Institutions and Dynamic Relational Contracts in the Oil & Gas Industry

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Abstract

International contracts are difficult to enforce, especially in countries with weak institutions. Thus, oil rich countries can hold up international oil firms by renegotiating taxes once the investment is sunk. If future gains from trade exist, countries can devise a self-enforcing agreement instead. We use elections to show that governments in countries with weak institutions indeed face a binding self-enforceability constraint, while countries with strong institutions do not. In countries with weak institutions, incumbent governments, facing a non-zero probability of losing power, increase taxes by 8pp in the year of the election to satisfy the self-enforceability constraint. A self-enforcing agreement would require investment and taxes to be backloaded (Thomas and Worrall (1994)). We show that contracts in countries with weak institutions seem to be relatively more backloaded than those in countries with strong institutions.

Keywords: Relational Contracts, Taxation, Institutions, Oil.

JEL Classification: D86, L14, H20, D02, P48, Q30.

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1 Introduction

Formal institutions set rules and restrictions such as constitutions and laws that limit individuals' ability (including the state) to manipulate outcomes to their advantage. Most economists agree that well-functioning institutions at least should protect property rights and enforce private contracts (Friedman, 1962). Indeed, previous work has established a positive correlation across countries between various measures of economic performance and the quality of institutions (La Porta et al., 1999; Rodrik, 2000; Acemoglu, Johnson and Robinson, 2005).

In the absence of formal institutions, informal institutions sometimes emerge to substitute for the lack of the former. Hired professional protection of property rights (Gambetta, 1993), informal networks to share information, social norms or punishments (Milgrom, North and Weingast, 1990; Greif, 1993) and trust-based long-term relationships (McMillan and Woodruff, 1999; Antràs and Foley, 2015; Macchiavello and Morjaria, 2015) are great examples. In all previous examples, informal institutions emerge between private parties only. However, informal institutions are also important when one of the transacting parties is the government itself. For instance, the government of a resource rich economy and a firm agree on a framework under which a resource is extracted. In such a setting, it has already been shown that weaker institutions in general and poor ownership rights in particular, slow down the use of resources and, thus, reduce the potential for countries to exploit the natural resources (Bohn and Deacon, 2000; Cust, Harding et al., 2014). This paper aims to document whether governments use self-enforcing agreements when they cannot legally enforce contracts because of weak institutions.

To test this idea, we use the model of Thomas and Worrall (1994) as a framework to think about the lack of executive constraints of the government. The model features a government (he) and an oil company (she) who have a self-enforcing agreement regarding taxes and investment over an infinite number of periods. Every period, the company makes an observable investment to produce oil which cannot be formally contracted on.

To motivate investment, the government promises a favorable tax scheme that is not legally enforceable. The investment, together with the random realization of the oil price, determines the company's profits. At this point, the government decides which level of taxes to impose. If the government reneges on the tax agreement, the company will never invest in the country again, while if the company reneges on the investment, the government expropriates any future investment. Both, the level of investment and taxes need to be self-enforceable.

A self-enforcing taxation agreement requires that the government's short-term incentive to expropriate is less valuable than the long-term incentive to attract investment in the future (i.e. the self-enforceability constraint). If the government expropriates the firm in the current period, it gains the assets but forfeits both current taxes and the discounted value of the relationship (in terms of future taxes and asset value later). This constraint delivers two empirical predictions. First, a government that is facing a temporary smaller discount factor (e.g. the incumbent government is facing an impending election and with some probability will not be reelected), will increase taxation today to maintain self-enforcement (i.e. refrain himself from expropriating). Second, in a country with strong institutions, expropriation is not allowed so the self-enforceability constraint is never in play. Therefore, we should observe a positive relationship between taxes and unpending elections only in countries with weak institutions.

Thomas and Worrall (1994) also show that the optimal self-enforcing agreement is "back-loaded". In particular, the company underinvest early, and increases investment progressively, and then also increases the taxes paid to the government. Delaying the collection of taxes and the investment makes the threat of terminating the relationship more effective by increasing the government's cost of any deviation. In other words, a back-loaded agreement enhances the credibility of the government with weak executive constraints by pushing more of the potential gains towards the end of the relationship. In contrast, when governments are not constrained by the self-enforceability constraint, there is no need to under-invest at the beginning of the relationship.

To test these predictions, we use a proprietary database which has been collected and provided to us by Wood Mackenzie [1]. The data contain information on revenues, capital costs, labor costs and - crucially - tax expenditures for all major oil and gas companies at the country-concession-firm level from 1975 to 2013. This amounts to 274 firm-concession combinations, and 6218 observations, across 60 countries. In our preferred specification, we classify the 60 countries according to their quality of institutions using the level of constraints imposed on the country's executives. Measures on institutional quality in general and the level of executive constraints, in particular, are taken from Polity IV. Polity IV is a database which provides information on the quality of institutions for a large number of countries going back to the 19^{th} century. Finally, we use electoral information from the database of Political Institutions provided by the World Bank.[2]

First, we test whether the government's self-enforceability constraint that prevents reneging on the agreement is more binding for governments with less executive constraints. To do that, we look at the relationship between taxation and elections in countries with weak institutions and compare it to the relationship in countries with strong institutions. For countries with weak institutions, we expect to observe an increase in taxation in the year of the election due to a drop in the discount factor of the incumbent government just before the elections. This is because with some probability the incumbent will lose power next period. Since, ceteris paribus, the incumbent's self-enforceability constraint is tighter, he needs to increase taxation today to relax it and prevent himself from expropriating. Consistent with this idea, we find that taxes grow on average by almost 8 percentage points during election years in countries with weak institutions, while we do not observe such a relationship in countries with strong institutions. In the most parsimonious specification, we only account for the revenues from which the taxes are deducted and for country-firm specific fixed effects (FE) by taking first differences. However, the estimated

[1] Wood Mackenzie is a leading consultancy in the energy and mining industries. See https://www.woodmac.com/

[2] Available here: https://publications.iadb.org/en/publication/12390/database-political-institutions-2015-dpi2015

coefficient remains nearly unaltered once we additionally account for year FE, length of the firm-country relationship FE, firm-time FE and an additional country-firm FE, capturing the country-firm specific linear trend in the level specification.

