The Geoeconomics of Contract Enforcement

Elena Paltseva, Gerhard Toews and Marta Troya-Martinez*

January 14, 2026

Abstract

Historically, contract enforcement between multinationals and host governments relied on military power. In the late 1960s, Western Great Powers—U.S., U.K., France— sharply reduced such interventions, increasing expropriation risk in weak-institution countries. We exploit this shift as an exogenous change in enforcement using microdata on oil and gas fields worldwide. We find that firms headquartered in these countries delayed ("backloaded") production by two to four years, converging to the backloading exhibited by other multinationals. This delay caused annual revenue losses of $1 billion per country, offset by higher government rent shares. These patterns are consistent with a shift toward self-enforcing contracts.

Keywords: Dynamic Incentives, Political Economy, Institutions, Oil.

JEL Classification: D86, L14, O13, H20, P48.

*Paltseva: SITE, Stockholm School of Economics, (email: elena.paltseva@hhs.se), Toews: New Economic School and University of Stavanger (email: gerhardtoews@gmail.com) and Troya-Martinez: Universitat Autonoma de Barcelona, New Economic School, Barcelona School of Economics and CEPR (email: Marta.Troya@uab.cat). We are grateful to Jørgen J. Andersen, Jean Beuve, Decio Coviello, Joyee Deb, Georgy Egorov, Tore Ellingsen, Matthias Fahn, Leonardo Felli, Dana Foarta, Guido Friebel, Willie Fuchs, Markus Gebauer, Bob Gibbons, Jonathan Greenacre, Charles Hodgson, Alberto Iozzi, Namrata Kala, Rachel Kranton, Francine Lafontaine, Rocco Macchiavello, Pepita Miquel-Florensa, Jim Malcomson, Ameet Morjaria, Debraj Ray, Léo Reitzmann, Anouk Rigterink, Anna Sanktjohanser, Daniel Spiro, Pierre-Louis Vezina, Liam Wren-Lewis, Giorgio Zanarone, Kuncheng Zheng, Ekaterina Zhuravskaya and the participants of the ES World Congress, IIOC, SIOE, Norwegian Virtual Political Economy Workshop, 7th Workshop on Relational Contracts, EALE, CEPR-IMO, EWMES, NOITS, NEUDC, Org. Econ. NBER meeting, CASBS-CJBS Conference on Shared Governance, IOEA, CEPR-IO, NASMES, IBEO, JEI, CSAE, BSE Summer Forum, MCO, EEA, PolEcCon, Williamson Workshop and the seminars at UNSW, University of Sydney, UAB, City, Erasmus, NES, Nottingham, CEMFI, UIB, Bilgi, Stirling, UPF, UCD and SITE for many insightful comments. We thank Anton Didenko, Alina Gafanova, Maria Loskutnikova, Anastasia Nebolsina, Kira Silvestrovich, Alexander Tonis, Dmitrii Urentsov and Mikhail Zhokhov for excellent research assistance. Paltseva's work on this project was partially funded by The Research Council of Norway, Grant 275387. A previous version of the paper has been circulated under the title: I'll pay you later: Backloading to Sustain Opportunistic Relationships. Any remaining errors are our own.

> *"Without a legal system to enforce contracts, investors must find other mechanisms to ensure that the profitability of their investments is not infringed by hostile governments of the recipient countries."*
>
> — Eaton and Gersovitz (1983)

1 Introduction

For much of the twentieth century, international investment in institutionally weak states relied on more than contracts and courts. It was implicitly supported by the credible threat that powerful home governments would intervene if their firms' assets were expropriated (Keohane et al., 1972).[1] While this form of external enforcement is often associated with a bygone era of "gunboat diplomacy," recent events suggest that the economic consequences of military power remain highly relevant for modern markets. The resurgence of geopolitical coercion in resource-rich and institutionally fragile countries has renewed concerns about how external force shapes investment incentives, bargaining power and the structure of economic relationships between governments and multinational firms. Yet despite the central role of enforcement in theories of contracting and investment, there is little causal evidence on how changes in external enforcement affect the timing of investment, production, and revenue sharing in long-term international contracts.

We examine these mechanisms in the context of the global oil and gas industry. Oil and gas investments are large, sunk, geographically immobile (Bohn and Deacon, 2000; Ross, 2012), and politically salient, making them particularly exposed to expropriation risk. Governments face strong incentives to renegotiate once capital is installed, while firms anticipate this risk when deciding how and when to invest. The sector therefore provides a natural setting to study how firms and governments adapt contractual dynamics in response to changes in enforcement.

Our empirical strategy exploits a sharp decline in external contract enforcement that occurred in the late 1960s. During this period, U.S., U.K. and France (henceforth, the Western Great Powers, *WGP*) sharply reduced the use of military interventions to protect

[1] A prominent example is the 1953 episode in Iran, in which U.S. and U.K. naval deployments curtailed oil exports and were followed by the CIA–MI6-backed coup against Prime Minister Mohammad Mossadegh after he tried to renegotiate contracts with the Anglo-Persian Oil Company (now BP) (Yergin, 2011*b*).

overseas commercial interests (Sullivan and Koch, 2009). This shift coincided with the largest wave of expropriation in recent history (Kobrin, 1980; Hajzler, 2012) and is widely interpreted as marking the end of an era in which foreign military power could credibly be used to enforce private contracts abroad.[2] We treat this change as a negative shock to contract enforceability for firms headquartered in these countries when operating in environments with weak domestic institutions.

We use this shock to identify the causal effect of enforcement on contractual dynamics by combining three sources of variation: time (before and after the decline in external enforcement), host-country institutional quality (weak versus strong domestic enforcement), and firm headquarters (*WGP* versus other OECD countries). This structure motivates a triple-difference design that compares how the timing of production and fiscal transfers changes for affected firms operating in weak-institution countries relative to several counterfactual groups: unaffected firms, unaffected countries, and the pre-shock period. This structure allows us to isolate the effect of external enforcement from other contemporaneous forces such as oil price movements, technological change, or shifting global demand.

We use micro-level data from Rystad Energy on 7,450 oil and gas fields worldwide operated by 144 firms and that started production between 1960 and 1999. Our main outcome is a field-level[3] measure of backloading: the number of years required for a field to reach a fixed cumulative share of its lifetime production or government payments. This measure captures dynamic distortions in timing while allowing comparisons across heterogeneous fields with different sizes, technologies, and geological conditions. We estimate how this measure changes following the decline in external enforcement, controlling for firm-specific, country-specific, and time-varying confounders, as well as for field-level characteristics.

Our main finding is that the retreat from external enforcement led to substantial and persistent backloading of production and fiscal transfers in weak-institution environments. After the late 1960s, multinational firms headquartered in *WGP* delayed production and the onset of tax payments by an average of three years relative to comparable fields in strong-institution countries. These changes are not observed for firms headquartered in

[2] As Eaton and Gersovitz (1983) put it, this decline was a natural experiment in which *"expropriation is first viewed as impossible and then becomes possible"*.

[3] A field contains at least one well operated by at least one firm in one country.

non-WGP, nor in countries with strong legal institutions. At the same time, host governments captured a significantly larger share of rents once coercive enforcement declined.

