	2	2	3
Bolivia	1996	0.84	1	0	6
Brazil	2000[a]	0.71[a]	10	4	21
Chile	1990	0.56	23	0	0
Colombia	1994	0.76	0	16	4
Costa Rica	1996	0.74	0	8	0
Dominican Republic	1998	0.75	0	0	2
Ecuador	1999	0.61	0	19	1
El Salvador	1997	0.82	1	0	4
Guatemala	1996	0.79	1	0	0
Haiti	1983	0.37	0	1	0
Honduras	1995	0.56	0	1	0
Jamaica	1997	0.72	1	0	0
Mexico	1995	0.72	0	2	0
Nicaragua	1985	0.75	0	0	2
Panama	1996	0.63	0	0	3
Peru	1996	0.84	2	7	7
Uruguay	2000	0.73	1	0	0
Overall median/total	1997	0.72	41	61	53

Source: World Bank; International Country Risk Guide

[a] For Argentina/Brazil, regulatory statistics given are the median of the province/state regulators.

and whether the firm is privately managed. Summary statistics of the firms' characteristics are provided in Panel A of Table 1.

Data on corruption are from the International Country Risk Guide, which contains annual country-level data. I use this dataset because it is specifically designed to allow for comparisons between years and countries and contains observations for the entire period for which there are data on firms' performance. The ICRG corruption index is designed to capture the likelihood that government officials will demand special payments and the extent to which illegal payments are expected throughout government tiers as ranked by panels of international experts. The ICRG index ranges globally between 6 (highly clean) and 0 (highly corrupt). To clarify the results, I reverse the ordering of the data such that greater values represent higher levels of corruption, and I transform the data such that the mean level of corruption in the total sample is 0. A positive value therefore represents an environment in which corruption is above the sample average, whereas a negative value represents a level of corruption below the sample average. Panel B of Table 1 provides summary statistics of the variables by country.

Data on regulatory governance are from Andres et al. (2007) and include information on national electricity regulators in more than 20 countries as well as information on provincial regulators for certain states in Brazil and provinces in Argentina. The data are compiled from a survey containing more than 50 different questions to produce indices of various aspects of regulatory governance, including accountability, autonomy, and transparency. These include questions such as whether the regulator is financed directly by the government, whether minutes are available publicly, and the way in which the head of the agency is appointed. I primarily use the Electricity Regulatory Governance Index (ERGI) constructed by Andres et al. (2007), where a rating of 0 represents the worst possible measure of governance and 1 represents the best. For Argentina and Brazil, I use data on the provincial and state regulatory agencies because the regulation of electricity distribution firms is conducted at this level. Henceforth,

the term "province" means the area for which the regulatory agency is responsible (the country, state, or province, as appropriate). Panel C of Table 1 provides summary statistics of the regulatory governance index (ERGI) and when the agencies were created. The data are cross-sectional, but because they include the year in which each regulatory agency was created, I transform the data into a panel by giving zero values to all variables in each year before the agency's creation.[9]

In total, these three data sources combine to create a database of 153 firms across 18 countries with a total of 1,359 observations (this is the largest possible intersection of the three datasets). Panel C of Table 1 shows the number of firms of each type in each country. Of the 153 firms, 53 change ownership over the period (all but three from public to private), whereas 66 begin in the sample without a regulator and then become regulated.

Econometric Methodology

Kumbhakar and Hjalmarsson (1998) note that although productivity in electricity generation is mainly determined by technology, productivity in distribution is largely driven by management and efficient labor use. Moreover, because electricity distribution is highly regulated, decisions on technology and capital are likely to be outside of the firm's control, whereas the firm typically has control over labor. I therefore focus on labor productivity. Electricity distribution firms in the sample have the obligation to meet demand. We can therefore consider the amount of electricity sold to final customers and the number of final customers served to be exogenous outputs.

I follow Dal Bó and Rossi (2007) in estimating a parametric labor requirement function.

[9] I am therefore implicitly assuming that regulatory governance remains constant during the reign of the agency and that it is unrelated to the quality of regulation prior to the creation of the agency. This is obviously a strong assumption, but if it has any effect on my results, it is likely to bias them toward insignificance. Therefore, it should not be of great concern when interpreting the results.

In particular, I use a translog functional form because it provides a good second-order approximation to a broad class of functions. Included in this function are the number of electricity connections the firm serves and the amount of electricity it sells. This equation for a panel of $i = 1, , N$ firms producing in $c = 1, , C$ countries and observed over $t = 1, , T$ periods may therefore be specified as follows:

$$\begin{aligned} l^{i,t} &= \alpha_i + \psi_t + \omega_1 y_1^{i,t} + \omega_2 y_2^{i,t} + \omega_3 \left(y_1^{i,t}\right)^2 + \omega_4 \left(y_2^{i,t}\right)^2 + \omega_5 y_1^{i,t} y_2^{i,t} \\ &\quad + \beta_1 Cor^{c,t} + \beta_2 Cor^{c,t} * Pri^{i,t} + \beta_3 Cor^{c,t} * IRA^{i,t} + \beta_4 Pri^{i,t} + \beta_5 IRA^{i,t} + \epsilon^{i,t}, \end{aligned} \tag{4}$$

where l, y_1, and y_2 are the natural logarithms of labor, sales, and customers, Cor is the level of national corruption, Pri is a dummy variable for private ownership, IRA is a dummy variable indicating whether the firm is regulated by an IRA, the ω and β terms represent the coefficients on the variables, and ϵ is the random error term. Because each firm is present in only one country, there is a unique mapping from firm i to country c.

Firm fixed effects are included to control for any time-invariant unobservables, represented as α_i in the equation above.[10] Because each firm is present in only one country/province, this approach controls for any time-invariant unobservables at the country/province level. Hence, the corruption and regulation terms are estimated based only on changes in these variables within countries/provinces over time. To account for time effects in a flexible way, I include year fixed effects ψ_t. The year fixed effects measure the productivity impact of sector-level shifts over time, such as secular technology trends, international macroeconomic fluctuations,

[10]In addition to electricity produced and connections, Dal Bó and Rossi (2007) also include the service area as an exogenous output and transformer capacity and the length of the distribution lines as exogenous capital variables. Unfortunately, the first two of these variables are not available in the extended dataset used here, and including the latter reduces my sample by more than half. However, because these variables vary little over time, they are likely to be controlled for by using firm fixed effects. I test for this by performing the regressions with the length of distribution lines included in the translog function and find the variable to be insignificant, with no significant changes in my results. Moreover, using the dataset from Dal Bó and Rossi (2007), I find that their results are insensitive to the removal of the service area and transformer capacity from the labor demand function.

or energy price shocks. Standard errors are clustered on country-year combinations to address the concern that the shocks affecting firms in a given country in the same year may be correlated.

Overall, the estimated equation resembles Equation (2) from the theoretical model. Proposition 1 predicts that $\beta_1 > 0$ and $\beta_2 < 0$, with $|\beta_1| > |\beta_2|$ and $\beta_3 > -\beta_1$. Although the model also suggests that there should be an interaction between ownership and regulation, unfortunately, this cannot be analyzed empirically in this study because there are very few observations of unregulated private firms in the sample.

Discussion

The identification strategy described above exploits variation over time in corruption and infrastructure reforms. This variation may be driven by a range of factors, including changes within government, the number of years since the government has been elected, and policy makers learning about best practices.[11] Because we cannot precisely identify the causes of such variation, we must be cautious when drawing inferences from the results. In particular, factors that lead to variations in corruption and reform may also affect firms' productivity in other ways. To the extent that such alternative channels are observable, we can rule them out by adding extra control variables. I undertake such robustness checks in Section IV. However, a particular concern may be that countries carry out the observed reforms as part of a package of changes designed to improve performance or reduce corruption, and other (unobserved) parts of the package may thus have a significant impact. If this is the case, we cannot identify how many of the resulting productivity changes are the results of the measured reforms and how many of these changes relate to other parts of the reform package. Thus, when interpreting the

[11] Spiller and Tommasi (2005), for instance, argue that regulatory independence is more likely to occur when there is a greater division of powers and less preference homogeneity across government.

results, it is important to bear in mind that it is not necessarily the particular aspect of reform measured that is driving changes in productivity, and it should not be assumed that the reform in question would have exactly the same impacts elsewhere (Joskow 2005). Nonetheless, it is useful for guiding both policy and future research to understand whether significant changes in productivity have accompanied these sector reforms. If the aspects of reform measured here explain significant productivity changes better than other observables, this brings us closer to understanding how policy can affect firm performance.

A second concern that may arise with the outlined methodology is the risk of reverse causality, which would arise if changes in firms' productivity affected our independent variables. In the case of corruption, reverse causality seems unlikely to be a concern. Sector-specific shocks will generally not affect country-level corruption, whereas economy-wide shocks are likely to be captured by the use of control variables such as GDP per capita in Section IV. However, reverse causality could be a problem in the case of sectoral reforms because under-performing firms might encourage such reforms. However, this is likely to be more of an issue over the longer term because reform decisions are unlikely to be strongly influenced by poor performance over a small number of years. This issue is therefore unlikely to bias our results given the use of firm fixed effects. However, to check for reverse causality, an instrumental variable approach is used in Section IV.

Finally, it should be noted that in the model above, corruption and infrastructure reforms are treated as independent of one another. In reality, the two may well be correlated - for example, corrupt governments may reform less, or corruption may be reduced through a broad package of regulatory reforms. For our empirical methodology, however, this is not a serious problem because both variables appear simultaneously on the right-hand-side of our regression.

III Empirical Results

Before beginning the econometric analysis using the methodology described above, we present the data graphically to consider the links among inefficiency, corruption, and regulatory governance.