For the sub-sample of countries with weak institutions, we further explore this relationship. First, we find that the tax increase occurs in the year of the election (as opposed to the year before) and that there is a similarly large reduction in taxes after the elections. Second, the increase is associated with expected elections determined by the regular political cycle (e.g. pre-determined) as opposed to unexpected or irregular ones. Third, this relationship between elections and taxation is driven by countries which have a large national oil firm. This is presumably because the government's value of expropriating is larger if there is a large national oil firm that can take over the operations after an expropriation. Finally, we explore the heterogeneity created by the duration of country-firm specific relationships. In particular, we look at how the increase in taxation is driven by firms that have been in the country for more than 15 years and those that have not. The tax increase is approximately twice as large for country-firm relationships which remain below the 15 years threshold (median in our sample).

Finally, considering the whole sample again, we explore how the quality of institutions is related to the level of backloading relative to the average in our sample. To do that, we first provide an example by focusing on Chevron, one of the biggest and oldest oil companies in the world, initially created by J.D. Rockefeller. We simply plot the average development of tax payments and investments as a function of the length of the relationship for the years 1975 to 2013. We then reproduce the plot for the bottom 25% and the top 25% in terms of the institutional quality for the sample of countries which Chevron had an agreement with. As theoretically expected, we find that the contracts that Chevron has with countries with worse quality of institutions are relatively backloaded, while its agreements in countries with better quality of institutions appear to be front loaded (in terms of investment and in terms of tax payments). We then consider

the whole sample and decompose the changes in investment and taxation into the country-firm FE which, in the growth specification, capture the country specific linear growth component in the LHS variable, and the country-firm specific linear trend in the level specification. Plotting these FEs as a function of the quality of institutions confirms that the observed relationship for Chevron extends to the full sample.

The findings of the paper contribute to the empirical literature on relational contracts such as Antràs and Foley (2015), Macchiavello and Morjaria (2015), Gibbons and Henderson (2013) and Blader et al. (2015).[3] This literature has mainly focused on inter and intra-firm relationships. Moreover, the empirical progress of this literature has been limited by the unavailability of transaction data in environments with limited or no formal contract enforcement. Instead, in our paper, one side of the relationship is the government allowing us to explore the effect of institutions on relational contracting. Moreover, to the best of our knowledge, we are the first to provide evidence about the contract back-loading predicted by the theory.

In the resource economics literature, other papers have looked at the effect of institutions in the oil industry. Stroebel and Van Benthem (2013) consider a model where the oil company can provide the government with insurance. They consider stationary contracts and show that expropriation occurs in equilibrium (unlike in Thomas and Worrall (1994)) because the government's expropriation cost is private information. Empirically, they find that expropriation is more likely when oil prices are high and that oil companies offer more insurance to countries with better institutions. Guriev, Kolotilin and Sonin (2011) also find empirically that nationalization is more likely to occur when oil prices are high and the quality of institutions low, but they use a model where firms (not the governments) can renege on the taxes. Thus, taxes cannot be too high to ensure that they are paid, such that, as a result the government has incentives to expropriate when oil prices are high. Finally, Jaakkola, Spiro and Van Benthem (2019) show that taxation and investment exhibit cycles by using a model where the government's commitment is limited to one period and the company

[3]See Gil and Zanarone (2017) for a recent survey.

cannot commit to never invest in the future. We are the first to document empirically the consequences of lack of commitment on the timing of investment and tax collection. Also, the previous literature use oil prices as a source of variation. High oil prices increase the value of staying within the relationship as well as the value of expropriating. Thus it is not clear if the self-enforcing constraint becomes tighter as a result. Instead, we use elections which unambiguously decrease the value of staying with the relationship.

In the next section we set up a model and derive the hypotheses. In section 3 we describe the data and the stylized facts. In section 4 we present the results. In the last section we conclude.

2 The model

In this section, we present a model of the relationship between a risk neutral government and a risk neutral oil and gas firm who interact repeatedly over an infinite horizon of discrete periods. We borrow this model from Thomas and Worrall (1994), and adapt it to the oil and gas industry. We use the model as a framework to think about the firm and government relationship. In doing so, we derive two predictions which we then test in Section 4.

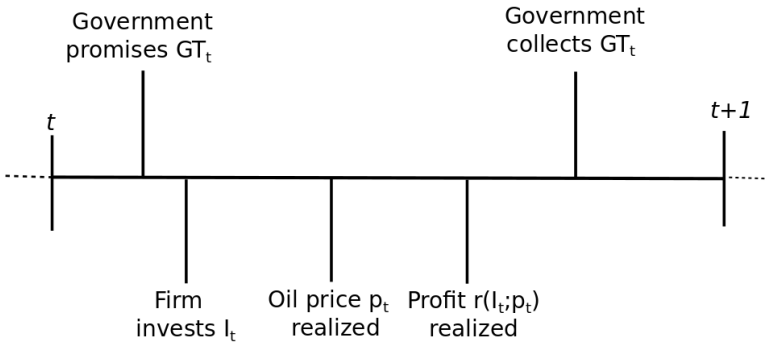


Figure 1: Timeline of period t

The timeline for each period is shown in Figure 1. Every period, the government and the firm agree on a non-contractible investment and a transfer. Then, the firm provides an investment I_t (which depreciates within one period[4]). An oil price p_t is then realized which, together with the investment, determines the firm's profit $r(I_t; p_t)$. The price is *i.i.d.* over time and the probability of a price p is s_p, independent of time. It is assumed that $r(I_t; p_t)$ is twice-continously differentiable in I_t, increasing and concave in I_t, $r(0; p_t) = 0$, and increasing in p_t. Finally, the government chooses a transfer GT_t (i.e. overall government take), leaving the firm a net profit of $r(I_t; p) - GT_t$. Thomas and Worrall (1994) assume that both the government and the firm have the same discount factor δ and are credit-constrained: $r(I_t; p_t) - GT_t \geq 0$ and $GT_t \geq 0$. Regarding the information structure, everything is observable to everyone.

A contract c at time t is a pair $(I_t(h^{t-1}), GT_t(h^t))$ that depends on the history up to time $t-1$, h^{t-1}. Thomas and Worrall (1994) define the optimal contract as the one that maximizes the firm's payoff at the beginning of the game. The expected per-period payoff functions of the government and the firm can be written respectively as follows:

$$V(c; h^{t-1}) = (1-\delta)\mathbb{E}\left[GT_t(h^t)\right] + \delta\mathbb{E}\left[V(c; h^t)\right]$$
$$U(c; h^{t-1}) = (1-\delta)[-I_t(h^{t-1}) + \mathbb{E}\left[r(I_t(h^{t-1}); p_t) - GT_t(h^t)\right]] + \delta\mathbb{E}\left[U(c; h^t)\right]$$

When the contract c offered by the government is not legally enforceable, it then needs to be self-enforcing. This means that neither the government nor the firm should ever have an incentive to violate it ex-post. Assume that if the firm does not invest the agreed amount, the government expropriates. Therefore, the following condition guarantees that the firm has incentives to honor the investment at time t:

$$U(c; h^t) \geq 0 \tag{1}$$

This condition requires the firm's expected payoff to be above the firm's

[4] Thomas and Worrall (1994) show that the results are not qualitatively affected by capital accumulation, which is clearly the case in the oil and gas industry.

outside option, which is normalized to 0.