To interpret these findings, we develop a model that builds on Thomas and Worrall (1994) by explicitly incorporating formal contract enforcement, which can rely on internal mechanisms (e.g., strong institutions) or external ones (e.g., military coercion). When contract enforcement weakens, the model predicts that firms optimally delay investment and production while promising higher future transfers to the government, making continuation more valuable than expropriation. The model generates three testable predictions: weaker enforcement leads to more backloaded investment and production; it delays the start of tax payments; and it increases the government's long-run share of rents. All three predictions are borne out in the data, consistent with a shift from coercively enforced contracts toward self-enforcing relational agreements that rely on dynamic incentives rather than external force. As a complementary test, we study U.S. non-invasive military deployments following the Iranian Revolution as a local increase in external enforcement, and find a discontinuous reduction in backloading and host-government rent shares after troop arrivals, consistent with the same mechanism.

Our results highlight a fundamental but underappreciated channel through which institutions and geopolitical power affect economic outcomes: not only whether investment occurs, but when it occurs, and how surplus is dynamically allocated over time. These timing distortions are economically large. A simple back-of-the-envelope calculation suggests that these delays resulted in annual revenue losses exceeding \$1 billion per country. However, a simultaneous 20-percentage-point increase in the government's share of rents left resource-rich economies better off.[4]

The analysis contributes to several literatures. First, it contributes to the literature in economics, international relations, and political science that documents the shift in the relationship between multinational firms and governments in resource-rich developing countries during the late 1960s and 1970s, and the associated rise in expropriations. In the context of the oil and gas sector, existing work emphasizes the role of commodity prices and economic incentives in driving expropriations (e.g., Guriev, Kolotilin and Sonin, 2011; Stroebel and Van Benthem, 2013; Jaakkola, Spiro and Van Benthem, 2019), while other contributions highlight the reduced willingness of Western powers to engage

[4] This post-1970s increase in oil rents accruing to governments has been linked to weaker democratic transitions in resource-rich economies (Andersen and Ross, 2014).

in military interventions as a key institutional change (e.g., Eaton and Gersovitz, 1983; Ross, 2012). Historical accounts document the use of military and political power to enforce contracts prior to this shift and the subsequent wave of expropriations once that enforcement weakened (Yergin, 2011*a*; Kobrin, 1984). Building on this literature, we provide causal evidence that external military power historically worked as an enforcement mechanism for international contracts, and that its withdrawal altered firms' investment and contracting behavior.

Second, the paper contributes to the literature on imperfect contract enforcement, which is central to many economic environments (North, 1991; Djankov et al., 2003), including contracts involving the government (e.g. sovereign debt Kletzer and Wright (2000) or state ownership Aldashev, Rantakari and Zanarone (2023)). A large theoretical literature shows that self-enforcing agreements can emerge when formal enforcement is limited (Malcomson, 2013; Thomas and Worrall, 1994). In a range of settings — including political economy (Acemoglu, Golosov and Tsyvinski, 2008), lending (Albuquerque and Hopenhayn, 2004; Fuchs, Green and Levine, 2022), and employment relationships (Fong and Li, 2017) — optimal relational contracts often feature backloading. We extend this literature by studying how informal contracting responds to changes in formal enforcement, and by providing an empirically relevant measure of backloading together with causal evidence on its response to an external shock.[5]

This contribution also relates to empirical work on relational contracting and informal institutions, where progress has been limited by data and identification constraints (e.g., Antràs and Foley, 2015; Macchiavello and Morjaria, 2015; Calzolari et al., 2021; see Gil and Zanarone, 2017 for a survey). While existing work shows that relational contracts can sustain cooperation even without formal enforcement (Brown, Falk and Fehr, 2004) and that backloading incentives may weaken as relationships mature (Brugues, forthcoming), we show that backloading can emerge in response to an external shock and persist across projects of different ages and institutional environments.

Third, the paper offers a new perspective on the political economy of resource extraction by showing that increases in government rent shares following the 1970s (Ross, 2012; Andersen and Ross, 2014) were not merely redistributive, but were tightly linked to changes in contractual dynamics.

[5] Alternative theories rationalize backloading under asymmetric information (see Ghosh and Ray, 2022 for an overview). In Section 5.2, we discuss why these mechanisms are unlikely to explain our findings.

Finally, the paper speaks to the growth and public finance literature that links taxation, investment, and economic performance (Lucas, 1990; De Long and Summers, 1991; Easterly and Rebelo, 1993). Standard arguments emphasize that higher taxes discourage investment and slow growth. Our results suggest that in weak institutional environments, lowering taxes in isolation may be ineffective or even counterproductive, as it can exacerbate expropriation risk and undermine self-enforcing arrangements. Instead, higher and backloaded taxes may be necessary to sustain investment when formal enforcement is limited.

The remainder of the paper is organized as follows. Section 2 describes the data, including the construction of the field-level measures of production, taxes, and backloading, and the classification of countries by institutional quality. Section 3 provides historical background on the decline in external enforcement and documents the associated increase in expropriations and changes in geopolitical conditions. Section 4 presents the theoretical framework and derives testable implications for how investment, production, and rent sharing respond to changes in enforcement. Section 5 outlines the empirical strategy and presents the main results on backloading and rent shares. It also reports robustness checks and explores alternative explanations. Section 6 reports the complementary evidence from U.S. military deployments as a local increase in enforcement. Section7 discusses implications and concludes.

2 Data

Oil and Gas Data. At the core of our empirical analysis is a proprietary micro-level data set on oil & gas fields[6] from Rystad Energy. Its database contains information on physical, geological and financial features for the universe of oil & gas fields worldwide. Rystad collects the data from a wide range of sources, including company and government reports and expert interviews. In some cases, Rystad imputes observations. Asker, Collard-Wexler and De Loecker (2019) provide a very detailed description of the data construction process.[7] Our discussions with Rystad representatives and researchers using

[6]A field is defined as having at least one production well and being operated by at least one firm in at least one country. A fraction of the fields in our data set is jointly owned by firms. Since ownership rights can be bought and sold throughout the lifetime of a field, we treat them as separate fields.

[7]There is a growing multifaceted literature using the Rystad database. Asker, Collard-Wexler and De Loecker (2019) is among the earliest and most prominent examples of this literature. They document the allocative inefficiencies generated by the OPEC cartel, but they also offer perhaps one of the most

this dataset suggest that Rystad provides the highest quality data available in the industry and that the information on the physical production volumes and tax payments at the field level are particularly accurate. Therefore, we focus on these two variables in the main text and present the results on investment in the Online Appendix C.

Our sample includes all oil and gas fields globally that are owned by at least one multinational company headquartered in an OECD country (defined in 1973)[8] and operating in at least one country with weak institutions. We impose this restriction because we are interested in examining how multinationals exhibit different contract dynamics in countries with weak institutions following changes in external enforcement, while the contract dynamics in countries with strong institutions remain unaffected. We focus on fields that began production between 1960 and 1999, and we continue to observe these fields until 2019. The lower bound of this period is due to the quality of the data significantly deteriorating prior to 1960. The upper bound is driven by the necessity to have enough years of a field's life to assess the extent of backloading - so, we concentrate on fields that have been operational for at least 20 years and have generated a positive surplus. For countries that gained independence after 1960, we focus on the post-independence period. Ultimately, these restrictions leave us with 7450 fields, which account for 20% of global oil and gas production during our sample period.[9] These fields are depicted in Figure 1 and cover most petro-rich countries.