Graphical Analysis

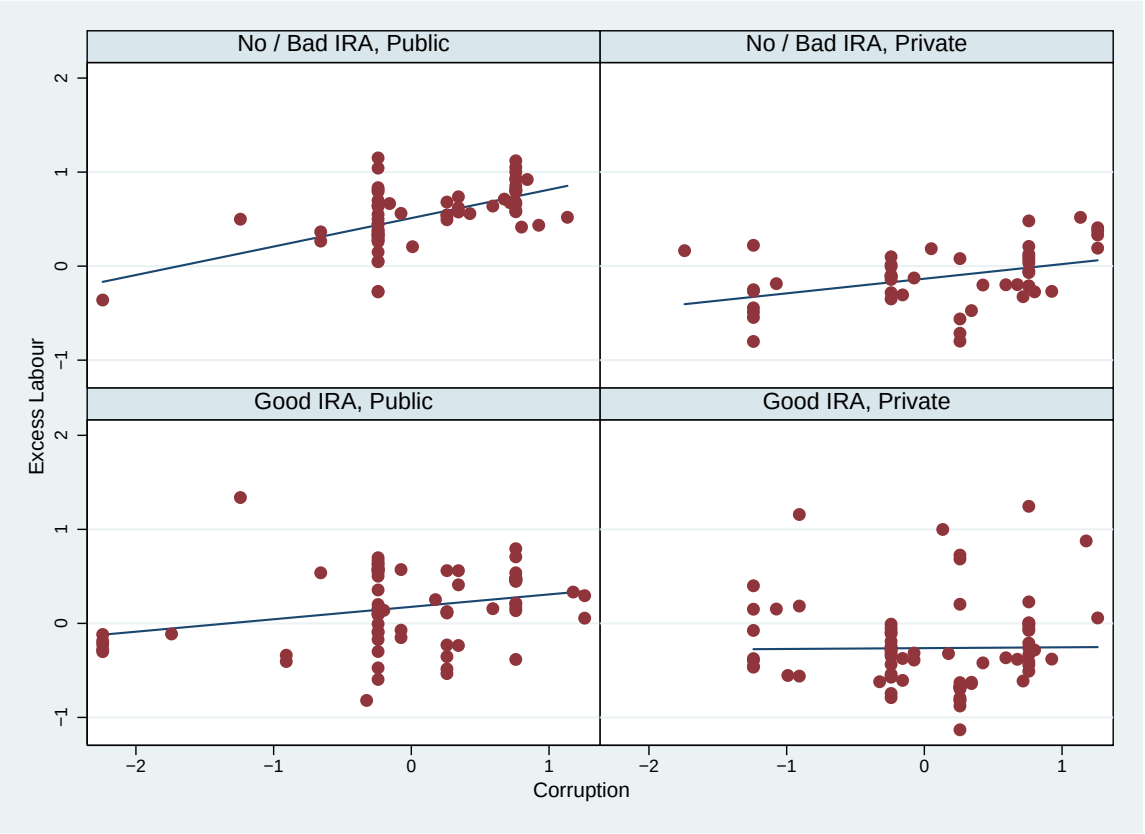
For this subsection, inefficiency is measured by regressing the log of employees on the translog function described in the first line of Equation (4) and storing the residuals.[12] This creates a measure of "excess labor", which gives us an idea of how productive the firm is in any year compared to the average of all firms over the whole period.

Figure 1 plots excess labor against corruption separately for firms in four different environments. The upper two panels consider observations of firms operating under either no IRA or a "bad" IRA (i.e., below-median ERGI score), whereas the lower two panels consider observations of firms operating under "good" IRAs (i.e., an above-median ERGI score). These pairs are then divided into publicly operated firms on the left panel and privately operated firms on the right.

Both reforms appear to affect the relationship between corruption and inefficiency (Figure 1). The upper left panel, where firms are publicly owned and not regulated by an above-average IRA, shows the clearest positive relationship between corruption and inefficiency. The upper right and lower left panels show that the relationship between corruption and inefficiency is weaker for firms that are either privately operated or regulated by an IRA with above-median governance. Moreover, there appears to be no clear relationship between corruption and inef-

[12] Firm and year fixed effects are not included in this graphical analysis.

Figure 1: **Inefficiency and Corruption by Ownership and IRA Governance**



Source: Author's analysis based on data from the World Bank and the International Country Risk Guide
Note: Excess labor is the residual when labor is regressed on the translog function of firm outputs. An IRA is categorized as "bad" or "good" depending on whether its ERGI score is above or below median. The points plotted are averages across firms for a given country-year after observations have been divided according to their ownership and regulation.

ficiency when both of these reforms are undertaken, as shown in the lower right panel. I now investigate these results more formally using an econometric analysis.

Econometric Analysis

The results of the econometric analysis outlined in Section II are presented in Table III. The coefficients on the translog function and year dummies are not reported to save space. It is worth noting that coefficients on the terms in the translog function are reasonable, suggesting

that firms have increasing returns to scale.[13] The coefficients on the translog function are very similar if the sample is split into private and public firms, supporting the assumption that the translog function is relatively unaffected by ownership.

Table 2: **Baseline Regression**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Corruption	0.21***	0.21***	0.21***	*0.34***	0.17**	0.20***	0.35***
	(0.033)	(0.028)	(0.028)	*(.017)*	(0.072)	(0.026)	(0.039)
Corruption × private	-	-	-	-0.26***	-	-0.054**	-0.10**
	0.092***	0.084***	0.084***		0.076***		
	(0.025)	(0.024)	(0.023)	(0.057)	(0.022)	(0.021)	(0.049)
Corruption × IRA	-0.14***		-0.14***	-0.14***	-0.099	-0.15***	-0.25***
	(0.032)		(0.027)	(0.027)	(0.074)	(0.023)	(0.037)
Private dummy	-0.29***	-0.26***	-0.26***	-0.27***	-0.26***	*-0.25***	-0.43***
	(0.036)	(0.035)	(0.035)	(0.036)	(0.041)	*(0.026)*	(0.042)
IRA dummy	-0.021				*-0.022*		
	(0.037)				*(0.23)*		
Bad IRA dummy		0.12***	0.12***	0.12***		0.14***	-0.072*
		(0.037)	(0.036)	(0.041)		(0.038)	(0.041)
Good IRA dummy		-0.11***	-0.11***	-0.13***	-0.19***	-0.14***	-0.27***
		(0.038)	(0.038)	(0.040)	(0.037)	(0.031)	(0.035)
Corruption × bad IRA		-0.14***					
		(0.037)					
Corruption × good IRA		-0.14***					
		(0.027)					
Firm dummies	Yes	Yes	Yes	Yes	Yes	Yes	
Country dummies							Yes
Corruption * firm dummies				Yes			
IRA * country dummies					Yes		
Private * country dummies						Yes	
Observations	1359	1359	1359	1359	1359	1359	1359
Number of firms	153	153	153	153	153	153	153
Adjusted R^2	0.35	0.37	0.37	0.45	0.39	0.41	

Source: Author's analysis based on data from the World Bank and the International Country Risk Guide
Note: The dependent variable is ln(labor employed). In all cases, we are estimating a translog labor requirement function with year dummies and firm fixed effects. To save space, the technological parameters of the translog function are not shown. Country-year clustered standard errors in parentheses. Coefficients shown in italics are the mean effects across firms/countries, with standard errors calculated accordingly.
*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

[13]The coefficients suggest that if both output measures were to double, then the increase in labor required would be 59%. This is very close to the value obtained using the data from Dal Bó and Rossi (2007), which suggest that a doubling of outputs requires a 62% increase in employees.

Column (1) of Table III explores the association between corruption and productivity. We can see that the coefficient on the corruption term is positive and strongly significant, which suggests that higher corruption levels accompany a greater number of workers employed for a given function of outputs. However, we also see that corruption interacts significantly with both the private ownership dummy and the dummy indicating the presence of an IRA. In both cases, the coefficient is negative and of a smaller magnitude than the coefficient of corruption. This finding suggests that the negative relationship between corruption and productivity is significantly reduced if the firm is either privately owned or regulated by an IRA. These results are consistent with Proposition 1 in the theoretical model above.[14]

It is also informative to consider the terms that do not involve corruption. The coefficient on the IRA dummy in column (1) is insignificant. Given that corruption is scaled such that its mean sample value is zero, this finding suggests that the creation of a regulatory agency has no effect on productivity if corruption is at the average sample level. The significant coefficient on the private dummy suggests that private firms are more productive than public ones at average corruption levels.

Column (2) introduces a measure of regulatory governance. The "Bad IRA" dummy indicates the presence of an IRA in the bottom 30% of regulators scored on the ERGI, whereas the "Good IRA" dummy represents the presence of an IRA that has an ERGI score in the top 70% of regulators.[15] It is interesting to note that the coefficient on the "Bad IRA" dummy is significantly positive, whereas that on the "Good IRA" dummy is significantly negative, sug-

[14]The model also suggests that there may be an interaction among corruption, ownership, and regulatory autonomy. However, the introduction of this extra term is found to be insignificant. This result is likely due to the lack of firms in the sample that are privately owned and not regulated by an IRA.

[15]The 30/70 split was chosen because it maximizes the difference between the coefficients on the two terms. The difference between the two coefficients, however, remains strongly significant for a range of other splits. I have also tried entering the ERGI directly, which returns similar results. I have explored breaking down the ERGI into different governance components, but no particular component is more successful in explaining firm performance than the ERGI measure. Similarly, no governance component consistently improves upon the IRA dummy when interacting with corruption. See Wren-Lewis (2010, pp. 207-213) for more details.

gesting that governance is important when considering the link between productivity and IRA creation.[16]

In contrast, the coefficients on the two terms interacted with corruption are almost identical, suggesting that both types of regulators are equally good at mitigating the effect of corruption. Column (3) displays the results of the regression using a simpler specification in which these two coefficients are imposed to be equal. This column forms the baseline regression for the future robustness checks.

To explore the results further, columns (4)-(6) include a range of dummy variables that I interact with the variables of interest. In column (4), I allow for firms to react differently to corruption by interacting corruption with time-invariant firm dummies. The lack of reduction in the size or significance of the Corruption $\times$ private or Corruption $\times$ IRA coefficients shows that these results are at least partly driven by firms that change ownership or regulation over the period. Column (5) allows for the effect of IRA creation to vary across countries. The Corruption $\times$ IRA term becomes insignificant here, which suggests that a large part of this result is driven by differences in corruption between countries. In other words, the time variation in corruption is insufficient to give significance to this coefficient, although the coefficient does not change significantly. This finding is unsurprising given that corruption is only measured at the country level and that the variance of measured corruption across countries is greater than the variance within countries. Finally, column (6) allows for the effect of privatization to vary across countries, with the coefficient shown in italics here representing the average effect of privatization across countries. Although the coefficient on the Corruption $\times$ private term falls, it is still statistically significant at the 5% level. This finding suggests that the privatization result is only partially driven by differences in the effect of privatization across countries, with a

[16]One factor in this result may be the greater commitment ability of well-governed regulators, as detailed by Levy and Spiller (1994)

significant portion of this result stemming from a difference in the reaction of firms to temporal changes in corruption levels.

Finally, column (7) shows the results of the regression conducted with country dummies rather than firm dummies. Here, we see that the results remain broadly similar, although the coefficients on the reform variables are more negative. This result suggests that within countries as well as across time, firms that are privately owned and/or better regulated employ less labor.

Let us consider the size of the various effects by studying the coefficients on the variables in column (3). Focusing on the coefficient on corruption, the value of .21 suggests that an increase in the measured corruption of one standard deviation (.82) is associated with a 19% increase in the amount of labor employed for a given amount of outputs. However, this finding assumes that the firm is publicly owned and not subject to regulation by an IRA. If the firm is private, then this association is reduced by approximately 40%. Alternatively, if the firm is public but subject to regulation by an IRA, then the association is reduced by approximately two-thirds. The average effect across all firms is therefore slightly smaller than that found by Dal Bó and Rossi (2007), which is consistent with their sample containing a smaller proportion of private firms and firms regulated by an IRA. The importance of governance is also substantial: firms regulated by a "Good IRA" rather than a "Bad IRA" have 25% fewer employees.

Overall, three main conclusions arise from this econometric analysis. First, corruption appears to be significantly negatively associated with labor productivity. Second, this association is reduced if the firm is either privately owned or if there exists an Independent Regulatory Agency. Third, firms operating under an IRA with a higher level of regulatory governance operate more productively.

IV Robustness Checks

In this section, we consider whether the results are robust to changes in the assumptions or methodology. The section begins by introducing extra control variables and then considers an instrumental variables approach. We also investigate the use of alternative measures of corruption, potential impacts on price and quality, and the precise timing of the impact of IRA introduction.