Likewise, if the government deviates from the agreed transfer, it is assumed that the firm will never again invest in the country. Therefore, if the government deviates, he appropriates all the profits. The following condition ensures that, for a given realization of the price, the government has incentives to honor the agreement at time t:

$$(1-\delta)GT_t(h^t) + \delta V(c;h^t) \geq (1-\delta)r(I_t(h^{t-1});p_t) \tag{2}$$

This constraint says that, for the government to honor the agreement, the current government take plus the future value of the relationship (in term of future taxes and investment) should be larger than what the government would get if he expropriates the firm's profits in the current period.

Countries with strong institutions

In countries with strong institutions, there is a well functioning rule of law. Thus, contracts can be enforced by the court, including the ones involving the government. In such countries, a government will not succeed in expropriating the firm so the right hand side of equation (2) is 0, and therefore, the constraint is always slack. Define I^* as the profit maximizing level of investment: $E\left[r'(I^*;p_t)\right] = 1$. If the firm and the government can legally enforce the contract, then the firm will invest I^* every period. The transfers will determine how the government and the firm share the surplus but will not affect the level of investment. For instance, the contract that maximizes the firm's payoff will have no transfers so the the government gets his outside option of zero. Any path with positive transfers (that satisfy the firm's participation constraint) is also possible.

Countries with weak institutions

Countries with weak institutions lack a strong rule of law including well-functioning constraints on their governments. As a result, the contract c offered by the government needs to satisfy conditions (1) and (2). Thomas

and Worrall (1994) find that when this is the case, the optimal self-enforcing agreement is "back-loaded"[5] so that the government's value for the relationship increases over time. The firm will do this: first, by progressively increasing investment until the first best level I^* is achieved,[6] and second, by increasing the taxes paid to the government. The authors show that if the government is risk averse or there is capital accumulation (i.e. I_t does not fully depreciate within each period), the government take can be paid earlier on but the dynamic backloaded structure of the contract will remain unchanged.

The rationale behind this contract is that, the firm, by delaying the payment of taxes and the investment, makes the threat of terminating the relationship more effective by increasing the government's cost of deviation. In other words, a back-loaded agreement enhances the government's credibility by pushing potential gains towards later parts of the relationship.

2.1 Testable Hypothesis

The first hypothesis we want to test is whether governments in countries that suffer from weak institutions face a binding self-enforcing constraint (2) while those with strong institutions do not. In order to do this, we exploit changes in the discount factor δ within the same country.[7] A government facing an impending election discounts the future more because, with some probability, he will lose the elections. In particular, the effective discount factor becomes $\hat{\delta} = \delta Prob[reelection]$. Equation (2) tells us that one way to compensate for a decrease in the discount factor is to increase the current government's take. In countries with strong institutions, the constraint (2) is slack because expropriation is illegal, so impending elections should not affect the current government take. Thus, the negative relationship between the discount factor and the government take should

[5] See Proposition 1 of their paper.

[6] If the discount factor is small enough, the efficient level of investment will never be reached, see Proposition 2 of their paper.

[7] Note that we are using the theory as framework because Thomas and Worrall (1994) do not consider changes in discount factor over time.

arise only in countries with weak institutions.[8]

Hypothesis 1: Impending elections will increase taxation only in countries with weak institutions.

If the first hypothesis is confirmed. Then, Thomas and Worrall (1994) show that when the self-enforceability constraint is binding, the agreement needs to be "back-loaded".

Hypothesis 2: The government's take and the firm's investment are back-loaded in countries with weak institutions compared to those with strong institutions.

3 Data Description

Oil and gas contracts Our first data set contains the contract characteristics for the 24 biggest private and public oil and gas firms. The selection of firms is based on Ross (2012), who constructed the list based on the stock value and the value of the resources owned by the firms.[9]

For each of these firms we observe a number of financial variables reflecting their activities across countries between 1975 and 2013. This data has been collected by Wood Mackenzie. They collect the data first via face to face interviews with energy firms in the relevant countries and use the official reports of such firms. Second, they use information from publications of regulatory authorities and governments of the respective countries. Third, they use a variety of media sources.[10]

[8] In principle, an incumbent who has won the elections experiences an increase in the discount factor. This relaxes the self-enforceability constraint and may decrease the government take the year after the elections. We are currently collecting information on who won the elections to shed light on this.

[9] Three firms were not included due to data limitations: the national oil companies of Iraq and Libya, and Surgutneftegaz which is a Russian hybrid (partly private and partly public).

[10] We are not the first to use their data for research purposes (see for instance Stroebel and Van Benthem (2013) and Jaakkola, Spiro and Van Benthem (2019)).

The involvement of a firm in a particular country is always preceded by the creation of an agreement between the firm and the country hosting the firm. If the firm is granted 100% ownership of the product extracted, the agreement is referred to as a concession. The agreement is referred to as a service contract if the firm is granted 0% ownership and as a production sharing agreement if the firm is granted between 0 and 100% ownership. Such agreements imply that at least a share of the generated revenues by the firm is owned by the government of the country in which the firm is operating. The negotiation and the shares allocated vary greatly and depend on a country's petroleum laws and regulations.

The total amount and the structure of payments received by the government under an agreement are typically referred to as a fiscal system. In some countries, a single fiscal system applies to the entire country; in others, a variety of fiscal systems exist. In many cases, the agreements allocated to the same firm within the same country are also interlinked in a variety of ways, such as a joint calculation of the tax base.[11] Therefore, in what follows, we aggregate our variables to the country level and refer to repeated country-firm observations as a contract.