On the field level, we observe the year exploration rights were awarded and the year production started. We have information on ownership rights, enabling us to identify multinationals headquartered in OECD countries. We have detailed field-level data including the size of the reserve, the type of commodity extracted and the location of the field. Additionally, we track the fiscal regime governing production (which may be a concession, production sharing agreement or service contract), physical production (measured in million barrels), capital and operational expenditures, revenues, profits, and taxes. All financial figures are expressed in millions of real 2018 USD to maintain consistency. While the Rystad data is comprehensive, it is important to note that our dataset comprises realized contracts, not ex-ante agreements. More detailed information on all

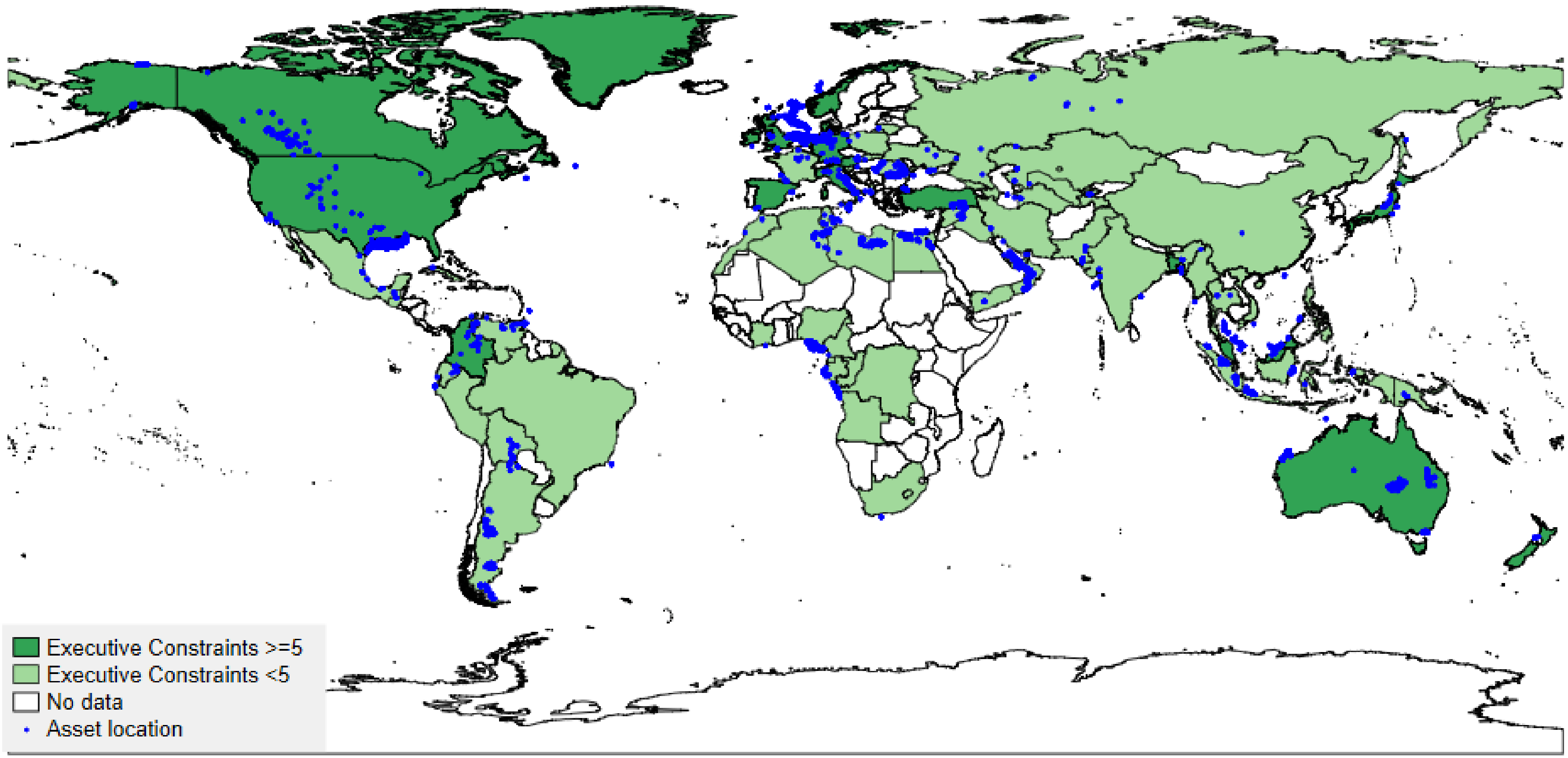
detailed and precise descriptions of Rystad database content and methods. More recently, Bornstein, Krusell and Rebelo (2023) use the same data to construct a global model of the oil market, while Ahlvik et al. (2022) use this data to quantify supply side climate policies.

[8]Korea, Poland, Czech Republic, Hungary, and Mexico joined after 1973.

[9]Restriction to fields with a positive surplus reduces the sample coverage from 24% to 20%.

variables is available in Online Appendix B.

Figure 1: Spatial distribution of fields and institutional quality



Note: Longitude and latitude of individual fields is provided by Rystad. The executive constraint indicator is taken from Polity IV and we use the median from the period 1950 to 1975. The cut-off of 5 implies that roughly one third of the countries are defined as having strong institutions and roughly 50% of all the fields which started operation between 1960 and 2000 are located in countries with weak institutions.

The tax payment variable deserves some additional attention. To construct it, we use information on tax payments under a variety of fiscal regimes. It captures the total amount of payments received by the government from a field including royalties, government oil profit (production sharing agreement equivalent to petroleum taxes), export duties, bonuses, income taxes and profit taxes. In the oil literature, this measure is known as the *government take*. For theoretical and empirical reasons, we abstract from subsidies.[10] We do this by considering two different measures. In our preferred measure, we use all taxes, while setting the value of the income tax to zero in periods in which the reported government take is negative.[11] Alternatively, we use royalties and profit taxes only, which do not contain subsidies.

Institutional Measures. We differentiate countries by their institutional quality using country-level information on executive constraints (XCONST) from Polity IV. This variable measures the extent of institutional constraints on the decision-making powers of the chief executive. To reduce the possibility that causality flows from oil wealth to institutions rather than the other way, we use the median score (above and including 5 or below) received by a country from 1950 to 1975.[12] Using other institutional quality measures does not significantly alter our results.[13] The country classification into strong and weak institutional quality is depicted in Figure 1, with countries colored in a darker green having stronger institutions. See Table B.1 for the full list of countries and additional country level information.

Descriptive Statistics. In Table 1, we provide basic descriptive statistics for our sample, differentiating between fields which are located in countries with weak and strong institutions. We are covering 75 oil and gas rich economies, a quarter of which is classified

[10]It matches the assumptions of the modeling setup regarding the absence of negative tax payments and restricts our backloading measure to be positive and monotonically increasing over the life cycle.

[11]This does not have a significant impact on our measure since the cumulative amount of subsidies received by the median field in our sample adds up to 2.4% of the total government take while the average firm received less than 10%, which is consistent with Figure B.3.

[12]The country-specific median for the period 1974-2007 is negatively and significantly correlated with the number of expropriations in the oil and gas sector. Data on expropriations is taken from Guriev, Kolotilin and Sonin (2011) and Stroebel and Van Benthem (2013).