Extra Control Variables

One concern with the above results may be that the variables included are correlated with other omitted variables that affect firm productivity. To check for this problem, other variables can be introduced into the equation, and we can observe whether the coefficients on the original variables are affected.

Because the baseline regression includes ownership and IRA dummies linearly and interacted with corruption, to test for omitted variable bias in these coefficients, I include a range of control variables along with a term interacting each control variable with corruption. These control variables include a number of aspects of the regulatory environment, including the power of the incentive scheme and whether the electricity sector has been vertically disintegrated. I then consider a number of country-level variables, such as GDP per capita, national wage levels, and labor regulation. A selection of these variables and their sources are provided in the Appendix. Key coefficients of the regressions are reported in Columns (1) to (4) of Table 3, with the full results reported in the online appendix. Columns (1) and (2) of Table 3 report the coefficients on the control variable and the control variable interacted with corruption. We can see that several of these additional variables and their interactions are significant when introduced. However, from columns (3) and (4) of Table 3, we can see that the Corruption $\times$ IRA

and Corruption $\times$ private terms always remain significant with similar coefficients. Therefore, we can conclude that these interaction terms do not proxy for any other country-level variable. Moreover, the difference between the "Bad IRA" dummy and the "Good IRA" dummy always remains significant. Hence, I conclude that regulatory governance does not proxy for an alternative country-level variable.

To test whether corruption is proxying for an alternative variable, I include each control variable and its interaction with both private ownership and the IRA dummy. The results for a selection of the control variables used are reported in columns (5) to (9) of Table 3. Again, several of the variables and their interactions are significant, but in general, the significance of our terms of interest is not affected. On one occasion in Table 3, we can see that the coefficient on the Corruption $\times$ private term becomes insignificant. This coefficient becomes negative when the control variable of government surplus/deficit over GDP is included in the regression along with an interaction with private ownership, which may be the result of the sample size being reduced substantially (from 1359 observations to 302), but it may also make us slightly more cautious about the interaction between private ownership and corruption. A plausible hypothesis is that less fiscally responsible governments (i.e., ones with a higher deficit) are associated with inefficient public companies and that privatization has a stronger impact on productivity in these countries than in others. Because these governments are also more frequently corrupt, it appears that we cannot distinguish between whether corruption or the government's deficit is a better variable to explain the heterogeneous impact of privatization. However, we can say with some confidence that there is no evidence that an alternative control variable would explain heterogeneity in the impact of IRA introduction better than corruption. Overall, therefore, I can conclude that the results are unlikely to be driven by omitted variable bias.

Table 3: **Additional control variables**

	Control X interacted with corruption				Control X interacted with reforms				
	X	Cor × X	Cor × IRA	Cor × Pri	X	X × IRA	X × Pri	Cor × IRA	Cor× pri
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Price cap	-0.83***	-0.0045	-0.094***	-0.078***	-0.096***		0.055	-0.088***	-0.082***
Vert. disintegr.	0.77**	-0.017	-0.15***	-0.076***	0.13**	-0.076	-0.0060	-0.095***	-0.082***
ln(GDP per capita)	0.40*	0.097**	-0.14***	-0.095***	0.58**	-0.016	-0.23*	-0.13***	-0.078***
Compensation/GDP	0.0062	-0.010**	-0.14***	-0.086***	-0.060***	-0.054***	-0.013	-0.14***	-0.074***
Fuel exports/GDP	0.0014	-0.00013	-0.15***	-0.076***	-0.0032	-0.0066***	-0.0051**	-0.13***	-0.063***
Urbanisation	-0.0035	-0.0031**	-0.15***	-0.12***	-0.0026	-0.0086***	-0.00089	-0.085*	-0.079***
Exports/GDP	-0.0054***	-0.00046	-0.16***	-0.086***	-0.00083***	0.0039	-0.0062***	-0.14***	-0.068***
Shadow Economy	0.0068	0.00066	-0.17***	-0.081***	-0.0022	0.0082	-0.0071	-0.20***	-0.083***
Party's yr in office	-0.0044***	0.0020	-0.15***	-0.100***	-0.027***	0.022**	-0.0083**	-0.18***	-0.098***
Political color	-0.035***	0.015**	-0.11***	-0.086***	0.027	0.048	-0.0051*	-0.14***	-0.078***
Seperation of powers	-0.095***	0.068**	-0.15***	-0.10***	-0.012	-0.18***	0.13**	-0.13***	-0.084***
Leg. election	-0.0030	0.057***	-0.15***	-0.087***	-0.00097	-0.023	0.025	-0.14***	-0.085***
WB projects	-0.0031	0.014***	-0.14***	-0.12***	0.0012	-0.0047	0.0011	-0.14***	-0.10***
IMF agreement	-0.018	0.031	-0.12***	-0.084***	-0.084*	0.044	0.058	-0.13***	-0.085***
Leg effectiveness		0.0096	-0.13***	-0.099***		0.085	0.0070*	-0.11***	-0.10***
General strikes	-0.0049	0.046**	-0.080**	-0.11**	-0.0044	-0.039	0.046	-0.13***	-0.10***
Workers rights	-0.013	-0.019	-0.014***	-0.11***	-0.12**	0.088*	0.13***	-0.15***	-0.095***
Government defecit	0.028***	0.011*	-0.20***	-0.15***	0.082*	-0.068	0.038**	-0.17***	-0.072
Accountability	-0.0053	0.021	-0.018***	-0.075**	0.25	-0.23	-0.065	-0.19***	-0.065**
Pol. stability	-0.046	-0.0034	-0.019***	-0.071**	-0.090	0.0072	0.066	-0.19***	-0.074**
Reg. quality	-0.057	0.0055	-0.018***	-0.071**	-0.28*	0.12	0.19***	-0.17***	-0.056**
Rule of law	-0.011	-0.0069	-0.018***	-0.065**	0.28	-0.39**	0.17	-0.17***	-0.063**
Judic. Ind.	0.00018	-0.0039	-0.017***	-0.055**	0.026	-0.024	-0.0036	-0.18***	-0.057***
Poperty rights	-0.023*	0.011*	-0.017***	-0.066***	-0.046	0.018	0.0057	-0.16***	-0.055**
Credit reg.	-0.029	0.073	-0.017***	-0.058**	-0.068***	0.066*	-0.013	-0.16***	-0.060**
Labor reg.	0.0090	0.035	-0.017***	-0.055**	0.070	-0.035	-0.053	-0.17***	-0.064***
Business reg.	-0.019	0.00021	-0.017***	-0.053**	-0.065**	0.015	0.052*3	-0.16***	-0.041**
Bank deposits	-.46**	-0.11	-0.013***	-0.066**	-1.23***	0.55**	0.19	-0.16***	-0.085***
Emplmnt. elasticity	-.044***	-0.010	-0.014***	-0.080***	-0.080	0.034	0.011	-0.13***	-0.078***
Unemployment	-0.0082	0.0050	-0.013***	-0.093***	-0.018**	0.015**	-0.0046	-0.15***	-0.090***
Aid/GDP	-2.39	-1.41**	-0.014***	-0.079***	-6.20***	4.15***	-1.57	-0.15***	-0.083***
Inflation	-0.00023	0.0018	-0.013***	-0.078***	0.0027**	-0.0057***	-0.0021	-0.17***	-0.094***

Source: Author's analysis based on data from the World Bank and the International Country Risk Guide

Notes: Columns (1)-(4) report the results from the regression where the relevant control variable is interacted with corruption, and columns (5)-(9) report the results from the regression where the relevant control variable is interacted with the reform variables. The regression used is as in column (3) of Table 2. The columns report the coefficients on the relevant variables, with X representing the control variable. See also notes to Table 2

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Instrumental Variables

One way to control for the potential endogeneity of the key explanatory variables is to use an instrumental variable approach. Therefore, this subsection tests the robustness of the results to instrumenting for the potentially endogenous variables: ownership, regulatory governance, and corruption. Instruments are chosen on the basis of being strong correlates of the variables in question and being most likely to meet the exclusion restriction (of not having an alternative channel through which they affect labor productivity). Although the available instruments are imperfect, they may provide some reassurance that the results are not driven by endogeneity problems.

Although sectoral reforms were undertaken as a response to sector-specific concerns in some cases, in most instances, privatization and independent regulation were part of a wave of reforms that took place across multiple regulated sectors. Henisz, Zelner, and Guillen (2005) show that the factors that push countries toward reform include the number of reforms undertaken by trade partners and competitors as well as pressure from international donors. In the case of Brazil, for example, Prado (2012) describes how a combination of political factors and international trends led the government to undertake similar reforms across various regulated industries. Given that a large amount of the variation in the timing of reforms comes from factors that are not specific to the electricity sector, we can instrument for our reforms using indicators of reform in other sectors. In this way, we can remove any bias in our estimates that result from sector-specific endogeneity, such as electricity reform prompted by firm performance or omitted variables at the sector level.

To instrument for regulatory governance, I use measures of regulatory governance in two other sectors: telecoms and water.[17] Firm performance in the electricity sector is unlikely to

[17]For the telecoms sector, I use an index of regulatory governance constructed by Gutiérrez (2003b). For water, I use a simple dummy that indicates whether an IRA exists, which I take from Estache and Goicoechea (2005)

influence regulatory governance in other sectors, and regulation of these sectors is unlikely to affect the electricity distribution sector through any means other than the effect through regulation. It is difficult to find a suitable instrument for firm ownership because this is a firm-level variable and because other available firm-level variables are likely to affect productivity directly or to be affected by productivity. Therefore, I mustuse an instrument that is measured at the province or country level. I use dummy variables indicating whether private participation exists in various other infrastructure sectors in the province.[18] This approach provides an indication of a province's tendency to privatize network infrastructure, which is generally unaffected by the performance of the electricity distribution sector. Because these private projects occur outside the electricity sector, they are unlikely to affect electricity distribution productivity through other channels.

In their study of corruption on labor productivity, Dal Bó and Rossi (2007) find no evidence that corruption should be treated as an endogenous variable, arguing that reverse causality is unlikely to be a problem due to the relatively small size of the electricity sector in the overall economy. Nonetheless, I also instrument for corruption because we cannot rule out any potential endogeneity. The instrument used is a measure of freedom of the press, with the assumption that countries with greater press freedom have lower corruption.[19] For the exclusion restriction to hold, we must also assume that press freedom does not affect electricity performance other than through corruption. Such an assumption may be reasonable if we believe that the press may report on poor electricity performance that results from corruption but that the press is unlikely to detail poor performance resulting from other factors that are typically more

[18]This is constructed from the World Bank's PPI Project Database. The four sectors are water, gas, railways, and sea ports.

[19]Evidence for this assumption is provided, for example, by Chowdhury (2004). Dal Bó and Rossi (2007) use imports over GDP as an instrument for corruption. This is not a strong instrument for the full sample that I use, but when I restrict my sample to the period that they analyze (before 2002), I find that the instrument provides significant results similar to those reported in Table IV.

technically complex.

Estimation is undertaken using the two-stage least squares estimator, with each of the instruments and their appropriate interaction terms included in the first-stage regression. The F-statistics from the first-stage regressions suggest that the instruments are fairly strong, except for private ownership.[20] Whereas the F-stat for the first-stage regressions of the other terms range from 12.14 to 27.13, the first-stage regression for the ownership dummy has an F-stat of 9.31, and the first-stage regression for the ownership dummy multiplied by corruption has an F-stat of 1.61. This is perhaps unsurprising given the difficulties of instrumenting for interaction terms between two variables and the fact that ownership varies at the firm level, unlike any of the instruments. Nonetheless, it may suggest that we should be more cautious when interpreting the coefficients related to private ownership.