Once agreed upon, a contract grants exclusive rights to firms to explore and extract oil and gas in a geographically defined area and sell the extracted amount. The most important variable for our analysis is the government's take. The government's take should be thought of as the price the firm pays for the right to explore and extract the product. It captures the total amount of payments received by the government. This measure typically captures a variety of different flows such as bonuses, rentals, royalties, corporate income taxes, and a number of special taxes. We use the government take since it is the the most common statistic used for the evaluation of contracts (Johnston, 2007; Venables, 2016). See Johnston (2007) for a discussion of the advantages and the disadvantages of such a measure. See Mintz and Chen (2012) for an excellent survey of tax and royalty

[11] See the Global Oil and Gas Tax Guide 2017 for examples. Available at: http://www.ey.com/gl/en/services/tax/tax-services_access-our-global-tax-guides

Table 1: Country-Firm Specific Characteristics (in mil. 1965 US$)

	mean	**p50**	**sd**	**max**	**min**
Real Revenue	116.11	9.73	619.95	9301.38	0.00
Real Gov. Take	52.92	2.50	355.88	5558.43	0.00
Duration	18.82	15.00	14.51	48.00	0.00

Based on 274 country-firm observations that are averages over the country-firm specific values.

systems across a number of countries for which detailed data is publicly available.

In Table 1, we provide basic descriptive statistics of the agreements in US$. Total Revenue mainly consists of quantity produced in barrels of oil-equivalent multiplied by price. Capital Costs are the amount spent on durable goods (assets with lifetime $>$ 1 year). Operational Costs are the amount spent on labor and non-durable goods e.g. (mostly) salaries and wages but also materials, insurance and maintenance. Our main variable of interest is the Government Take which has already been mentioned and described above. It is worth noting that contracts are long-lasting with a median length of 15 years. Moreover, contracts are large with an average real revenue of 112 mil. US$ (in 1965 price), which would be almost 1 billion in 2019. Roughly half of the revenues goes to the government.

Institutions and elections To test our hypothesis, we need data that differentiates between countries with weak and strong institutions. We obtain this data from Polity IV, which has measures containing annual information on regime and authority characteristics for a large number of countries. In particular, we use the variable executive constraints (XCONST), which measures the extent of institutional constraints on the decision-making powers of the chief executive, whether an individual or a collective executive. For interpretation purposes, we normalize the executive constraints variable to be between 0 and 1. As a robustness check, we also use the variables on political competition (PARCOMP) and the competitive-

Table 2: Institutions and Elections

	mean	**p50**	**sd**	**min**	**max**
Political Competition	0.65	0.80	0.33	0	1
Executive Constraints	0.67	0.71	0.32	0.14	1
Competitive Recruitment	0.67	0.67	0.36	0	1
Election	0.22	0.00	0.42	0	1

Source: Polity IV and own calculations.

ness of executive recruitment (XRCOMP). Table 2 provides the summary statistics for our sample of countries.

We collect data on the dates of legislative and executive elections for the countries in our database, which represents our main explanatory variable in the analysis to follow. We obtain this information from database of Political Institutions, provided by the World Bank. We use this information to construct a dummy variable which is equal to 1 in the period of an election and zero otherwise. In the bottom row of Table 2 we provide the summary statistics, which implies that on average election occur every 5^{th} year.

Finally, to make revenue flows and government take comparable across time, we need to discount them. While there are many ways to do that, we choose to adjust the nominal values by constructing discounted present values using returns from a reasonable outside option in our preferred specification. To do that, we use the information on the development of stock prices and dividends of the S&P 500, which allows us to discount all the flows to the starting period of a project.[12] This discount method is particularly useful in the second part of the analysis when we evaluate which share of the cumulative cash flow of a project has been received by the government until a particular production period. Alternatively, we provide results using the US CPI to discount and results in which we keep the results unadjusted. As the reader will be able to observe in column 2-3 of

[12]This information is publicly available on Robert Shiller's webpage.

Table 4, the results are not significantly affected by our choice. To avoid discounting completely and to weight the observations by the importance of the cash flows for a country's economy, we also provide the results in which we divide the nominal values of the government take and revenues by GDP. The results are provided in the last column of Table 4.

4 Results

4.1 Relationship between institutions, elections and government take

We test hypothesis 1 by estimating a relationship which allows us to evaluate the importance of a country's institutions during political cycles. Figure 2 presents the relationship between discounted government takes and discounted revenues. It shows that a simple log-log relationship seems to capture well the observations. Note that the observations must be below the 45° line, otherwise firms incur losses. We also see some upfront fees paid to the government at zero revenue and some subsidies paid by the government (negative values).

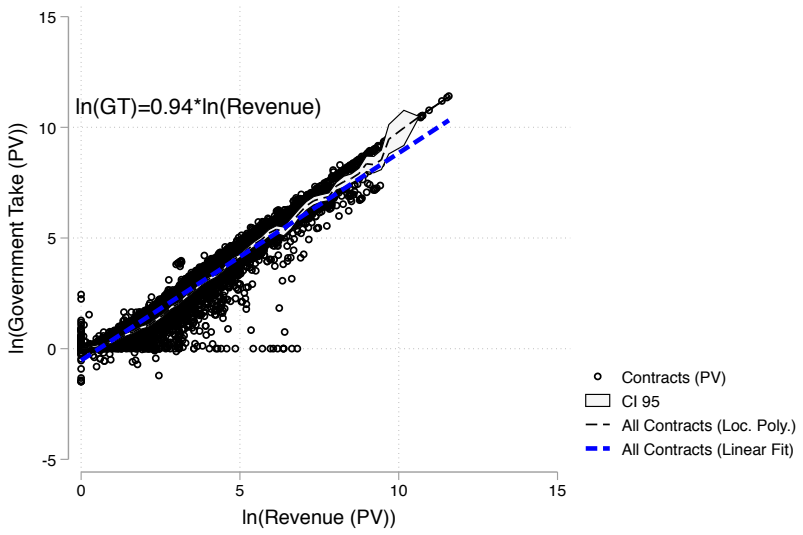
Given the relationship captured in Figure 2, we start by considering the following equation:

$$ln(\mathrm{GT}_{ift\tau}) = \theta ln(\mathrm{Rev}_{ift\tau}) + \epsilon_{ift\tau} \tag{3}$$

where $\mathrm{GT}_{ift\tau}$ is country's i discounted government take from firm f in year t at period τ of their relationship,[13] $\mathrm{Rev}_{ift\tau}$ is firm's f discounted revenues in country i in year t at period τ of their relationship and ϵ is the error term. We estimate this equation and report the results in the first column of Table 3. We can see that θ is close to 1. The second column takes the first difference of government take and revenues. We do this to

[13]Our data starts in 1965, so we attribute the right τ to those relationships starting after that date and we drop the relationships that already existed in 1965. Assuming instead that those relationships started in 1965 does not change the results.