[13]For instance, we identify countries with strong institutions as those which join the OECD by 1973. This has the advantage of being predetermined and independent of any specific metric of institutional quality. At the same time, joining the OECD requires a country to meet various economic, policy, and legal criteria which are strongly correlated with a countries legal institutions such as the enforcement of contracts and a fair and consistent application of the rule of law as well as an adherence to international standards. This results in Brunei, Bangladesh, Colombia, Malaysia, and Trinidad and Tobago (156 fields) to be move to countries with weak institutions while France (24 fields) would be classified as a country with strong institutions.

Table 1: Descriptive Statistics

Fields 1960-1999	**Strong Institutions**	**Weak Institutions**	**Mean Difference**	**Comparison P-Value**
Field Lifetime, years	32.74	33.38	.64	.01
Cum. Production, MMbbl	83.15	76.4	-6.76	.41
Cum. Real Revenue, MUSD	1246.24	1297.89	51.65	.73
Cum. Real Cost, MUSD	470.01	339.1	-130.91	0
Cum. Real Taxes, MUSD	524.57	682.93	158.36	.04
Cum. Real Profit, MUSD	251.66	275.86	24.2	.49
Countries	20	55	.	.
Firms	144	144	.	.
Fields	4182	3268	.	.
Firms per country	7.85	5	-2.85	.07
Fields per country and year	5.84	4.18	-1.66	.07

as having strong institutions. By construction, the number of firms in countries with strong and weak institutions is the same, 144, since we focus only on firms which are active in both types of countries. We find no significant differences in cumulative production and revenues between these groups. However, the average lifetime of a field is one year longer in countries with weak institutions compared to those with strong ones, supporting the notion of backloading in weaker institutional environments. Additionally, the cost of extraction per field is higher in countries with strong institutions, a well-documented phenomenon attributed to longer periods of oil and gas exploration in those countries which have depleted the more accessible fields (Hamang, 2024). Conversely, the amount of taxes paid in countries with weak institutions is higher. This suggests that governments in these countries capture larger rents, aligning with the theory in Section 4.1. Despite higher taxes, the lower extraction costs in countries with weak institutions balance out the financial equation, resulting in profits that do not significantly differ between groups of countries.

Additional Data Sets. We also use military interventions data by the WGPs between 1945 and 2000 from Sullivan and Koch (2009) to determine the year of the baseline in the our empirical analysis (see Section 3). We use data on US troops from Allen, Flynn and Martinez Machain (2022) to determine the arrival of US troops in individual countries in the Middle East in our case study. Finally, we use the number of expropriations in all industries using data from Kobrin (1984) and Hajzler (2012).

3 Historical Background

Gunboat diplomacy as external enforcement. Historically, the operations of firms from developed countries in the developing world have been supported by the "gunboat diplomacy" of their home nations. This has been especially true in the oil industry, where the Western Great Powers — the US, the UK and France (hereafter WGPs) — have deployed military force to ensure that contracts were honored (Yergin, 2011*a*). One of the most notorious examples is the 1953 coup d'état against Iranian Prime Minister Mohammad Mossadegh, orchestrated by the CIA and Britain's MI6. Mossadegh had unsuccessfully attempted to renegotiate the contractual terms with the Anglo-Persian Oil Company (now BP). In response to the Iranian nationalization of the oil industry in 1951, the US and the UK leveraged their political influence and military force to reduce the global uptake of Iranian oil, leading to a loss in government revenue and an eventually successful coup d'état. As British officials in the Ministry of Fuel and Power stated, *"If we reached settlement on Mussadiq's (sic) terms, we would jeopardize not only British but also American oil interests throughout the world. We would destroy prospects of the investments of foreign capital in backward countries. (...) We have a duty to stay and use force to protect our interest"* (Abrahamian, 2013). Frightened by this policy of coercion[14], very few developing economies dared to renegotiate deals with multinational firms over the following decade. Hence, contracts were externally (militarily) enforced in countries with a weak rule of law.

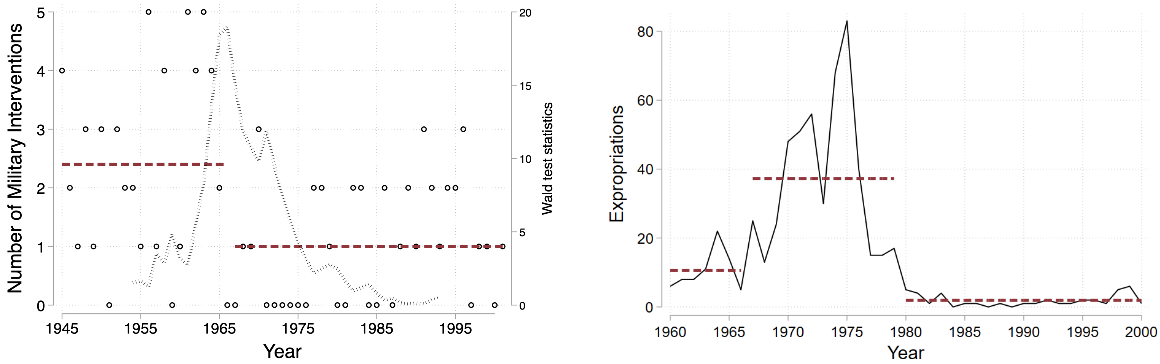
Reduction in external enforcement. By the late 1960s, there was a noticeable decline in military interventions by WGPS, driven by two main factors. First, the wave of post-war decolonization shifted the international economic system towards recognizing state sovereignty over natural resources. Although initially slow to take effect, these changes gradually reshaped global attitudes about states' rights with regards to their resources, reducing the justification for Western military interventions.[15] This shift was formally recognized in 1974 when the UN General Assembly granted resource-rich economies permanent sovereignty over their resources.[16] Second, military interventions faced a growing domestic opposition, particularly in the US, due to the Vietnam War. By 1964, over

[14]See Dube, Kaplan and Naidu (2011) and Berger et al. (2013) for an account of how US-backed military interventions have economically benefited the multinational firms.

[15]A notable example is Britain's phased military withdrawal from the Middle East, beginning with the 1967 declaration to fully withdraw from regions "East of Suez," including the Persian Gulf, by 1971.

[16]U.N. resolution 3201 (S-VI) established a New International Economic Order.

Figure 2: Military activity and expropriations



Notes: Left graph depicts the average number of military interventions by the US, UK and France between 1945 and 2000 from Sullivan and Koch (2009). In the background, we present the Wald Test results for the endogenous structural break and the dashed horizontal lines represent the averages for the periods before and after the breaks suggested by the Wald tests. The graph to the right plots the number of expropriations in all industries using data from Kobrin (1984) and Hajzler (2012).