The results are presented in column (1) of Table IV. From this, we can see that the coefficients keep the same sign as in the baseline equation, and the terms previously found to be significantly different from zero generally remain so. Two exceptions are the coefficient on the "bad regulator" dummy and the coefficient on private ownership, which are now both insignificantly different from zero. However, we still reject the hypothesis that the coefficients on the two regulator dummy variables are the same. The coefficients of the corruption terms are slightly larger in magnitude than in the baseline regression, but they are less precisely estimated and therefore not significantly different.

The lower rows of Table IV present the results of tests of the validity of the assumptions used. These results include the p-value of the Sargan-Hansen test of instrument validity, which suggests that, on the assumption that at least one of the instruments is valid, there are no grounds to reject the assumption that the other instruments are valid. To test whether corruption, regulatory governance, and ownership can be treated as exogenous, the difference of two

[20]The full results from the first-stage regressions can be found in the online appendix

Table 4: **Robustness checks**

		Corruption measure:		
	IV estimation	0/1	WBES	Brazil
	(1)	(2)	(3)	(4)
Corruption	0.43**	0.20***	0.085***	
	(0.18)	(0.059)	(0.037)	
Corruption × private	-0.32*	-0.13***	-0.021	0.067
	(0.17)	(0.032)	(0.045)	(0.36)
Corruption × IRA	-0.24*	-0.10*	-0.16***	-0.85**
	(0.13)	(0.059)	(0.033)	(0.28)
Private dummy	-0.19	-0.23***	-0.29***	-0.31
	(0.040)	(0.038)	(0.048)	(0.28)
Bad IRA dummy	0.015	0.17***	0.22***	0.78**
	(0.16)	(0.035)	(0.053)	(0.27)
Good IRA dummy	-0.25*	-0.070**	0.066*	0.64**
	(0.14)	(0.035)	(0.033)	(0.23)
Observations	1359	1359	1229	343
Number of firms	153	153	141	35
R^2	0.17	0.38	0.39	0.65
Endogeneity test p-value	0.21			
Hansen J exog. test p-value	0.68			

Source: Author's analysis based on data from the World Bank and the International Country Risk Guide
Notes: See notes to Table 2.
*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Sargan-Hansen statistics is calculated, one for the equation in which the possibly endogenous variables are instrumented and one for a specification in which these possibly endogenous variables are added to the instrument set.[21] The p-value resulting from the associated test is 0.21; hence, we cannot reject the null hypothesis that these variables can be treated as exogenous. Alternatively, one can test for the endogeneity of the variables by running a Hausman test comparing the baseline regression with the IV regression, and the obtained results cannot reject the null hypothesis of non-systematic differences in the coefficients. I therefore conclude that it is reasonable to treat all of these variables as exogenous, as in the main analysis.

[21] For more details of this test, see Baum, Schaffer, and Stillman (2003).

Alternative Corruption Measures

As stated earlier, I have used the corruption index produced by ICRG because it was designed to be comparable over time within countries as well as between countries. However, there may be concerns that the results are driven by the peculiarities of this index. Therefore, I perform the baseline regression using three alternative measures of corruption, the results of which are presented in Table IV.

First, the ICRG index is replaced with an indicator variable that takes a value of one if the ICRG corruption index is above the sample median and a value of zero if it is below. This indicator is largely insensitive to extreme values or small annual changes in the index. From column (2), we can see that the results do not change significantly. Hence, we can be confident that the results are not driven by extreme values in the corruption index.

Second, I use a measure of how significant corruption is as an obstacle to doing business for firms based on World Bank Enterprise Surveys. The measure differs from the ICRG index in that it is sourced from firms rather than experts and that it provides an indication of corruption costs rather than corruption frequency.[22] Moreover, because I have access to the firm-level data, I can construct a measure of corruption for some states and provinces within Brazil and Argentina. Therefore, I do not use country-level indicators for these two countries. However, there are only one or two waves of this survey per country; therefore, I have to fill in missing values.[23] The measure is also scaled to produce comparable coefficients to the measure of corruption used in the main analysis. The regression using this data is presented in column (3). We can see that all coefficients remain similar to those obtained when the ICRG index is used. Although the Corruption $\times$ private term loses significance, we cannot reject the hypothesis that

[22] See Dethier, Hirn, and Straub (2008) for a survey of the literature using firm survey data on corruption.

[23] For locations for which I have at least one observation, I use linear interpolation to fill in missing values between observations and take the value of the observation closest in time otherwise.

the ratio β_2/β_1 is as previously found, and these coefficients are as defined in Equation (4).

Third, I use a measure of observed corruption constructed from data on the federal auditing of Brazilian municipalities used by Ferraz and Finan (2011). The corruption measure is the fraction of audited municipalities in which corruption was detected, varying by state, with municipalities weighted by their population. This variable measures the occurrence of corruption rather than corruption perceptions. This distinction is important if corruption perceptions systematically differ from true corruption levels, as suggested by Olken (2009). The results are presented in column (4), from which we can see that the Corruption $\times$ IRA term is again significant and negative. Because the measure of corruption is invariant over time, the fixed effects model used here cannot estimate the effect of corruption. However, using a random effects model (not reported here) obtains a positive coefficient that is significant at the 5% level, with the Corruption $\times$ IRA term remaining negative and significant.

Overall, we can see that the previously identified negative association between corruption and productivity and the mitigating effect of an IRA are robust to using these three alternative corruption measures.

Quality and Prices

One concern with the previous analysis is that the dependent variable, "excess labor", may not have been "excess" but instead may have been employed to raise the quality of outputs. Moreover, it would be useful to know whether the results identified above extend beyond changes in labor employed to changes in consumer prices. Table IV presents the results of regressing other firm-level variables on corruption, ownership, and regulation.[24] Columns (1) and (2) use two measures of quality, the frequency and duration of interruptions in the power supply, whereas

[24]Unlike the prior analysis, I do not regress the dependent variables on a function of firm outputs. Doing so does not affect the results significantly.

Column (3) shows the percentage of electricity lost through distribution as the dependent variable. In columns (4) and (5), two price measures are given: the tariffs faced (in $) by residential and industrial consumers, respectively. These variables were not included in the main analysis because they are not always observed. Summary statistics of all of these variables can be found in Table 1.

Table 5: **Quality and prices**

Dependent variable:	Interruption Frequency	Interruption Duration	% of elec. Lost	Residential Tariff	Industrial Tariff
	(1)	(2)	(3)	(4)	(5)
Corruption	-5.92	-7.34	0.048	14.5	40.4*
	(8.00)	(11.6)	(1.04)	(12.9)	(22.8)
Corruption × Private	1.68	1.37	1.10**	-1.37	-7.15*
	(4.79)	(7.87)	(0.50)	(3.19)	(3.86)
Corruption × IRA	1.31	1.31	-0.51	-13.2	-35.6
	(4.46)	(6.53)	(0.98)	(12.8)	(23.2)
Private dummy	-11.6*	-16.3*	-1.27*	-6.73***	-2.87
	(6.51)	(9.54)	(0.72)	(2.26)	(4.06)
Bad IRA dummy	-15.0***	-21.1***	6.32***	15.0**	7.92
	(4.13)	(7.11)	(1.04)	(6.42)	(14.9)
Good IRA dummy	-21.8*	-20.6**	-0.035	-18.3***	-11.8
	(11.3)	(9.52)	(1.58)	(4.23)	(8.75)
Observations	776	809	1211	979	571
Number of firms	118	119	147	130	78
Adjusted R^2	0.052	0.032	0.11	0.35	0.22

Source: Author's analysis based on data from the World Bank and the International Country Risk Guide
Note: In all cases we are estimating with year dummies and firm fixed effects. Country-year clustered standard errors are in parentheses.
*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

The results presented in columns (1)-(3) help alleviate any concern that previously noted variations in labor employed may reflect variations in quality.[25] The coefficients involving corruption in these regressions are generally insignificant, suggesting that the corruption-related

[25]I also enter each quality variable into the baseline regression and find each to be insignificant, with no significant changes to the other coefficients of interest.

results found previously are not driven by changes in quality. Moreover, the reforms of interest generally appear to be significantly positively associated with quality.

The coefficients in columns (4) and (5) suggest that the previously noted changes in productivity may correlate with changes in consumer prices. Though generally not highly significant, each coefficient is of the same sign as in the baseline regression. This finding suggests that consumers may be reaping some of the gains of productivity improvements noted previously and gives some weight to the assumption in the model that productivity effects are driven by revenue control methods of regulation. The fact that these coefficients are not as significant as those in the productivity regression suggests that, in addition to consumers, other parties are gaining from the increase in labor productivity. This other party may be the government, because frequently marginal payments to utility firms come from government subsidies. However, this finding may suggest that other actors, such as politicians or firm owners, are gaining at the expense of workers, potentially producing a negative effect on social welfare.

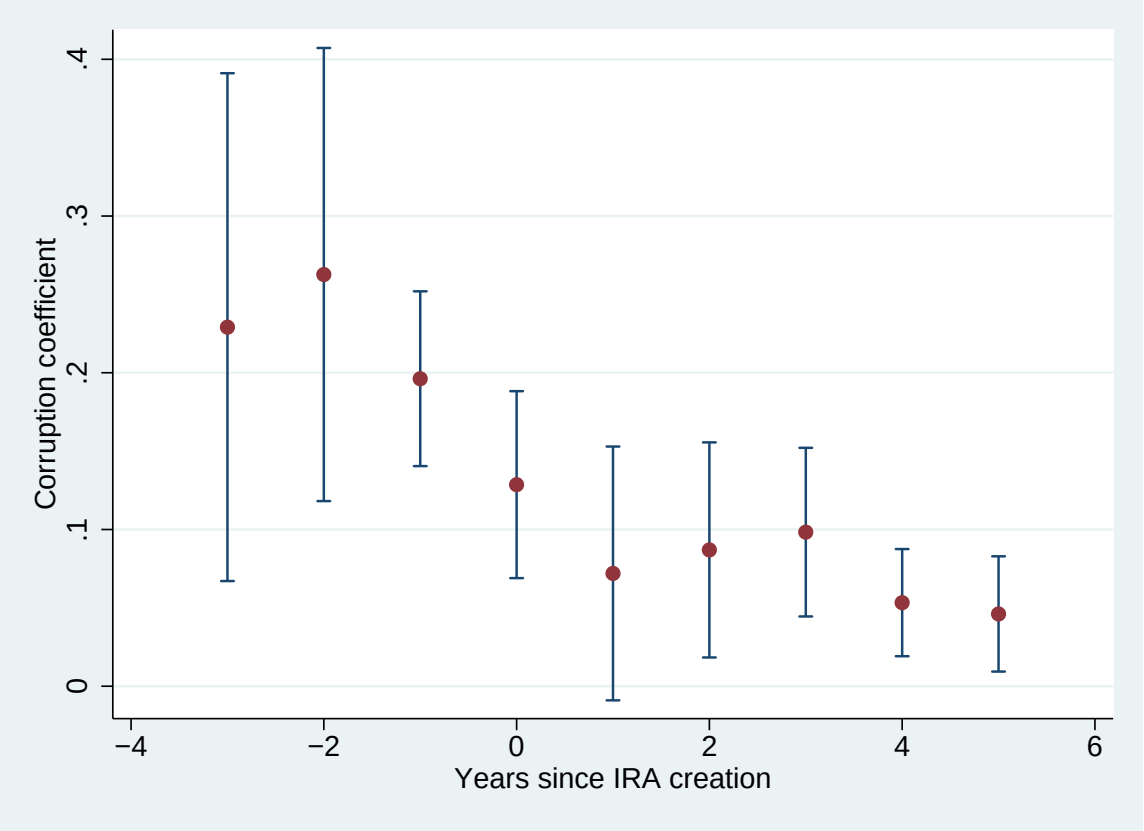
Dynamic Effects

The econometric methodology above is based ona static model. However, we may be concerned that the underlying processes are much more dynamic and that failing to account for this dynamism may bias our results. For instance, if regulatory independence were influenced by corruption in the previous year (controlling for current corruption) and the effects of corruption on productivity were cumulative, then the omission of lagged corruption would bias the coefficient on the independent regulator term. To ensure that the results are not driven by such dynamic effects, I perform a number of further robustness checks.