Figure 2: Contracts (in logs)



account for non-stationarities[14] in the variables and to control for country-firm FEs such as time unvarying aspects like geology. As expected, the impact of revenues on government take is attenuated. We expected θ to be upward biased since a more promising geology which will generate large revenues may result in larger bargaining power on the government side. Alternatively, we account for the country-firm specific FE using the level specification and the results are not statistically different from each other (see column 1 and 2 in Table 4).

We now use the theory to augment specification (3) by introducing our measure of institutions and elections:

$$\Delta ln(\text{GT}_{ift\tau}) = \theta \Delta ln(\text{Rev}_{ift\tau}) + \alpha \text{Inst}_{it} + \beta \text{Elec}_{it} + \gamma \text{Inst}_{it} \times \text{Elec}_{it} + e_{ift\tau} \tag{4}$$

where Inst_{it} indicates a measure for the quality of institutions[15] in coun-

[14]Using standard non-stationarity test we reject the null of non-stationary of the first difference variables for a variety of alternative specifications.

[15]The results in Table 3 use the indicator of Executive Constraints. In Figure 3

Table 3: Government Take and Institutions

	(1) ln(GT PV)	(2) Δ ln(GT PV)	(3) Δ ln(GT PV)	(4) Δ ln(GT PV)
ln(Revenue PV)	0.856***			
	(0.021)			
Δ ln(Revenue PV)		0.675***	0.670***	0.669***
		(0.032)	(0.033)	(0.033)
Election (=1)			0.018	0.077**
			(0.017)	(0.031)
Institutions (0-1)			-0.005	0.014
			(0.013)	(0.018)
Election (=1) × Instituions (0-1)				-0.080*
				(0.040)
N	5612	5279	5213	5213
R-sq	0.93	0.56	0.55	0.55

The results in column 1 indicates the coefficient from linear fit in Figure 2. We account for the country-firm FE by taking the first difference in column 2-4. While in column 1 we use all, observations, in column 2-4 we use only observations for which we know exactly the first year of production following 1965. Standard errors in parenthesis clustered by country and year, and * stands for statistical significance at the 10% level, ** at the 5% level and *** at the 1% percent level.

try i at year t and Elec_{it} is a dummy indicating the year of an election. Finally, $e_{ijt\rho}$ is an error term clustered at the country-year level. We expect α to be close to zero since institutions change slowly and we account for country-firm time invariant characteristics. In addition, we expect β to be positive and γ to be negative and have the same absolute value as β. The fourth column of Table 3 reports the results and confirms our expectations.

In Table 4 we confirm that our results are robust to alternative specifications, methods of discounting and the use of weights.

Graphically, the main result is presented in Figure 3, where we plot the marginal effect of elections on the government take for different institutional measures.

$$\frac{\partial \Delta ln(\text{GT}_{ift\tau})}{\partial \text{Elec}_{it}} = \beta + \gamma \text{Inst}_{it}$$

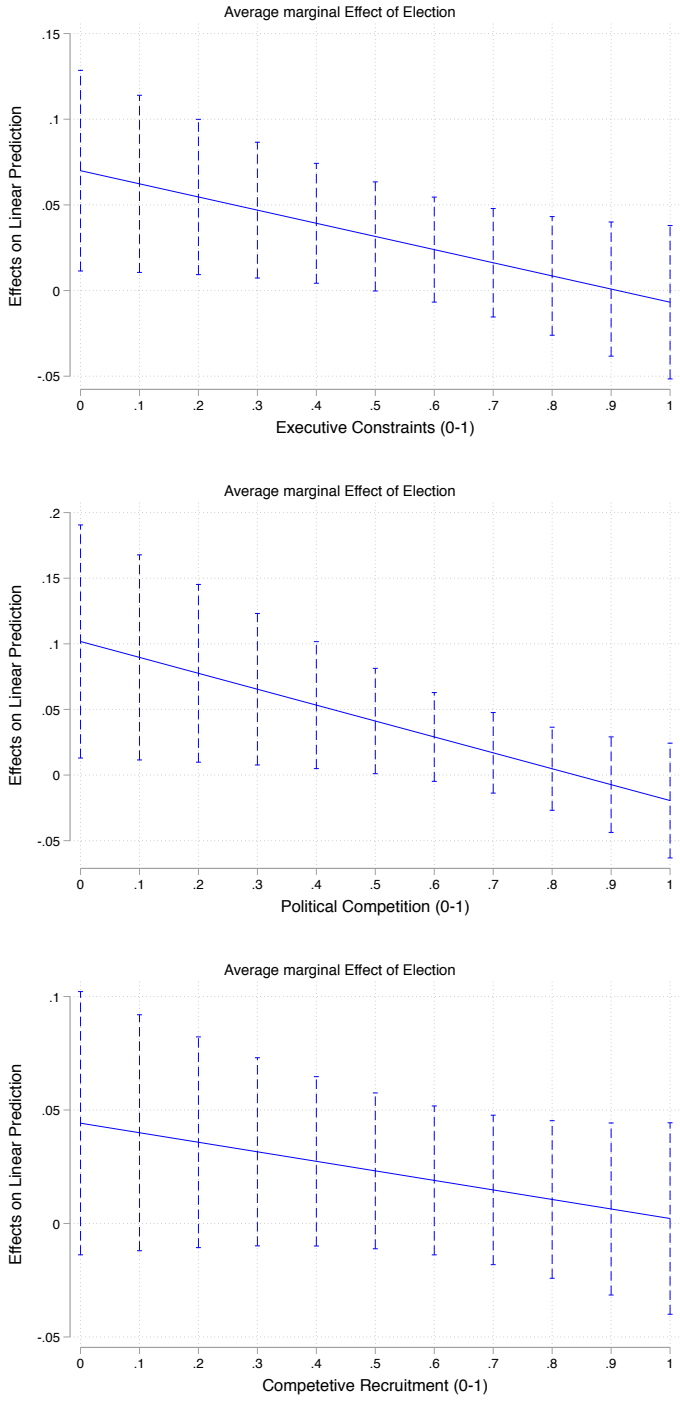
we show that the same pattern emerge using Political Competition and Competitive Recruitment.