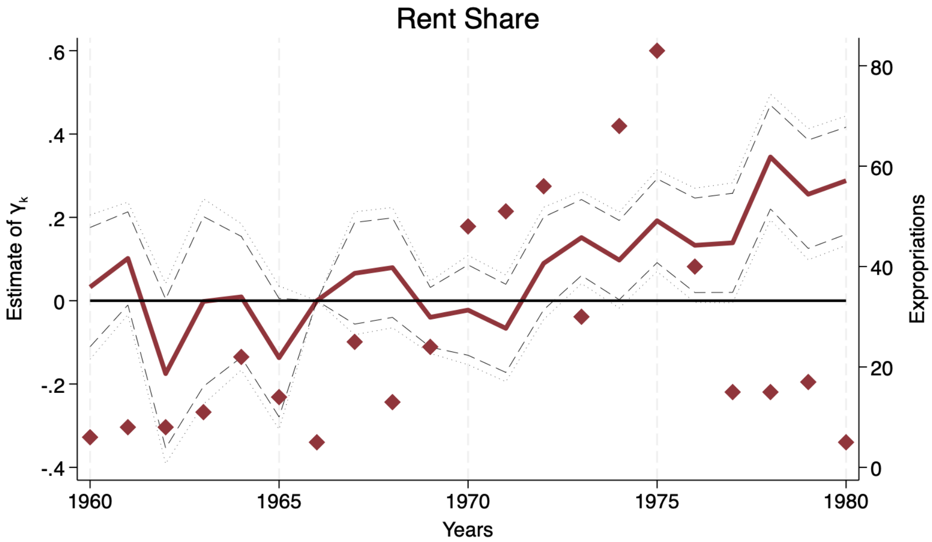
20,000 US soldiers were deployed in Vietnam, sparking widespread anti-war protests[17] and contributing to significant political shifts, including the replacement of President Lyndon Johnson with Richard Nixon in 1968. As a result, by 1973, the US fully withdrew from Vietnam. Overall, the 1970s were characterized by a decline in political interest in, and an underfunding for, non-NATO undertakings, with Davis (1982) emphasizing that it was *"striking to note that the Defense Reports between 1970 and 1979 had virtually nothing to say on the subject, by contrast with [...] those of the 1960s"*. This confirms the appearance of an international power vacuum and the need for the creation of self-enforcing agreements between multinationals and countries with a weak rule of law.

We identify the turning point using data on military interventions by WGPs from Sullivan and Koch (2009). The Wald test statistic indicates a single structural break, leading to a decline in 1967 from approximately 2.4 to 1 military interventions per year, as shown in the first panel of Figure 2. In the oil and gas sector, the reluctance to use military power was unambiguously revealed during the events surrounding the Arab-Israeli Yom Kippur War in 1973. The US and a few allies supported Israel, prompting the Arab members of OPEC (Organization of the Petroleum Exporting Countries)[18] to impose a successful oil embargo against these countries. OPEC's costly cuts in oil supply

[17]See the data from the Mapping American Social Movement available here: `https://depts.washington.edu/moves/antiwar_map_protests.shtml`

[18]Created by Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela in 1960 with the intention of returning resource sovereignty to its owners, OPEC had limited influence until the late 1960s.

Figure 3: Rent Share



Note: Sample consists of all fields which started production between 1960 and 1980 by multinational firms. The rent share measure is calculated on the year-country level. The estimates indicate the difference in the rent share between countries with weak and strong institutions relative to the difference in 1966, the year before the structural break. The standard errors are clusters by country.

did not trigger any military response, confirming the structural change (Yergin, 2011*a*).

This global change lead to a sharp increase in expropriations due to a reduction in contract enforcement, as summarized by Kobrin (1984): *"[T]he success of Third World countries in pressing for agreement on the issue of National Sovereignty of Natural Resources at the U.N., the ability of Vietnam to withstand US military action, and OPEC's achievement of control over pricing and participation, resulted in a climate that may have exacerbated tendencies toward direct and dramatic action such as expropriation."* Indeed, as shown in the right panel of Figure 2, the largest expropriation wave in recent history began just after 1967 with expropriations increasing from around 15 to 40 per year (Kobrin, 1980; Minor, 1994; Hajzler, 2012). In the empirical section, we exploit the increased threat of expropriations triggered by a decrease in external (military) enforcement to identify the causal effect on the appearance of self-enforcing agreements between multinationals in the oil and gas industry and countries with a weak rule of law.

Rent Share. If the institutional environment shifts away from a regime in which one party can enforce contracts through the credible threat of military force—thereby suppressing the other party's share of revenues—then a reduction or elimination of such coercive enforcement should immediately increase the revenue share accruing to the previously disadvantaged party. In other words, once the ability to impose terms by force disappears, the bargaining frontier shifts, and the weaker party's share should jump discretely toward the competitive or institutionally constrained outcome. To examine this mechanism, we focus on contracts that were predetermined before 1967 and estimate how the share of profits, $rentshare_{ct}$, received by the resource-rich country c in year t evolves, controlling for country and year fixed effects. We separately estimate the effects for contracts signed between Western Great Powers (WGPs) and developing countries, and for all other groups, following the specification in Equation 1. Our dynamic specification is:

$$rentshare_{ct} = \sum_{i \neq 1966} \beta_i \times \mathbf{1}\{t = i\} \times \text{Weak}_c + \mu_c + \tau_t + \varepsilon_{ct}. \tag{1}$$

Figure ?? illustrates these dynamics. For fields operated by Western Great Powers (top panel), we find a clear and sustained increase in the rent share accruing to weak-institution countries after 1970. This pattern is consistent with a shift from coercively enforced contracts to negotiated, self-enforcing agreements once the threat of military intervention disappeared. For non-WGP firms (bottom panel), the pattern is far weaker, underscoring that the rents redistribution was primarily driven by the decline in WGP coercive capacity.

Using the full set of contracts—including newly signed ones—produces similar results (Figure 3), with rent shares gradually rising after the structural break as post-1970 contracts mature. This redistribution of rents has been documented by Ross (2012) and Andersen and Ross (2014) and is often linked to the emergence of the resource curse in countries with weak institutions. Here, however, we emphasize that the redistribution is strongly driven by the behavioral shift of Western Great Powers following the collapse of external enforcement in 1967.

4 Theory and Measure of Backloading

We first present a model that captures the dynamics of an ongoing informal relationship between a government and a multinational firm. To assess the impact of contract enforcement on this relationship, we build upon the framework of Thomas and Worrall (1994) by explicitly modeling a mechanism that enforces contractual obligations, thereby restricting the parties' abilities to violate agreements. We then introduce an empirically relevant measure of backloading, and discuss how the theoretical findings need to be reshaped to match this measure. We conclude by formulating our testable hypotheses. All proofs are relegated to Appendix A.

4.1 Optimal self-enforcing agreement

Our model considers a government and a multinational firm who have an ongoing informal investment and tax agreement. Every period, the government can attempt to expropriate the firm. The success of expropriation depends on the level of contract enforcement, which we denote by e. This enforcement can be internal or external to the host country. In the former case, e would represent the extent of property rights protection within the country (such as the quality of courts); in the latter case, enforcement is achieved by a (coercive or non-coercive) foreign military presence.