One particular concern may be that the above results relating to reforms are driven by some other trend in the way that corruption affects infrastructure productivity. To test for this

possibility, I perform the baseline regression including country-specific trends and allowing for the effect of corruption to vary over time. In both of these cases, there are no significant changes to the main results. Another test is to consider how the impact of corruption on productivity changes according to when the IRA was created. The results of such an analysis can be seen in Figure 2, which plots the coefficient on the corruption term interacted with indicator variables that depend on the number of years since an IRA was created.

Figure 2: **Coefficient on Corruption, by Year since IRA Creation**



Source: Author's analysis based on data from the World Bank and the International Country Risk Guide
Note: The points represent the estimated coefficient on the corruption term according by the number of years since the IRA was created, with the lines representing the 95% confidence interval. With the exception of these terms, the regression was as it was performed in column (1) of Table III. The plot for -3 corresponds to the effect of corruption when the regulator will be set up in three or more years time, whereas the plot for 5 corresponds to the effect of corruption when a regulator was set up five or more years ago.

The way in which the corruption coefficient changes over time is more consistent with a discontinuous shift at the point of IRA creation than a general trend over time (Figure 2). Although it appears that there may be some "expectation" effect in the year prior to IRA creation, it is only after the regulator is created that 0.21 (the estimated coefficient on the corruption term in the baseline regression) is no longer in the confidence interval.[26]

In addition to the above, the regressions were performed with lagged terms of each of the dependent variables included, with no significant changes to the results. I also performed the regression clustering standard errors at the firm level, which allows for the error term to be correlated within these clusters. Because the coefficients of interest remain significant, we can conclude that the results are probably not driven by the use of a static model rather than a dynamic one.

Other Robustness Checks

I have attempted other permutations of the baseline equation, including the following:

- Dropping each year and country individually from the sample.
- Replacing the variable *MWh sold* with *MWh sold + losses* to reflect varying amounts of electricity lost.
- Using a Cobb-Douglas function rather than the translog used above as well as simply using *Connections/Employees* as a dependent variable.
- Using a random effects estimator rather than a fixed effects estimator.
- Including the length of the distribution network in the translog function.

[26] Wren-Lewis (2010, pp.204-207) considers in more detail how the effect of IRA creation and privatization changes over time. In terms of privatization, productivity does appear to increase prior to the change in ownership, but the interaction with corruption is insignificant.

- Weighting by firm size and splitting the sample into firms that are small (i.e., below the median amount of electricity sold) and firms that are large (i.e., above the median amount of electricity sold).

In each of these permutations, the Corruption, Corruption $\times$ IRA, and Corruption $\times$ private terms remain significant with the expected signs.

V Conclusion

This paper analyzes the relationship between corruption and regulated firms' productivity and the way in which this relationship interacts with policy reforms. The paper sets out a potential channel through which corruption increases labor employed and analyzes how privatization and regulatory autonomy may interact with this mechanism. This approach provides a framework for an empirical investigation of the effect of corruption on electricity distribution firms in Latin America.

The econometric analysis shows that corruption at the national level is negatively associated with firm productivity. This result adds to the increasing evidence that corruption can be detrimental to the performance of utilities.

The association between corruption and productivity is smaller for private firms than for public ones. This finding suggests that privatization may be a way to reduce the potentially negative effects of corruption. However, the analysis suggests caution when making this prediction because the significance of this result disappears when I include an interaction between ownership and the size of the government deficit or use corruption measures from alternative sources.

A more robust finding is that the introduction of an Independent Regulatory Agency substantially reduces the negative association between corruption and productivity. This result

survives controlling for firm-specific corruption effects and introducing a large range of control variables. Moreover, the result is robust to instrumenting for corruption and sector reforms and still holds when using alternative corruption measures based on firm surveys and observed corruption. Such a result is possibly surprising given that the theoretical literature has generally focused on capture of the regulatory agent as the mechanism through which corruption impacts on regulated monopolies (Estache and Wren-Lewis 2011).

However, there is reason to be cautious when interpreting the implications of these results. There is not strong evidence that electricity consumers are paying directly for the lower productivity associated with corruption or that that they benefit from the reduced effect of corruption produced by reforms. Although this may simply reflect a lack of sufficient data on consumer prices and government subsidies, it remains possible that a sizable portion of the gains are captured by firm owners or other actors. More data are needed to be able to draw strong normative conclusions about the impacts of the reforms.

Overall, the results emphasize the need to consider institutional weaknesses when developing appropriate sectoral policies. The findings suggest that the implementation of policies considered international "best practices" has different effects depending on the level of corruption in the country. Identifying precisely why this occurs and which aspects of regulatory governance are important in addressing corruption will require further research, through further study of individual countries and through the development of cross-country data on how regulatory governance varies over time.

Notes

[1]Other studies include Guasch and Straub (2009), who examine the effect of corruption on

renegotiation, and Estache, Goicoechea, and Trujillo (2009), who consider the impact of corruption on country-level measures of access, affordability, and quality. Clarke and Xu (2004) take a different approach by considering the effect of reforms on petty bribery to utility firms.

[2]For surveys of the empirical literature on privatization in developing countries, see Parker and Kirkpatrick (2005); Megginson and Sutter (2006); Boubakri, Cosset, and Guedhami (2008).

[3]The model therefore follows a tradition of modeling corruption in a three-tier hierarchy, as in Spiller (1990) and Laffont and Tirole (1991). Within this literature, other models also consider a situation with multiple supervisors (see, for example, Laffont and Martimort (1999)), and Estache and Wren-Lewis (2009) argue that it is important to consider the multiplicity of actors involved in the regulatory process.

[4]For the purposes of the model, it is not necessary to specify the size of this share. We simply require that the share needed to persuade the politician is sufficiently small that there is always enough money to bribe.

[5]We assume that the regulator cannot overrule the politician in the other direction - that is, set revenue high when the politician is not corrupted. In a more general model where this is possible, the creation of an independent regulator would have ambiguous effects with regard to corruption.

[6]For the purposes of this model, we abstract from the reasons why these reforms are implemented. Because corrupt politicians may lose out from the reforms, one potential explanation is that these reforms are a response to pressure from outside actors, including citizens and international bodies. See Section IV for a brief discussion of such motivations.

[7]This effect is similar to the effects of privatization in Shleifer and Vishny (1994), where

privatization decreases the relative influence of those pushing for excess labor compared to profit-motivated managers. Bai et al. (2000) also discusses why state-owned firms may be required to use their funds to over-employ.

[8]An alternative model could consider the idea that a regulator's independence might directly impact the way in which rents are shared within the firm in a way similar to privatization. For example, more transparent regulation may reduce the rents that workers obtain from holding more information than owners or politicians. In such a model, greater independence could then reduce the impact of corruption on labor productivity without an effect on revenue. However, such a model is not investigated here because revenue setting is generally considered to be a regulator's primary role.

[9]I am therefore implicitly assuming that regulatory governance remains constant during the reign of the agency and that it is unrelated to the quality of regulation prior to the creation of the agency. This is obviously a strong assumption, but if it has any effect on my results, it is likely to bias them toward insignificance. Therefore, it should not be of great concern when interpreting the results.

[10]In addition to electricity produced and connections, Dal Bó and Rossi (2007) also include the service area as an exogenous output and transformer capacity and the length of the distribution lines as exogenous capital variables. Unfortunately, the first two of these variables are not available in the extended dataset used here, and including the latter reduces my sample by more than half. However, because these variables vary little over time, they are likely to be controlled for by using firm fixed effects. I test for this by performing the regressions with the length of distribution lines included in the translog function and find the variable to be insignificant, with no significant changes in my results. Moreover, using the dataset from Dal Bó

and Rossi (2007), I find that their results are insensitive to the removal of the service area and transformer capacity from the labor demand function.

[11]Spiller and Tommasi (2005), for instance, argue that regulatory independence is more likely to occur when there is a greater division of powers and less preference homogeneity across government.

[12]Firm and year fixed effects are not included in this graphical analysis.

[13]The coefficients suggest that if both output measures were to double, then the increase in labor required would be 59%. This is very close to the value obtained using the data from Dal Bó and Rossi (2007), which suggest that a doubling of outputs requires a 62% increase in employees.

[14]The model also suggests that there may be an interaction among corruption, ownership, and regulatory autonomy. However, the introduction of this extra term is found to be insignificant. This result is likely due to the lack of firms in the sample that are privately owned and not regulated by an IRA.

[15]The 30/70 split was chosen because it maximizes the difference between the coefficients on the two terms. The difference between the two coefficients, however, remains strongly significant for a range of other splits. I have also tried entering the ERGI directly, which returns similar results. I have explored breaking down the ERGI into different governance components, but no particular component is more successful in explaining firm performance than the ERGI measure. Similarly, no governance component consistently improves upon the IRA dummy when interacting with corruption. See Wren-Lewis (2010, pp. 207-213) for more details.

[16]One factor in this result may be the greater commitment ability of well-governed regulators, as detailed by Levy and Spiller (1994)

[17]For the telecoms sector, I use an index of regulatory governance constructed by Gutiérrez (2003b). For water, I use a simple dummy that indicates whether an IRA exists, which I take from Estache and Goicoechea (2005)

[18]This is constructed from the World Bank's PPI Project Database. The four sectors are water, gas, railways, and sea ports.

[19]Evidence for this assumption is provided, for example, by Chowdhury (2004). Dal Bó and Rossi (2007) use imports over GDP as an instrument for corruption. This is not a strong instrument for the full sample that I use, but when I restrict my sample to the period that they analyze (before 2002), I find that the instrument provides significant results similar to those reported in Table IV.

[20]The full results from the first-stage regressions can be found in the online appendix

[21]For more details of this test, see Baum, Schaffer, and Stillman (2003).

[22]See Dethier, Hirn, and Straub (2008) for a survey of the literature using firm survey data on corruption.

[23]For locations for which I have at least one observation, I use linear interpolation to fill in missing values between observations and take the value of the observation closest in time otherwise.