Table 4: Alternative Specifications

	(1)	(2)	(3)	(4)	(5)
	Δ ln(GT PV)	ln(GT PV)	ln(GT/CPI)	ln(GT)	GT/GDP
Δ ln(Revenue PV)	0.669***				
	(0.033)				
ln(Revenue PV)		0.856***			
		(0.021)			
ln(Revenue/CPI)			0.876***		
			(0.017)		
ln(Revenue)				0.845***	
				(0.026)	
Revenue/GDP					0.514***
					(0.032)
Election (=1)	0.077**	0.116***	0.147***	0.225***	0.014**
	(0.031)	(0.037)	(0.054)	(0.070)	(0.006)
Institutions (0-1)	0.014	-0.034	-0.036	0.112	0.001
	(0.018)	(0.099)	(0.171)	(0.142)	(0.019)
Election (=1) × Instituions (0-1)	-0.080*	-0.110**	-0.141**	-0.185*	-0.014**
	(0.040)	(0.043)	(0.061)	(0.095)	(0.007)
N	5213	5541	5541	5541	5450
R-sq	0.55	0.86	0.84	0.74	0.93

We account for the country-firm FE by taking first differences. In column 1 we reproduce the results from column 4 in the previous Table. In column 2 we account for the fixed effect by accounting for averages. In column 3 we use the CPI to discount the variables. In column 4 we do not discount at all. In column 5 we divide revenues and government take by GDP to account for the importance of flows in the economy. Standard errors in parentheses clustered by country and year. * stands for statistical significance at the 10% level, ** at the 5% level and *** at the 1% percent level.

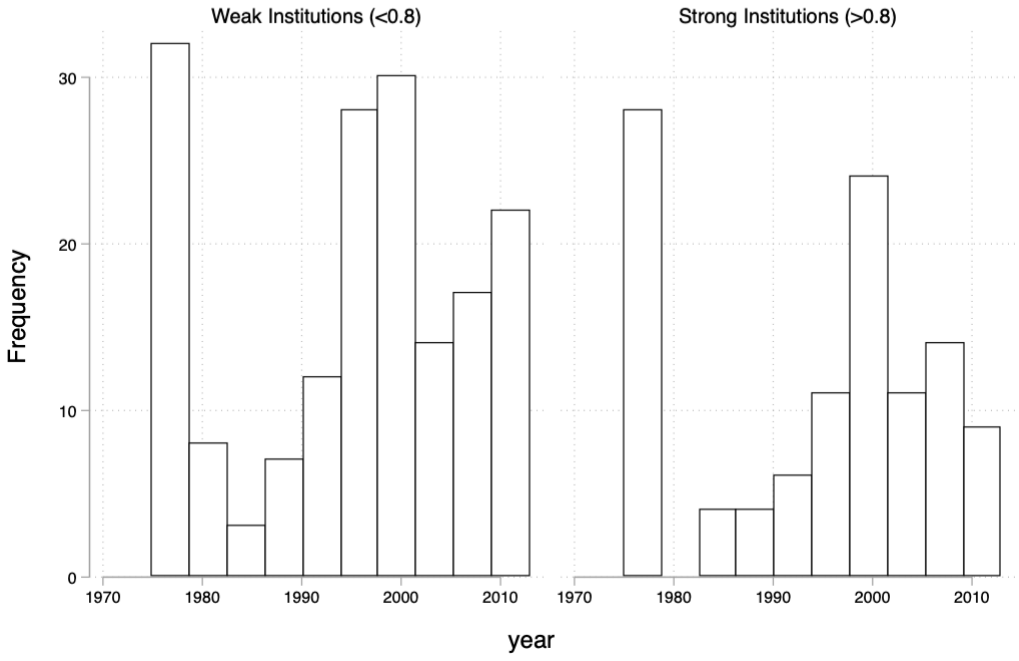
Figure 3: Marginal Effect of Elections on the Government Take



Consistent with our predictions, the marginal effect is precisely estimated at 0 when the quality of institutions takes the maximum value of 1

for all three measures. These results already indicate that there is a threshold from which the quality of institutions guarantees that the political cycle does not relate to the government take. Informed by Figure 3, we choose 0.8 as our threshold to group countries by weak and strong institutions. We use this divide in the next section.[16] Note that this threshold is above the mean and median values for our sample of countries (see Table 2). Figure 4 indicates how many firm-government relationships start in countries with weak and strong executive constraints each year.

Figure 4: Number of relationships starting in year t



Finally, in Table 5, we reproduce the results from Table 3 in column (1) and then account for a variety of fixed effects which capture alternative sources of confounding factors. This table shows that the results are not affected by these extra control variables. In particular, we gradually account for year, length of the relationship, firm-time and country-firm fixed effects:

[16] A threshold of 0.9 or 0.7 does not yield significantly different results.

Table 5: Robustness

	(1) Δ ln(GT PV)	(2) Δ ln(GT PV)	(3) Δ ln(GT PV)	(4) Δ ln(GT PV)	(5) Δ ln(GT PV)
Δ ln(Revenue PV)	0.678***	0.627***	0.638***	0.617***	0.600***
	(0.031)	(0.032)	(0.033)	(0.033)	(0.036)
Election (=1)	0.080**	0.073***	0.072**	0.065*	0.066*
	(0.030)	(0.027)	(0.028)	(0.033)	(0.035)
Instituions (0-1)	0.016	0.008	0.008	0.003	0.040
	(0.017)	(0.015)	(0.015)	(0.018)	(0.037)
Election (=1) × Instituions (0-1)	-0.084**	-0.086**	-0.086**	-0.083*	-0.081*
	(0.039)	(0.038)	(0.039)	(0.046)	(0.048)
N	5634	5634	5634	5634	5634
R-sq	0.56	0.60	0.60	0.65	0.63

In column 1, we reproduce the results of column 3 in Table 3. In column 2, we account for year FE. In column 3, we account for year and production period FE. In column 4, we add firm-time FE. In the last column, we add a country-firm specific FE which captures the country-firm specific average growth in the government take. Standard errors in parentheses clustered by country and year. * stands for statistical significance at the 10% level, ** at the 5% level and *** at the 1% percent level.

$$e_{ift\tau} = \mu_t + \omega_\tau + \lambda_{ft} + \eta_{if} + \varepsilon_{ift\tau} \tag{5}$$

4.2 Heterogeneity effects in countries with weak institutions

To explore the results a bit further, we focus on the subsample of countries with weak institutions as determined by the 0.8 threshold on executive constraints. We explore potential sources of heterogeneity in Table 6 using the specification with all the FE above. In particular, we will estimate the following equation,[17] where X will change depending on which heterogeneity effect we want to explore:

$$\Delta ln(\mathrm{GT}_{ift\tau}) = \theta \Delta ln(\mathrm{Rev}_{ift\tau}) + X + \mu_t + \omega_\tau + \lambda_{ft} + \eta_{if} + \varepsilon_{ift\tau}$$

We first explore the timing of the change in the government take, hence

[17] We do not include Institutions because it was insignificant in the previous regressions.