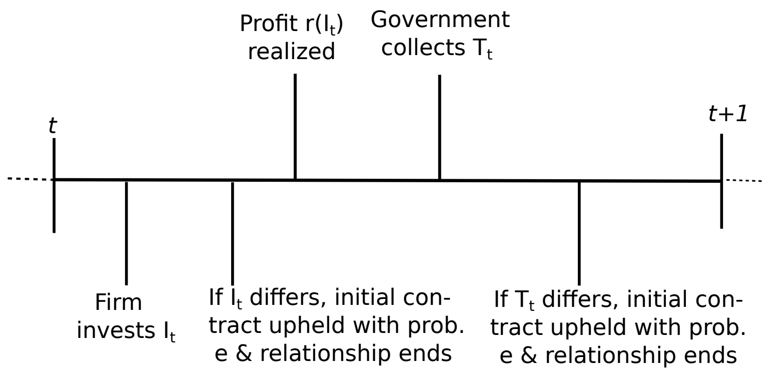
The timeline is shown in Figure 4. The government and the firm interact repeatedly over an infinite number of periods. Every period, the government and the firm agree on an investment I_t and tax payment T_t. Then, the firm invests I_t which depreciates within one period.[19] When the firm does not invest as agreed, the initial agreement is upheld with probability $e \in [0, 1]$ and, with probability $1 - e$, the government expropriates the firm. Next, the investment determines the revenues $r(I_t) = 2\sqrt{I_t}$. Then the government chooses a tax payment T_t, leaving the firm a net profit of $r(I_t) - T_t$. If the government collects a different T_t from the one agreed, the initial agreement is upheld with probability e. We assume that any deviation breaks the (informal) relationship, causing the firm to leave the country.

The government and the firm have perfect information about each other actions. They discount the future with δ, have 0 as an outside option and are credit-constrained: $r(I_t) - T_t \geq 0$ and $T_t \geq 0$.[20] The discounted values of the government V_t and the firm U_t

[19] Capital accumulation does not qualitatively change the nature of the game (Thomas and Worrall, 1994).

[20] Unrestricted upfront transfers from the government ($T_t < 0$) eliminate the hold-up problem by subsidizing the cost of investment before it is incurred (i.e. the firm "sells" the company). In the oil & gas industry, upfront transfers are very rare (see Figure B.3).

Figure 4: Timeline



are:

$$V_t = T_t + \delta V_{t+1}$$

$$U_t = -I_t + r(I_t) - T_t + \delta U_{t+1}$$

An agreement A=(I_t, T_t) at time t depends on the history up to time $t-1$. The agreement needs to be self-enforcing so that neither the government nor the firm have an incentive to violate it ex-post. The assumptions about the consequences of deviations imply that: 1) the firm never deviates from investing the agreed amount, and 2) if the government deviates, it tries to expropriate all the profits.[21] As a result, A is self-enforcing if the government has incentives to honor the agreement. The following condition ensures this at time t:

$$\delta V_{t+1} \geq (1-e)\left[r(I_t) - T_t\right] \tag{SE}$$

This constraint requires that the government's discounted future value of the relationship δV_{t+1} (in terms of future taxes) be at least as large as the successfully expropriated gains in the current period. If $e = 1$, the agreement is perfectly enforced, and (SE) is slack. If $e = 0$, there is no third-party enforcement, as in Thomas and Worrall (1994), and the agreement has to be self-enforcing to exist.

As a benchmark, consider the optimal contract under perfect enforcement. Define I^* as the efficient total surplus-maximizing level of investment determined by $r'(I^*) = 1$.

[21]The former follows from the observation that a deviation, if not overruled, leads to a complete expropriation, and the firm can always guarantee itself a zero payoff by not entering the country. The latter holds since the firm never invests again following the government's deviation.

The firm invests I^* every period and the tax payments determine how the surplus is shared but have no effect on the level of investment. We focus on the Pareto efficient equilibrium that maximizes the firm's payoff at the beginning of the game, as in Thomas and Worrall (1994).[22] The contract that maximizes the firm's payoff features no transfers to the government which receives its outside option. Therefore, with perfect enforcement, the optimal agreement is stationary and gives the same value to the government and the firm every period.

TO DO: MAYBE INTRODUCE THE ONE INSTRUMENT BENCHMARK SOMEWHERE HERE.

For a given e, if enforcement is imperfect such that (SE) binds at some time t, the efficient level of investment is not reached immediately. Instead, the agreement A is "back-loaded", meaning the government's future value from the relationship V_{t+1} increases over time. The firm achieves this by progressively increasing investment until I^* is reached. The initial under-investment is driven by the profit-maximizing behavior of the firm. Note that the firm could invest the efficient I^* from the first period onward, but this would require the firm to pay a sufficiently large tax to satisfy (SE) and prevent expropriation. The firm can achieve larger profits by reducing its initial investment and leveraging the promise of larger future tax payments to deter expropriations. Thus, it is optimal not to have tax payments until the period before I^* is reached. Intuitively, delaying taxes and investments makes the threat of terminating the relationship more costly to the government, and hence more effective, which increases the government's credibility not to expropriate. Our first result summarizes this intuition, confirming that the results of Proposition 1 in Thomas and Worrall (1994) also hold with imperfect formal enforcement:

Proposition 1. *In environments where the self-enforcing constraint (SE) binds, investment and production increase over time until the efficient steady-state is reached. Tax payments remain zero until the period immediately preceding the attainment of the efficient levels of investment and production.*

TO DO: MERGE PROPOSITION 2 AND 3

Next, we explore how contractual dynamics and outcomes vary across different levels

[22] Concentrating on the best equilibrium for the firm does not alter the characterization of the contract significantly. By doing so, we are selecting the most backloaded contract (Ray, 2002). In addition, for exposition purposes, we focus on a parameter range such that I^* is eventually reached with probability one. See the Appendix A for more details.

of formal enforcement. We find that weaker enforcement postpones investment and production, as well as the onset of tax payments, resulting in a more backloaded agreement. We also show that the level of enforcement significantly influences the distribution of surplus, with stronger enforcement curbing the host government's ability to expropriate assets. This reduction in expropriation risk, in turn, diminishes the need for the firm to compensate the government through higher tax payments.

Proposition 2. *(i) The number of periods to reach the efficient investment and production decreases with the degree of enforcement e.*

(ii) The government's discounted value in the initial period, V_1, decreases with the degree of enforcement e.

TO DO: REMOVE POINT (II)

The left column of Figure 5 illustrates this result by depicting the dynamic pattern of the optimal production for two levels of enforcement: $e = 0.8$ and $e = 0$. With weaker enforcement $e = 0$, production reaches and stabilizes at the efficient level later than in the setting with stronger enforcement $e = 0.8$. Regarding tax payments, they are paid later with weaker enforcement. However, their stationary levels are higher to prevent expropriation, which increases the government's value function.[23] Investment follows the same pattern as production and can be found in Figure A.1 in the Appendix A.