[24]Unlike the prior analysis, I do not regress the dependent variables on a function of firm outputs. Doing so does not affect the results significantly.

[25]I also enter each quality variable into the baseline regression and find each to be insignificant, with no significant changes to the other coefficients of interest.

[26]Wren-Lewis (2010, pp.204-207) considers in more detail how the effect of IRA creation and privatization changes over time. In terms of privatization, productivity does appear to increase prior to the change in ownership, but the interaction with corruption is insignificant.

Appendix: Selection of additional country control variables

Control variable	Description	Source
GDP per capita	Constant 2000 US$	World Bank (2009)
Workers' compensation	Employee compensation / GDP	World Bank (2009)
Fuel Exports	% of merchandise exports	World Bank (2009)
Urbanization	Urban population / total	World Bank (2009)
Trade	Imports & exports / GDP	World Bank (2009)
Shadow Economy	Share of total GDP	Schneider (2007)
Length of office	Yrs ruling party in power	Beck et al. (2001)
Executive orientation	Left-wing/central/right-wing	Beck et al. (2001)
Separation of powers	Does the party of the executive control legislature?	Beck et al. (2001)
Elections	Dummy for election year	Beck et al. (2001)
World Bank presence	Number of WB projects	Boockmann and Dreher (2003)
IMF presence	IMF agreement dummy	Dreher (2006b)
Legislative effectiveness	Index	Norris (2009)
General strikes	Number of strikes	Norris (2009)
Workers rights	Index	Teorell, Holmberg, and Rothstein (2009); Cingranelli and Richards (2009)
Government deficit	% of GDP	Teorell, Holmberg, and Rothstein (2009); Easterly (2001)
Accountability	Index	Kaufmann, Kraay, and Mastruzzi (2009); ICRG
Political stability	Index	Kaufmann, Kraay, and Mastruzzi (2009); ICRG
Regulatory quality	Index	Kaufmann, Kraay, and Mastruzzi (2009); ICRG
Rule of law	Index	Kaufmann, Kraay, and Mastruzzi (2009); ICRG
Judicial independence	Index	Gwartney and Lawson (2009)
Property rights	Index	Gwartney and Lawson (2009)
Credit market regulation	Index	Gwartney and Lawson (2009)
Labor market regulation	Index	Gwartney and Lawson (2009)
Business regulation	Index	Gwartney and Lawson (2009)
Financial development	Various measures	Beck, Demirguc-Kunt, and Levine (2000)
Employment elasticity	Δ Employment /Δ GDP	ILO (2009)
Unemployment	% of population	ILO (2009)
Aid	Total aid/GDP	Roodman (2005)
Education	Various measures	Barro and Lee (2001)
inflation		ECLAC (2009)
Legal origin		Porta, de Silanes, and Shleifer (2008)
Economic freedom	Various indices	Holmes, Feulner, and O'Grady (2008)
Political rights	Index	Freedom House
Civil liberties	Index	Freedom House
Freedom of the press	Index	Freedom House
Globalization	Various indices	Dreher (2006a)
Democracy	Various indices	Marshall and Jaggers (2007)
Government spending	Government share of real GDP	Heston, Summers, and Aten (2009)

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Online Appendix for:
'Do infrastructure reforms reduce the effect of corruption? Theory and evidence from Latin America and the Caribbean'

Abstract

This online appendix provides supplementary material to complement the main essay. In particular, Section 1 provides tables for the regressions undertaken as described in section 5.1. Section 2 then presents the first-stage regressions for the IV estimation carried out in section 5.2.

1. Additional control variables

This section provides regression tables for the baseline regression carried out with additional control variables, as described in section 5.2 of the paper. In Tables (1) to (5), these additional control variables are interacted with corruption. In tables (6) to (14), the variables are interacted with private ownership and independent regulator indicator variables. In each case, the regression is the same as the basline - i.e. the log of employment is the dependent variable, with firm fixed effects and a translog function included on the right hand side.

Table 1: **Additional control variables, interacted with corruption**

Corruption	-0.65*	0.24***	0.21***	0.0034	0.24***	0.20***	0.22***
	(0.35)	(0.027)	(0.032)	(0.095)	(0.040)	(0.050)	(0.029)
Corruption × Private	-0.095***	-0.086***	-0.076***	-0.12***	-0.086***	-0.081***	-0.100***
	(0.025)	(0.022)	(0.024)	(0.030)	(0.024)	(0.025)	(0.024)
Corruption × IRA	-0.14***	-0.14***	-0.15***	-0.15***	-0.16***	-0.17***	-0.15***
	(0.030)	(0.027)	(0.028)	(0.027)	(0.033)	(0.036)	(0.026)
Private dummy	-0.26***	-0.28***	-0.24***	-0.26***	-0.27***	-0.33***	-0.24***
	(0.034)	(0.036)	(0.036)	(0.036)	(0.035)	(0.066)	(0.033)
Bad IRA dummy	0.11***	0.091***	0.11***	0.12***	0.10***	0.14**	0.14***
	(0.036)	(0.031)	(0.037)	(0.036)	(0.038)	(0.067)	(0.037)
Good IRA dummy	-0.10**	-0.13***	-0.12***	-0.11***	-0.100**	-0.12**	-0.094**
	(0.041)	(0.041)	(0.038)	(0.039)	(0.040)	(0.049)	(0.037)
ln(GDP per capita)	0.40*						
	(0.24)						
GDP per cap × cor	0.097**						
	(0.039)						
Compensation/GDP		0.0062					
		(0.0087)					
Compenstation × cor		-0.010**					
		(0.0040)					
Fuel exports / exports			0.0014				
			(0.0017)				
Fuel exports × cor			0.00013				
			(0.00075)				
Urbanisation				-0.0035			
				(0.013)			
Urbanisation × cor				0.0031**			
				(0.0013)			
Exports / GDP					-0.0054***		
					(0.0020)		
Exports × cor					-0.00046		
					(0.00088)		
Shadow economy						0.0068	
						(0.0082)	
Shadow economy × cor						0.00066	
						(0.00090)	
Party's years in office							-0.0044***
							(0.0013)
Years in office × cor							0.0020
							(0.0016)
Observations	1325	1324	1315	1325	1325	687	1292
Number of firms	153	153	153	153	153	152	153
R^2	0.3865	0.3877	0.3743	0.3837	0.3845	0.4456	0.3986

*** Significant at the 1% level , ** Significant at the 5% level,* Significant at the 10% level

Table 2: **Additional control variables, interacted with corruption**

Corruption	0.16***	0.22***	0.20***	0.16***	0.18***	0.18*	0.14***
	(0.035)	(0.029)	(0.030)	(0.031)	(0.043)	(0.097)	(0.040)
Corruption × Private	-0.086***	-0.10***	-0.087***	-0.12***	-0.084***	-0.099***	-0.11***
	(0.024)	(0.027)	(0.024)	(0.024)	(0.024)	(0.029)	(0.025)
Corruption × IRA	-0.11***	-0.15***	-0.15***	-0.14***	-0.12***	-0.13***	-0.080**
	(0.030)	(0.027)	(0.028)	(0.029)	(0.041)	(0.029)	(0.035)
Private dummy	-0.25***	-0.25***	-0.26***	-0.26***	-0.25***	-0.22***	-0.22***
	(0.036)	(0.032)	(0.035)	(0.034)	(0.033)	(0.034)	(0.034)
Bad IRA dummy	0.13***	0.14***	0.11***	0.12***	0.13***	0.10**	0.11**
	(0.041)	(0.038)	(0.036)	(0.041)	(0.040)	(0.049)	(0.049)
Good IRA dummy	-0.11***	-0.11***	-0.11***	-0.13***	-0.11***	-0.12***	-0.11***
	(0.039)	(0.037)	(0.039)	(0.037)	(0.037)	(0.039)	(0.038)
Political colour	-0.035***						
	(0.012)						
Political colour × cor	0.015**						
	(0.0070)						
Seperation of powers		-0.095***					
		(0.023)					
Seperation of powers × cor		0.068**					
		(0.032)					
Legislative election held			-0.0030				
			(0.014)				
Legislative election × cor			0.057***				
			(0.017)				
World Bank projects				-0.0031			
				(0.0032)			
WB projects × cor				0.014***			
				(0.0037)			
IMF programme dummy					-0.018		
					(0.016)		
IMF × cor					0.031		
					(0.023)		
Legislative effectiveness						0	
						(0)	
Leg effectivenss × cor						0.0096	
						(0.031)	
General strikes							-0.0049
							(0.0098)
Strikes × cor							0.046**
							(0.018)
Observations	1338	1272	1359	1110	1238	975	975
Number of firms	153	153	153	153	153	151	151
R^2	0.3783	0.4091	0.3827	0.4295	0.4048	0.4227	0.4274

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 3: **Additional control variables, interacted with corruption**

Corruption	0.23***	0.36***	0.24***	0.25***	0.24***	0.24***	0.24***
	(0.038)	(0.043)	(0.052)	(0.049)	(0.045)	(0.049)	(0.058)
Corruption × Private	-0.11***	-0.15**	-0.075**	-0.071**	-0.071**	-0.065**	-0.055**
	(0.026)	(0.072)	(0.031)	(0.028)	(0.030)	(0.027)	(0.022)
Corruption × IRA	-0.14***	-0.20***	-0.18***	-0.19***	-0.18***	-0.18***	-0.17***
	(0.030)	(0.034)	(0.049)	(0.045)	(0.042)	(0.046)	(0.046)
Private dummy	-0.24***	-0.022	-0.29***	-0.28***	-0.29***	-0.29***	-0.34***
	(0.034)	(0.068)	(0.055)	(0.053)	(0.053)	(0.053)	(0.095)
Bad IRA dummy	0.12***	0.28***	0.11**	0.10**	0.100**	0.11**	0.015
	(0.042)	(0.041)	(0.044)	(0.040)	(0.042)	(0.046)	(0.051)
Good IRA dummy	-0.12***	-0.30***	-0.091*	-0.079	-0.085*	-0.091*	-0.16**
	(0.037)	(0.070)	(0.053)	(0.052)	(0.049)	(0.054)	(0.065)
Workers rights	-0.013						
	(0.024)						
Workers rights × cor	-0.019						
	(0.022)						
Government budget deficit / GDP		0.028***					
		(0.0083)					
Budget deficit × cor		0.011*					
		(0.0057)					
Voice and accountability			-0.0053				
			(0.064)				
Voice × cor			0.021				
			(0.022)				
Political stability				-0.046			
				(0.039)			
Political stability × cor				-0.0034			
				(0.014)			
Regulatory quality					-0.057		
					(0.050)		
Reg. qual. × cor					0.0055		
					(0.022)		
Rule of law						-0.011	
						(0.075)	
Rule of law × cor						-0.0069	
						(0.018)	
Judicial independence							0.00018
							(0.010)
Judicial independence × cor							-0.0039
							(0.0058)
Observations	1110	302	959	959	959	959	889
Number of firms	153	94	153	153	153	153	153
R^2	0.4204	0.3331	0.3349	0.3357	0.3360	0.3343	0.3577

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 4: **Additional control variables, interacted with corruption**