Table 6: Heterogeneity

	(1) Δ ln(GT PV)	(2) Δ ln(GT PV)	(3) Δ ln(GT PV)	(4) Δ ln(GT PV)	(5) Δ ln(GT PV)
Δ ln(Revenue PV)	0.648***	0.622***	0.650***	0.648***	0.647***
	(0.046)	(0.048)	(0.046)	(0.046)	(0.046)
Election_{t+1}		-0.002			
		(0.023)			
Election_{t} (=1)	0.059**	0.047*			
	(0.029)	(0.027)			
Election_{t-1}		-0.060*			
		(0.034)			
Election_{t} (unexpected)			-0.029		
			(0.066)		
Election_{t} (expected)			0.085***		
			(0.028)		
Election_{t} (No Big Oil)				0.022	
				(0.023)	
Election_{t} (Big Oil)				0.077*	
				(0.043)	
Election_{t} ($\geq$ 15 years)					0.034*
					(0.020)
Election_{t} ($<$ 15 years)					0.073*
					(0.038)
N	3205	3015	3205	3205	3205
R-sq	0.69	0.68	0.69	0.69	0.69

In the first column we reproduce the results of column 3 in Table 3. In the second column we account for year FE. In the third column we account for year and production period FE. In the fourth column we add firm-time FEs. In the last column we add a country-firm specific fixed effect which captures the country-firm specific average growth in the government take. Standard errors in parenthesis clustered by country and year, and * stands for statistical significance at the 10% level, ** at the 5% level and *** at the 1% percent level.

we replace X by $\sum_{k=-1}^{1} \alpha_k \text{Elec}_{it+k}$. The results, in column (2) of Table 6, show that the change in the government take increases by almost 5 pp in the election year, and decreases by 6 pp the year after. We are now collecting information on whether our results are driven by incumbents which ended up winning the election.

Then, we code the elections as being expected (i.e. according to the pre-established electoral cycle) or "unexpected" (i.e. outside the regular cycle) and replace X by $\alpha_1 \text{Elec}_{itexp} + \alpha_2 \text{Elec}_{itunexp}$. The results, in column (3) of Table 6, suggest that the increase in government take on the year of the election is exclusively driven by expected elections.

Third, we explore how the change in the government take is associated

with whether or not the country has a successful oil firm (i.e. it appears in our sample of the 24 biggest firms). To test this, we replace X by $\alpha_1 \text{Elec}_{itoil} + \alpha_2 \text{Elec}_{itnooil}$. We would expect the value of an expropriation to be larger if there is a large national oil firm. This is because the government presumably has more power to formally or informally influence this local firm to run the expropriated investment. Therefore, the government's self-enforceablity constraint is more binding when such local firm exist. The results, in column (4) of Table 6, confirm our expectations.

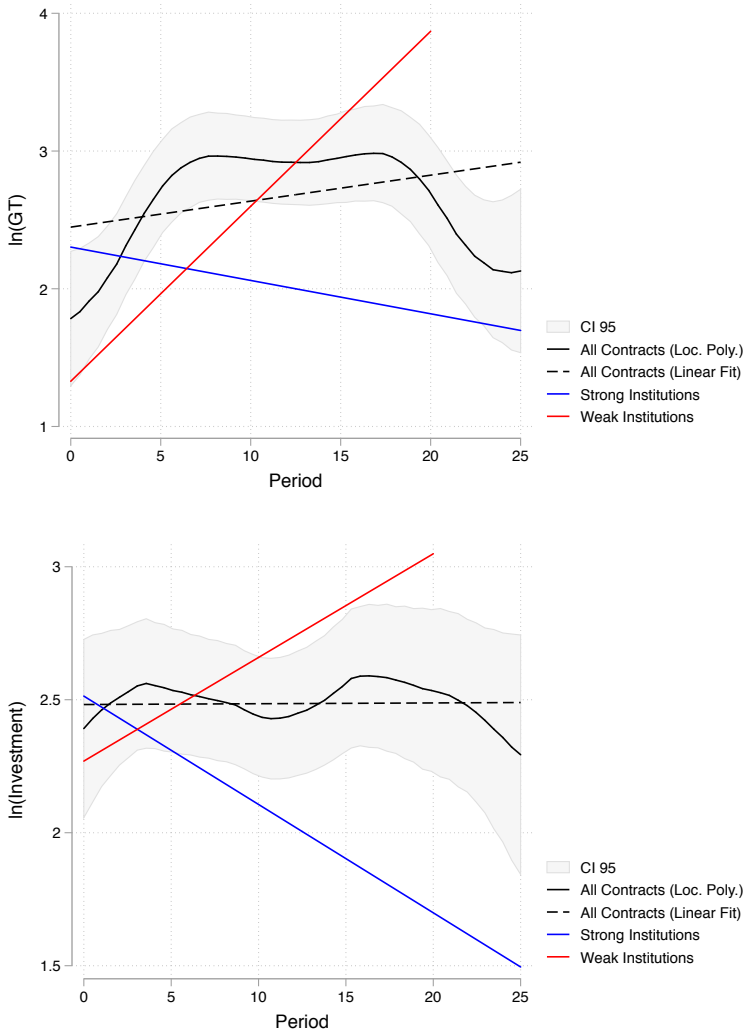
Finally, we look at whether the trust-based relationship between the government and the firm may be firm specific. In particular, we look at how the increase in government take is allocated between firms that have been in the country for more than 15 years (average length of relationships) and those that have not, replacing X by $\alpha_1 \text{Elec}_{itf \geq 15years} + \alpha_2 \text{Elec}_{itf < 15years}$. The results are displayed in column (5) of Table 6. We can see that both types of firms experience a growth in government take but the growth for newer relationships is 4 pp higher, that is, it is twice as high.

4.3 Investment and taxation dynamics

In Section 4.1 we saw that only countries with weak institutions seem to be facing a binding self-enforceability constraint. As we highlighted in section 2, Thomas and Worrall (1994) show that when this is the case, a firm maximizing its first period profits should backload the contract. In particular, the more the government constraint is binding, the more the contract should be backloaded. To explore the dynamics of the agreements, we consider the whole sample again. We show that, after controlling for a number of fixed effects, the average growth in the government take and investment is greater in countries with weak institutions than in countries with strong institutions.