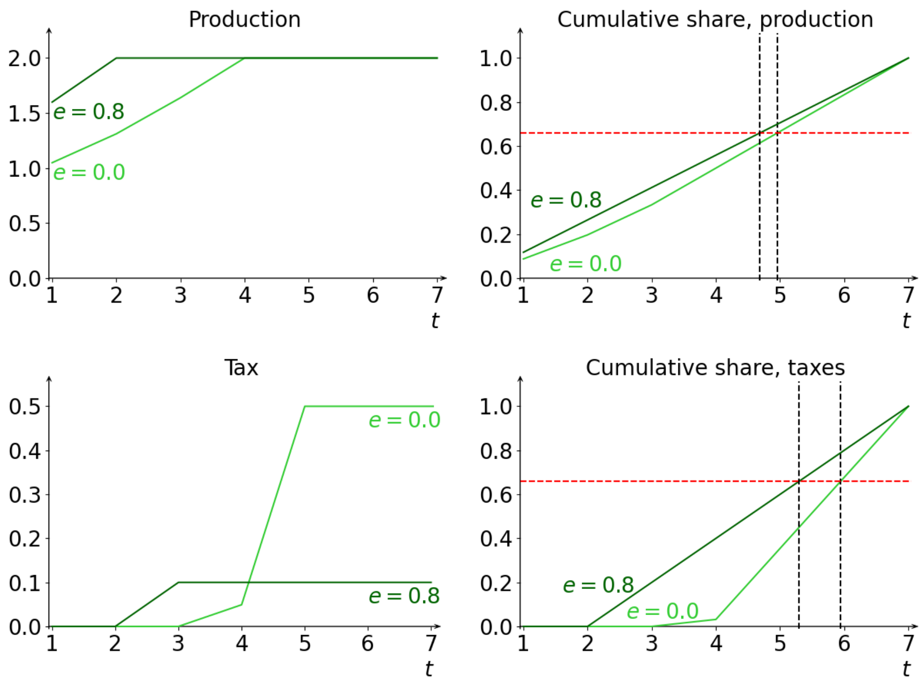
4.2 Measure of backloading

Proposition 2 provides the basis of our empirical analysis. However, in real life, the optimal levels of investment, production and tax payments differ greatly across fields for many reasons beyond the quality of enforcement. These reasons include geological, climatic and technological constraints. This suggests that the comparison of an over-time evolution of the *levels* of investment, production and taxes - as in Proposition 2 and the left panel of Figure 5 - may be misleading. To mitigate the impact of field-level heterogeneity, in this section we introduce two empirically more suitable indicators.

Our measure of backloading aims to capture the dynamics discussed in part (i) of Proposition 2. It measures how fast the different flows accumulate over a fixed period of time, while allowing for comparison across heterogeneous projects. Let X_n be *Investment,*

[23] Tax dynamics is depicted for a specific equilibrium discussed in Lemma 2 in Appendix A.

Figure 5: Production and tax dynamics with different levels of enforcement $e \in \{0.8, 0\}$) & $\delta = 0.8$



Production or Taxes in period n, N the number of periods over which the cumulative share of X_n is calculated and $s \in [0, 1]$ a chosen value for the cumulative share. Our measure of backloading is then the number of periods $\bar{n} \in \{1, \ldots, N\}$ needed to reach the cumulative share s:

$$CS_{f,\bar{n}} = \frac{\sum_{n=1}^{\bar{n}} X_n}{\sum_{n=1}^{N} X_n} = s \tag{2}$$

Using this measure, the stream X_n under agreement $A1$ is *backloaded* relative to that under agreement $A2$ if it accumulates slower under $A1$ than under $A2$. Slower accumulation is measured as the larger number of periods needed to reach the same cumulative share s. The right column of Figure 5 illustrates this measure. It shows that, under weak enforcement, production is backloaded, since it takes more periods (measured by the distance between the vertical lines) to reach 66% of the cumulative share indicated by the dashed horizontal line.

When it comes to the empirical measure of the government's share of the surplus, in our analysis we choose to track, and time, the rent-share evolution dynamically rather than look at the proxy of the cumulative allocation of the rents V_1. That is, our empirical equivalent of the rent-share measure is the share of the surplus that goes to the government *each period*:

$$RentShare_t = \frac{T_t}{r(I_t) - I_t} \tag{3}$$

Theoretically, per-period share of surplus is not uniquely defined along the first-best part of the equilibrium production path, making its reaction to changes in enforcement indeterminate.[24] At the same time, empirically, we can expect, and test, such a reaction.

Proposition 3. *(i) Investment and production are more backloaded with weaker enforcement. It takes longer to start tax payments under weaker enforcement, but the overall impact of enforcement on tax backloading is indeterminate.*
(ii) The per-period rent-share may decrease or increase with enforcement.

TO DO: REMOVE POINT (II)

With this result, we are ready to formulate the following two testable hypotheses:

TO DO: MAYBE ADD SOME HYPOTHESIS ON THE ONE INSTRUMENT

Hypothesis 1 ***(Backloading)*****:** *The time needed to achieve a specified threshold of the cumulative share of production, taxation or investment increases as enforcement weakens. Specifically:*

(H1a): *In the absence of external enforcement, countries with weaker internal enforcement exhibit more pronounced backloading in production, taxation and investment compared to those with robust internal enforcement. Conversely, the introduction of external enforcement reduces backloading in those countries.*

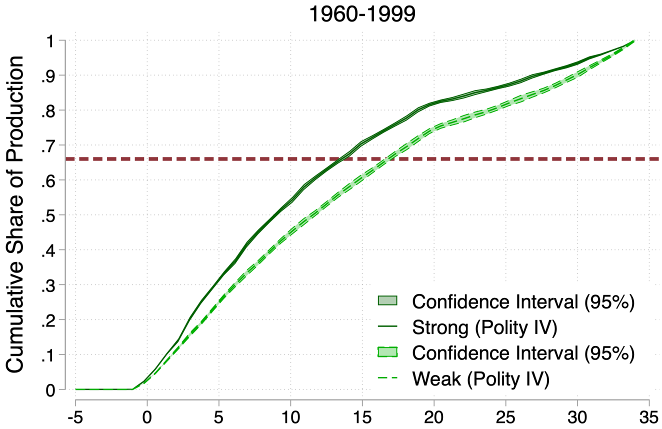
(H1b): *The period when taxes start being paid is delayed as enforcement weakens.*

Hypothesis 2 ***(Government rent share)*****:** *The per-period share of taxes in profit increases as external enforcement weakens. Similarly, this share is higher in countries with weak institutions in comparison to those with strong institutions.*

Empirical measure of backloading. We conclude this section by presenting the specific parametrization of the backloading measure we use throughout the estimation. In our main specification, we choose the baseline horizon N to be 35 years since the start of production, and the baseline cumulative share to be $s = 66\%$. Our empirical measure of backloading is the *number of years to reach* 66% *of the cumulative share of production*

[24] See the proof of Lemma 2

Figure 6: Measure of backloading



Note: Using the cumulative production of oil and gas from 155 firms operating in fields that began production between 1960 and 1999, we plot the cumulative share of production on the field level for countries with weak and strong institutions. The results indicate the presence of backloading in countries with weak institutions compared to those with strong institutions.

and tax payments over the first 35 years of field production.[25] While $n = 1$ corresponds to the first production year, we account for investment potentially taking place prior to the start of production by starting the count at $n = -5$:

$$CS_{f,\bar{n}} = \frac{\sum_{n=-5}^{\bar{n}} X_{f,n}}{\sum_{n=-5}^{35} X_{f,n}} = 0.66 \tag{4}$$

Figure 6 depicts the cumulative share of production distinguishing by the quality of institutions for the whole time period. The dashed horizontal line marks the threshold s of 66%, indicating when this level of cumulative production is achieved. We use the number of years it takes to reach this threshold as a measure of backloading. Overall, it takes approximately 14 years for countries with strong institutions and 16 years for countries with weak institutions to reach 66% of the cumulative share of production. Hence, production is backloaded by 2-3 years in countries with weak institutions.

[25] The results regarding investement can be found in Appendix C.