Corruption	0.17***	0.16	0.20***	0.22***	0.23***	0.20***	0.16***
	(0.056)	(0.100)	(0.065)	(0.078)	(0.039)	(0.030)	(0.045)
Corruption × Private	-0.066***	-0.058**	-0.055**	-0.053**	-0.066**	-0.080***	-0.093***
	(0.024)	(0.024)	(0.023)	(0.021)	(0.028)	(0.024)	(0.023)
Corruption × IRA	-0.17***	-0.17***	-0.17***	-0.17***	-0.13***	-0.14***	-0.13***
	(0.046)	(0.041)	(0.043)	(0.045)	(0.028)	(0.027)	(0.032)
Private dummy	-0.35***	-0.33***	-0.36***	-0.36***	-0.25***	-0.26***	-0.28***
	(0.085)	(0.065)	(0.088)	(0.087)	(0.036)	(0.036)	(0.036)
Bad IRA dummy	0.016	0.086	0.030	0.015	0.11***	0.11***	0.11**
	(0.049)	(0.056)	(0.054)	(0.055)	(0.032)	(0.035)	(0.043)
Good IRA dummy	-0.16**	-0.14**	-0.14**	-0.16**	-0.094**	-0.097**	-0.10**
	(0.066)	(0.062)	(0.063)	(0.066)	(0.039)	(0.038)	(0.039)
Property rights	-0.023*						
	(0.013)						
Property rights × cor	0.011*						
	(0.0058)						
Credit market regulation		-0.029					
		(0.020)					
Credit regulation × cor		0.0073					
		(0.0096)					
Labour regulation			-0.0090				
			(0.014)				
Labour regulation × cor			0.0035				
			(0.0072)				
Business regulation				-0.019			
				(0.014)			
Business regulation × cor				0.00021			
				(0.010)			
Bank deposits / GDP					-0.46**		
					(0.21)		
Bank deposits × cor					-0.11		
					(0.11)		
Employment elasticity						-0.044***	
						(0.014)	
Employment elasticity × cor						-0.010	
						(0.024)	
Unemployment							-0.0082
							(0.0051)
Unemployment × cor							0.0050
							(0.0035)
Observations	899	924	899	899	1325	1359	1184
Number of firms	153	153	153	153	153	153	151
R^2	0.3640	0.3562	0.3602	0.3609	0.3837	0.3826	0.3966

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 5: **Additional control variables, interacted with corruption**

Corruption	0.22***	0.18***	0.25***	0.25***	0.15	0.22***	0.13
	(0.028)	(0.038)	(0.041)	(0.043)	(0.11)	(0.036)	(0.12)
Corruption × Private	-0.079***	-0.078***	-0.088***	-0.090***	-0.10***	-0.082***	-0.088***
	(0.023)	(0.023)	(0.024)	(0.025)	(0.026)	(0.023)	(0.025)
Corruption × IRA	-0.14***	-0.13***	-0.14***	-0.14***	-0.14***	-0.14***	-0.14***
	(0.028)	(0.027)	(0.029)	(0.027)	(0.031)	(0.027)	(0.029)
Private dummy	-0.26***	-0.26***	-0.26***	-0.26***	-0.24***	-0.26***	-0.27***
	(0.034)	(0.036)	(0.035)	(0.036)	(0.033)	(0.035)	(0.036)
Bad IRA dummy	0.10***	0.11***	0.13***	0.12***	0.14***	0.13***	0.11***
	(0.035)	(0.037)	(0.040)	(0.035)	(0.046)	(0.037)	(0.032)
Good IRA dummy	-0.12***	-0.11***	-0.11***	-0.10***	-0.12***	-0.10**	-0.12***
	(0.037)	(0.038)	(0.040)	(0.038)	(0.037)	(0.040)	(0.039)
Aid / GDP	-2.39						
	(1.68)						
Aid × cor	-1.41**						
	(0.59)						
Inflation		-0.00023					
		(0.0013)					
Inflation × cor		0.0018					
		(0.0018)					
Political rights			-0.014				
			(0.0095)				
Political rights × cor			-0.013				
			(0.013)				
Civil liberties				0.023			
				(0.018)			
Civil liberties × cor				-0.011			
				(0.013)			
Democracy					0.0073		
					(0.011)		
Democracy × cor					0.0062		
					(0.013)		
Press freedom						-0.0027***	
						(0.0010)	
Press freedom × cor						-0.00056	
						(0.00079)	
Globalisation							0.0078**
							(0.0039)
Globalisation × cor							0.0013
							(0.0021)
Observations	1325	1359	1359	1359	1095	1359	1359
Number of firms	153	153	153	153	153	153	153
R^2	0.3883	0.3787	0.3791	0.3789	0.4263	0.3812	0.3814

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 6: **Additional control variables, interacted with regulation and ownership**

Corruption	0.19***	0.21***	0.19***	0.16***
	(0.035)	(0.028)	(0.029)	(0.047)
Corruption × private	-0.078***	-0.074***	-0.063***	-0.079***
	(0.023)	(0.022)	(0.023)	(0.023)
Corruption × IRA	-0.13***	-0.14***	-0.13***	-0.085*
	(0.033)	(0.028)	(0.028)	(0.046)
Private dummy	-0.13	-0.25***	-0.19***	-0.19
	(1.34)	(0.040)	(0.041)	(0.32)
Bad IRA dummy	2.12*	0.017	-0.035	0.73***
	(1.18)	(0.041)	(0.027)	(0.23)
Good IRA dummy	1.91	-0.20***	-0.14***	0.57**
	(1.19)	(0.043)	(0.038)	(0.25)
ln(GDP per capita)	0.58**			
	(0.25)			
ln(GDP per capita) × pri	-0.016			
	(0.15)			
ln(GDP per capita) × IRA	-0.23*			
	(0.13)			
Compensation/GDP		-0.060***		
		(0.016)		
Compensation/GDP × pri		-0.013		
		(0.013)		
Compensation/GDP × IRA		0.054***		
		(0.016)		
Fuel exports / exports			-0.0032	
			(0.0036)	
Fuel exports × pri			-0.0051**	
			(0.0024)	
Fuel exports × IRA			0.0066***	
			(0.0017)	
Urbanisation				0.0026
				(0.012)
Urbanisation × pri				-0.00089
				(0.0044)
Urbanisation × IRA				-0.0086***
				(0.0031)
Observations	1325	1324	1315	1325
Number of firms	153	153	153	153
R^2	0.3858	0.4015	0.3844	0.3889

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 7: **Additional control variables, interacted with regulation and ownership**

Corruption	0.20***	0.26***	0.26***	0.22***
	(0.042)	(0.051)	(0.022)	(0.030)
Corruption × Private	-0.068***	-0.083***	-0.098***	-0.078***
	(0.022)	(0.025)	(0.023)	(0.023)
Corruption × IRA	-0.14***	-0.20***	-0.18***	-0.14***
	(0.043)	(0.045)	(0.022)	(0.029)
Private dummy	-0.14***	-0.064	-0.27***	-0.13*
	(0.045)	(0.31)	(0.035)	(0.076)
Bad IRA dummy	0.011	-0.17	0.065	0.27**
	(0.050)	(0.26)	(0.051)	(0.11)
Good IRA dummy	-0.16***	-0.44*	-0.19***	0.0030
	(0.035)	(0.26)	(0.042)	(0.10)
Exports / GDP	-0.0083***			
	(0.0030)			
Exports / GDP × pri	-0.0062***			
	(0.0015)			
Exports / GDP × IRA	0.0039			
	(0.0025)			
Shadow economy		0.0022		
		(0.0077)		
Shadow economy × pri		-0.0071		
		(0.0067)		
Shadow economy × IRA		0.0082		
		(0.0057)		
Party's years in office			-0.027***	
			(0.0096)	
Party's years in office × pri			0.0083**	
			(0.0035)	
Party's years in office × IRA			0.022**	
			(0.0096)	
Political colour				0.027
				(0.033)
Political colour × pri				-0.051*
				(0.027)
Political colour × reg				-0.048
				(0.035)
Observations	1325	687	1292	1338
Number of firms	153	152	153	153
R^2	0.3966	0.4472	0.4071	0.3855

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 8: **Additional control variables, interacted with regulation and ownership**

Corruption	0.21***	0.21***	0.20***	0.19***
	(0.031)	(0.028)	(0.038)	(0.039)
Corruption × Private	-0.084***	-0.085***	-0.10***	-0.085***
	(0.023)	(0.023)	(0.027)	(0.024)
Corruption × IRA	-0.13***	-0.14***	-0.14***	-0.13***
	(0.030)	(0.027)	(0.037)	(0.039)
Private dummy	-0.26***	-0.27***	-0.24***	-0.26***
	(0.031)	(0.037)	(0.044)	(0.038)
Bad IRA dummy	0.16***	0.12***	0.15***	0.12***
	(0.042)	(0.043)	(0.053)	(0.040)
Good IRA dummy	-0.055	-0.11**	-0.090	-0.12***
	(0.037)	(0.041)	(0.061)	(0.040)
Seperation of powers	-0.012			
	(0.057)			
Seperation of powers × pri	0.13**			
	(0.054)			
Seperation of powers × IRA	-0.18***			
	(0.058)			
Legislative election held		-0.00097		
		(0.043)		
Legislative election held × pri		0.025		
		(0.029)		
Legislative election held × IRA		-0.023		
		(0.043)		
World Bank projects			0.0012	
			(0.0045)	
WB projects × pri			0.0011	
			(0.0056)	
WB projects × IRA			-0.0047	
			(0.0046)	
IMF agreement dummy				-0.084*
				(0.046)
IMF × pri				0.058
				(0.035)
IMF × IRA				0.044
				(0.047)
Observations	1272	1359	1110	1238
Number of firms	153	153	153	153
R^2	0.4144	0.3783	0.4205	0.4074

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 9: **Additional control variables, interacted with regulation and ownership**

Corruption	0.19***	0.20***	0.22***	0.26***
	(0.035)	(0.033)	(0.031)	(0.049)
Corruption × Private	-0.10***	-0.10***	-0.095***	-0.072
	(0.028)	(0.027)	(0.027)	(0.067)
Corruption × IRA	-0.11***	-0.13***	-0.15***	-0.17***
	(0.032)	(0.031)	(0.031)	(0.036)
Private dummy	-0.23	-0.24***	-0.36***	0.038
	(0.33)	(0.033)	(0.038)	(0.073)
Bad IRA dummy	-0.063	0.12**	-0.029	0.36***
	(0.12)	(0.050)	(0.081)	(0.12)
Good IRA dummy	-0.29**	-0.10***	-0.21***	-0.39***
	(0.11)	(0.036)	(0.068)	(0.078)
Legislative effectiveness	0			
	(0)			
Leg. effec. × pri	0.0070			
	(0.16)			
Leg. effec. × IRA	0.085*			
	(0.049)			
General strikes		-0.0044		
		(0.016)		
Strikes × pri		0.046		
		(0.032)		
Strikes × IRA		-0.039		
		(0.026)		
Workers rights			-0.12**	
			(0.048)	
Workers rights × pri			0.13***	
			(0.034)	
Workers rights × IRA			0.088*	
			(0.052)	
Government budget deficit / GDP				0.082*
				(0.046)
Budget deficit × pri				0.038**
				(0.016)
Budget deficit × IRA				-0.068
				(0.045)
Observations	975	975	1110	302
Number of firms	151	151	153	94
R^2	0.4233	0.4268	0.4424	0.3540