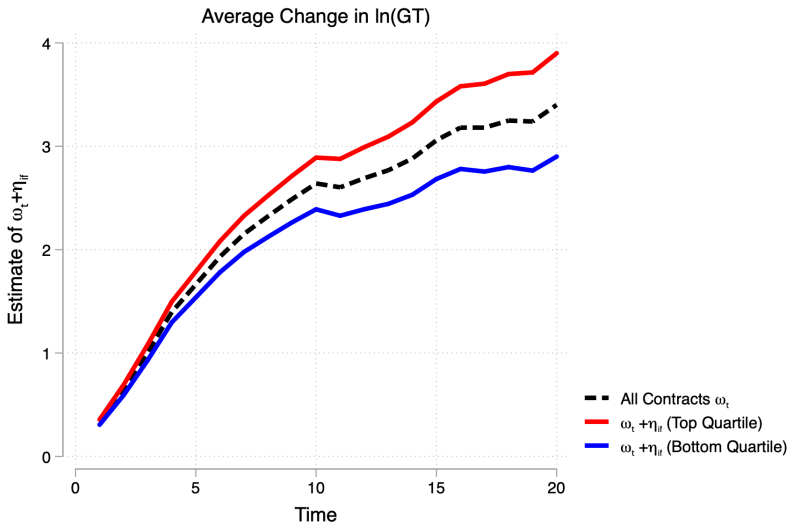
Let us consider first the example of Chevron, a US-based firm that produces in a variety of countries. Figure 5 depicts in black the universe of agreements in terms of government take (top panel) and investment (bot-

Figure 5: Timing of investment and government take by Chevron



Both graphs depict the evolution of the discounted government take and the discounted investment over the length of the relationship (ρ).

Figure 6: Average growth of government take



tom panel) as a function of the length of the relationship. In red (blue), we can see the government take and investment for the bottom (top) quartile of countries in term of their quality of institutions. Therefore, this example illustrates well that the backloading is, as expected, more prevalent in countries with weaker institutions. Moreover, it seems to be the case that in this industry it is desirable to frontload investment, making the backloading distortion even more dramatic than suggested by the theory.

To assess these effects more generally, we estimate equation (6) where $y_{ift\tau}$ is the placeholder for either investment or government take (in which case we also account for revenues).

$$\Delta ln(y_{ift\tau}) = \mu_t + \omega_\tau + \eta_{if} + \varepsilon_{ift\tau} \tag{6}$$

This specification allows us to capture the average growth of the government take and investment for all contracts as a function of the length of the relationship ω_τ. This corresponds to the dashed line in Figure 6.

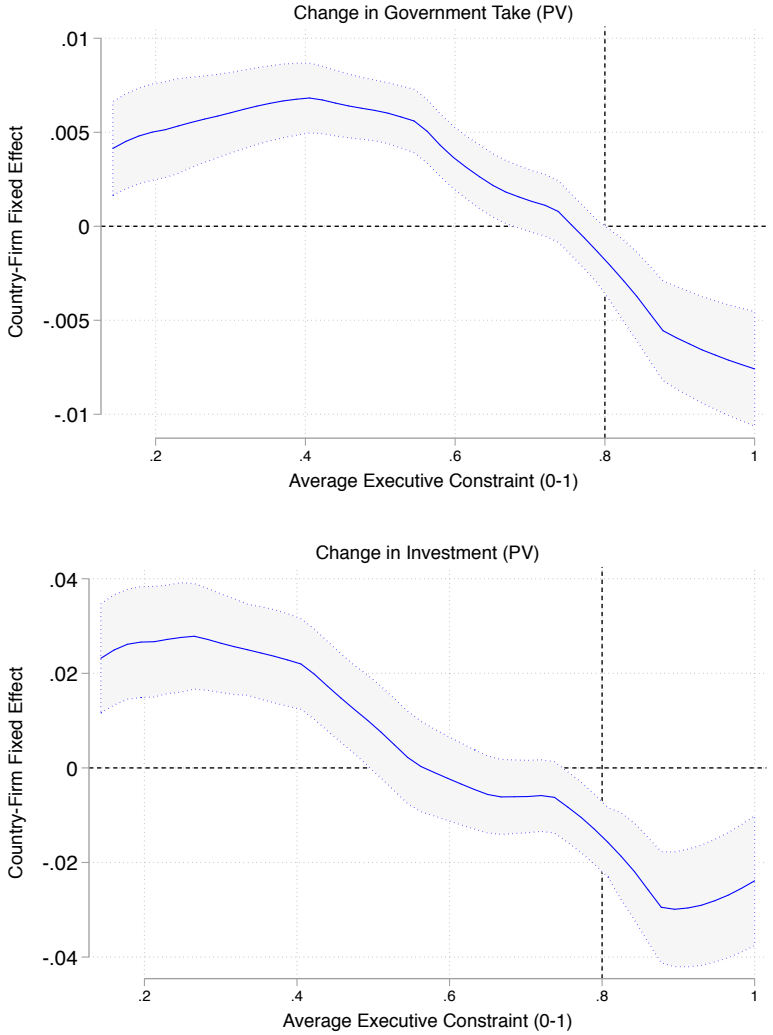
Furthermore, we can identify the country-firm specific average growth in the government take (and investment) as captured by η_{if}. When η_{if} is positive, the average change in government take grows faster than when it is negative. This is captured in Figure 6 where we plot the average change of the top quartile (red) and the bottom quartile (blue).

Since a positive η_{if} means that the contract is more backloaded, we expect this component to be positive in countries with weak institutions and negative in countries with strong institutions relative to the average change as captured by ω_τ. After, estimating (6) and predicting η_{if}, we plot the predictions against the average quality of executive constraints as estimated over the number of periods of existence of the relationship between i and f. The results are presented in Figure 7 and imply that countries with an average executive constraint measure below 0.8 are relatively backloaded while countries with an average executive constraint above 0.8 are not. This result holds for the growth in government takes and for investments.

5 Conclusion

This paper has aimed to shed light on whether the quality of institutions affects the government's credibility when contracting with oil and gas firms. We find that governments in countries with weak institutions increase their government take by 8 pp on the year of election. This increase is more prominent when there is a successful oil company from this country and is mostly driven by late entrants. Firms seem to respond to this lack of credibility by backloading investment and the payment of government take.

Figure 7: Timing of investment and government take



Both graphs depict the relationship between the average growth in real government take and real investment (conditional on year and period fixed effects and conditional on real government take in the former) and the average executive constraint over the life time of a firm-country relationship.

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