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 10: **Additional control variables, interacted with regulation and ownership**

Corruption	0.26***	0.26***	0.24***	0.23***
	(0.058)	(0.050)	(0.035)	(0.048)
Corruption × Private	-0.065**	-0.074**	-0.056**	-0.063**
	(0.026)	(0.029)	(0.026)	(0.028)
Corruption × IRA	-0.19***	-0.19***	-0.17***	-0.17***
	(0.057)	(0.045)	(0.033)	(0.046)
Private dummy	-0.29***	-0.25***	-0.32***	-0.22***
	(0.059)	(0.063)	(0.054)	(0.072)
Bad IRA dummy	0.14***	0.096**	0.042	-0.068
	(0.049)	(0.042)	(0.054)	(0.071)
Good IRA dummy	-0.039	-0.085*	-0.14**	-0.19***
	(0.080)	(0.047)	(0.055)	(0.058)
Voice and Accountability	0.25			
	(0.22)			
Voice × pri	-0.065			
	(0.12)			
Voice × IRA	-0.23			
	(0.19)			
Political stability		-0.090		
		(0.063)		
Political stability × pri		0.066		
		(0.079)		
Political stability × reg		0.0072		
		(0.057)		
Regulatory quality			-0.28*	
			(0.16)	
Reg quality × pri			0.19***	
			(0.070)	
Reg quality × IRA			0.12	
			(0.15)	
Rule of law				0.28
				(0.17)
Rule of law × pri				0.17
				(0.12)
Rule of law × IRA				-0.39**
				(0.16)
Observations	959	959	959	959
Number of firms	153	153	153	153
R^2	0.3363	0.3374	0.3460	0.3446

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 11: **Additional control variables, interacted with regulation and ownership**

Corruption	0.23***	0.21***	0.21***	0.23***
	(0.044)	(0.052)	(0.058)	(0.046)
Corruption * Private	-0.057***	-0.055**	-0.060**	-0.064***
	(0.021)	(0.022)	(0.023)	(0.023)
Corruption * IRA	-0.18***	-0.16***	-0.16***	-0.17***
	(0.042)	(0.049)	(0.054)	(0.045)
Private dummy	-0.32***	-0.38***	-0.25	-0.080
	(0.093)	(0.11)	(0.24)	(0.26)
Bad IRA dummy	0.14	-0.062	-0.34*	0.18
	(0.19)	(0.28)	(0.20)	(0.42)
Good IRA dummy	-0.052	-0.23	-0.56**	0.028
	(0.14)	(0.25)	(0.23)	(0.44)
Judicial independence	0.026			
	(0.024)			
Judicial independence X pri	-0.0036			
	(0.029)			
Judicial independence X IRA	-0.024			
	(0.033)			
Property rights		-0.046		
		(0.047)		
Property rights X pri		0.0057		
		(0.020)		
Property rights X IRA		0.018		
		(0.057)		
Credit market regulation			-0.068***	
			(0.024)	
Credit regulation X pri			-0.013	
			(0.031)	
Credit regulation X IRA			0.066*	
			(0.036)	
Labour regulation				0.070
				(0.088)
Labour regulation X pri				-0.053
				(0.043)
Labour regulation X IRA				-0.035
				(0.088)
Observations	889	899	924	899
Number of firms	153	153	153	153
R^2	0.3585	0.3623	0.3677	0.3631

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 12: **Additional control variables, interacted with regulation and ownership**

Corruption	0.20***	0.23***	0.19***	0.22***
	(0.056)	(0.031)	(0.032)	(0.034)
Corruption * Private	-0.041**	-0.085***	-0.078***	-0.090***
	(0.020)	(0.023)	(0.026)	(0.024)
Corruption * IRA	-0.16***	-0.16***	-0.13***	-0.15***
	(0.053)	(0.030)	(0.030)	(0.033)
Private dummy	-0.63***	-0.32***	-0.26***	-0.23***
	(0.14)	(0.094)	(0.048)	(0.083)
Bad IRA dummy	-0.091	-0.082	0.080	-0.034
	(0.21)	(0.086)	(0.060)	(0.080)
Good IRA dummy	-0.25	-0.26***	-0.11**	-0.23***
	(0.20)	(0.075)	(0.042)	(0.075)
Business regulation	-0.065**			
	(0.026)			
Business regulation X pri	0.052*			
	(0.029)			
Business regulation X IRA	0.015			
	(0.034)			
Bank deposits / GDP		-1.23***		
		(0.40)		
Bank deposits X pri		0.19		
		(0.22)		
Bank deposits X IRA		0.55**		
		(0.25)		
Employment elasticitiy			-0.080	
			(0.052)	
Employment elasticitiy X pri			0.011	
			(0.041)	
Employment elasticitiy X IRA			0.034	
			(0.053)	
Unemployment				-0.018**
				(0.0070)
Unemployment X pri				-0.0046
				(0.0092)
Unemployment X IRA				0.015**
				(0.0072)
Observations	899	1325	1359	1184
Number of firms	153	153	153	151
R^2	0.3664	0.3874	0.3829	0.3969

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 13: **Additional control variables, interacted with regulation and ownership**

Corruption	0.22***	0.25***	0.20***	0.18***
	(0.027)	(0.032)	(0.029)	(0.038)
Corruption * Private	-0.083***	-0.094***	-0.081***	-0.082***
	(0.023)	(0.021)	(0.024)	(0.024)
Corruption * IRA	-0.15***	-0.17***	-0.13***	-0.10***
	(0.027)	(0.032)	(0.028)	(0.039)
Private dummy	-0.26***	-0.24***	-0.32***	-0.32***
	(0.038)	(0.040)	(0.061)	(0.11)
Bad IRA dummy	0.090***	0.20***	0.20***	0.49***
	(0.034)	(0.049)	(0.068)	(0.11)
Good IRA dummy	-0.14***	-0.057	-0.031	0.29***
	(0.033)	(0.043)	(0.059)	(0.11)
Aid / GDP	-6.20***			
	(1.49)			
Aid X pri	-1.57			
	(1.27)			
Aid X IRA	4.15***			
	(1.33)			
Inflation		0.0027**		
		(0.0011)		
Inflation X pri		-0.0021		
		(0.0021)		
Inflation X reg		-0.0057***		
		(0.0012)		
Political rights			0.0020	
			(0.021)	
Political rights X pri			0.019	
			(0.018)	
Political rights X IRA			-0.027	
			(0.019)	
Civil liberties				0.10***
				(0.035)
Civil liberties X pri				0.023
				(0.031)
Civil liberties X IRA				-0.11***
				(0.028)
Observations	1325	1359	1359	1359
Number of firms	153	153	153	153
R^2	0.3897	0.3914	0.3798	0.3848

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

Table 14: **Additional control variables, interacted with regulation and ownership**

Corruption	0.18***	0.20***	0.20***
	(0.037)	(0.029)	(0.031)
Corruption * Private	-0.097***	-0.081***	-0.074***
	(0.027)	(0.023)	(0.021)
Corruption * IRA	-0.12***	-0.13***	-0.13***
	(0.037)	(0.027)	(0.029)
Private dummy	-0.13	-0.26***	0.44
	(0.13)	(0.091)	(0.29)
Bad IRA dummy	-0.19*	0.18*	-0.047
	(0.094)	(0.096)	(0.26)
Good IRA dummy	-0.42***	-0.056	-0.26
	(0.097)	(0.089)	(0.28)
Democracy	-0.024		
	(0.014)		
Democracy X pri	-0.014		
	(0.016)		
Democracy X IRA	0.041***		
	(0.012)		
Press freedom		-0.0013	
		(0.0022)	
Press freedom X pri		-0.000052	
		(0.0024)	
Press freedom X IRA		-0.0014	
		(0.0024)	
Globalisation			0.011*
			(0.0058)
Globalisation X pri			-0.012**
			(0.0053)
Globalisation X IRA			0.0026
			(0.0048)
Observations	1095	1359	1359
Number of firms	153	153	153
R^2	0.4296	0.3812	0.3860

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level

2. First-stage of instrumenting

This section presents the first-stage regression results of the instrumental variable estimation carried out in section 5.2 of the main paper. Table (15) presents the results for when corruption and interaction terms involving corruption are estimated, table (16) for private ownership and (17) for the regulator dummies.

Table 15: **IV First Stage**

LHS:	Corruption	Bad IRA	Good IRA	Private	Corruption × private	Corruption × IRA
Press Freedom	0.73**	0.21***	0.72***	0.22	-0.11	0.33
	(0.31)	(0.080)	(0.10)	(0.13)	(0.25)	(0.31)
Telecoms regulation index -1.24	0.73***	0.95***	0.41	-0.26	-2.38**	
	(1.00)	(0.26)	(0.34)	(0.43)	(0.81)	(1.01)
Water IRA dummy	-0.14	0.68***	1.84***	0.0039	-0.99	-3.07***
	(0.94)	(0.25)	(0.32)	(0.41)	(0.77)	(0.95)
Rail PPI dummy	2.18***	0.14	0.93***	1.36***	0.18	3.02***
	(0.69)	(0.18)	(0.23)	(0.30)	(0.56)	(0.70)
Ports PPI dummy	1.19*	-0.68***	0.76***	-0.81***	0.95	1.09
	(0.72)	(0.19)	(0.24)	(0.31)	(0.59)	(0.73)
Gas PPI dummy_ex	0.59	-0.40*	1.25***	-0.95**	0.74	0.093
	(0.89)	(0.24)	(0.30)	(0.39)	(0.73)	(0.90)
Water PPI dummy	1.55**	0.085	-0.71***	0.20	0.40	1.95***
	(0.74)	(0.19)	(0.25)	(0.32)	(0.60)	(0.74)
Press × Rail	-0.71***	-0.086*	-0.24***	-0.34***	-0.060	-0.89***
	(0.18)	(0.047)	(0.061)	(0.078)	(0.15)	(0.18)
Press × Ports	-0.21	0.23***	-0.17**	0.22***	-0.26	-0.21
	(0.19)	(0.051)	(0.066)	(0.084)	(0.16)	(0.20)
Press × Gas	-0.043	0.093	-0.32***	0.24**	-0.18	0.091
	(0.24)	(0.063)	(0.081)	(0.10)	(0.19)	(0.24)
Press × Water PPI	-0.44**	0.025	0.14**	-0.061	-0.13	-0.54***
	(0.20)	(0.053)	(0.068)	(0.087)	(0.16)	(0.20)
Press × Telecoms	0.37	-0.23***	-0.24**	-0.038	0.12	0.73**
	(0.29)	(0.077)	(0.099)	(0.13)	(0.24)	(0.30)
Press × Water IRA	0.0086	-0.22***	-0.53***	-0.053	0.32	0.75***
	(0.27)	(0.071)	(0.091)	(0.12)	(0.22)	(0.27)
Observations	1,359	1,359	1,359	1,359	1,359	1,359
R-squared	0.1246	0.2544	0.1936	0.1427	0.0218	0.1299
F-stat	12.14	27.13	19.51	9.31	1.61	12.64

*** Significant at the 1% level , ** Significant at the 5% level, * Significant at the 10% level