5 Empirical Strategy and Results

5.1 Decrease in external enforcement

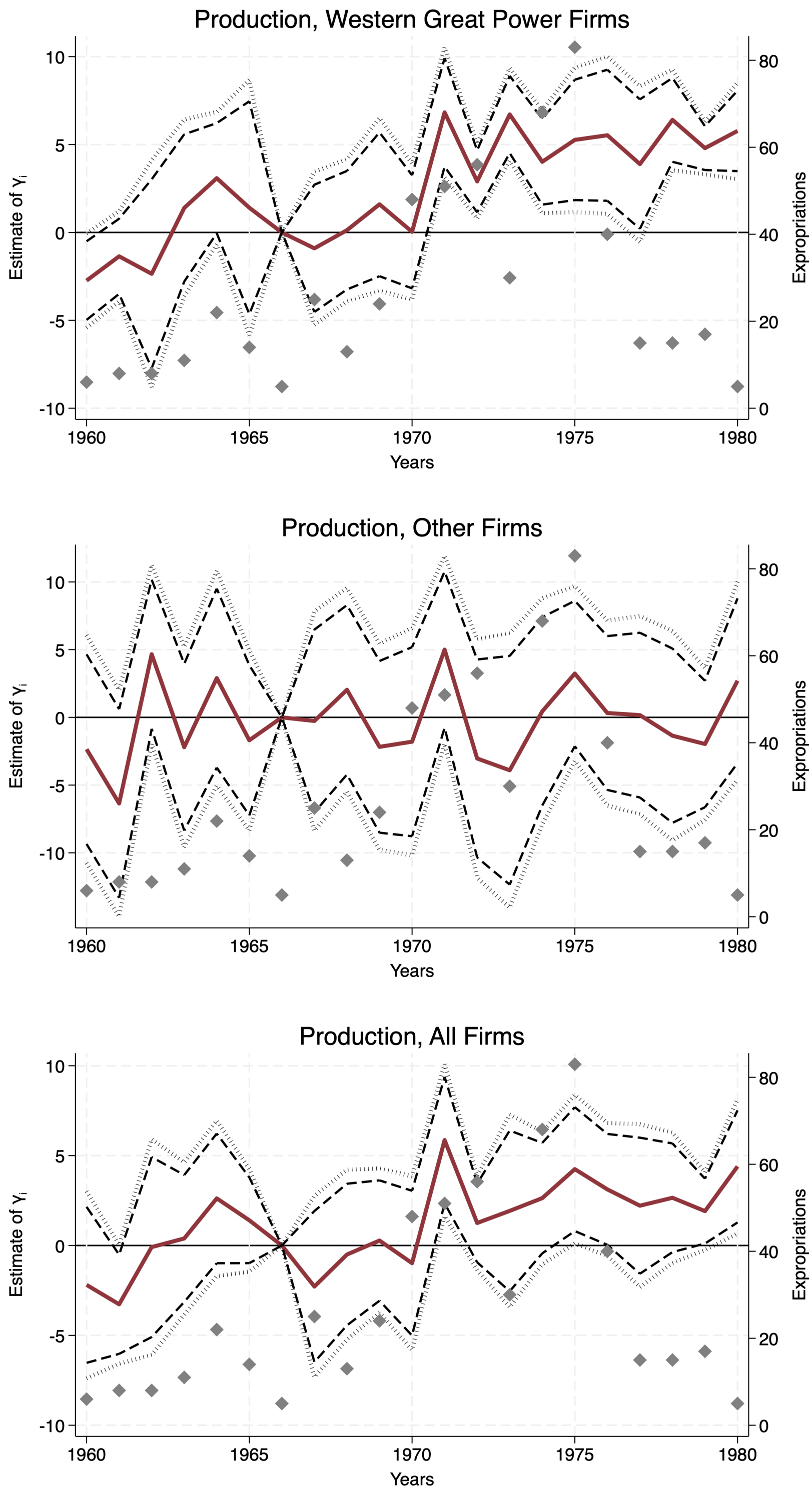
To estimate the causal effect of a reduction in external enforcement (through a reduction of global coercion by WGP and an increased risk of expropriation), we employ either a triple-difference specification or two separate difference-in-differences specifications, one of which serves as a placebo. Specifically, we estimate equation (5) separately for WGP firms and for other multinational firms:

$$y_{fc} = \sum_{\substack{i=1960 \\ i \neq 1966}}^{1980} \gamma_i \cdot 1\{t = i\} \cdot \text{Weak}_c \;+\; \eta_c \;+\; \theta_{t(f)} \;+\; X_f' \delta \;+\; \varepsilon_{fc}, \tag{5}$$

where y_{fc} is the backloading measure for field f in country c. Our main backloading measure is defined at the field level as the number of years required to reach 66% of cumulative production, as described in the previous section. The key explanatory variables are a set of dummy indicators equal to 1 if a field began production in year t and is located in a country c with weak institutions ($Weak_c$). The estimated coefficients γ_i flexibly trace how the backloading measure evolves over time in weak-institution countries relative to strong-institution countries, both before and after the structural break in 1967 identified in Section 3. The baseline year is 1966, the year immediately preceding the break. Country fixed effects are captured by η_c, while cohort fixed effects, $\theta_{t(f)}$, indicate the start year of production for field f. Because our backloading measure is defined over the lifetime of a field, each field is observed only once in the data.

Beyond external enforcement, the speed of oil and gas extraction—or the degree of backloading—may also depend on field-specific (e.g., geology), firm-specific (e.g., technology), and country-specific (e.g., institutions) factors. Accordingly, in addition to country and cohort fixed effects, our preferred specification includes geological controls in X_f: log reserve size, an offshore dummy, and a fossil-fuel-type dummy. We also control for unobserved firm-level heterogeneity in technological capabilities that may enhance extraction efficiency and enable access to previously unreachable reserves, using firm fixed effects. More importantly, our triple-difference estimates incorporate firm-by-country, firm-by-period, and country-by-period fixed effects, allowing for time-varying unobservables at both the firm and country level. This approach helps rule out many alternative

Figure 7: Backloading in the Oil Industry



Note: Sample consists of all fields which have been started between 1960 and 1980 by multinational firms. The dependent variable is the number of years necessary to reach 66% of cumulative production over a period of 35 years. In the top panel, we show the results for just WGP multinationals. In the second panel, we show only multinationals that are not headquartered in the US, UK and France. In the bottom row, we use the full sample. In all specifications, we control for country and year fixed effects, firm fixed effects, and field-specific geological and geographical observables: logged size, onshore dummy and a fossil fuel type dummy. The estimates indicate the difference in backloading between countries with weak and strong institutions, relative to the difference in 1966, the year before the structural break. Jointly, the results in the middle and bottom rows indicate that this difference is driven by increased backloading of WGP firms. The standard errors are clustered by country. The *grey diamonds* indicate the total number of expropriations globally per year.

explanations for our results, permitting us to interpret the estimated γ_i as the causal effect of increased expropriation risk on the speed of extraction. Standard errors, ε_{fc}, are clustered at the country level.

In this framework, we test **Hypothesis 1a**, an increase in backloading following a reduced use of coercion and an increase in expropriation risks as documented by the *gray diamonds* in the background of all the panels of Figure 7. The red lines indicate the estimate of γ_i from equation (5) with the dependent variable y_f representing our backloading measure in (4). The estimated coefficients are displayed, with 5% and 10% confidence intervals. In the top panel, the dependent variable is our backloading measure of physical production, for the sample of WGP firms, while the second panel shows the results for the other firms and a the bottom we show the results for the complete sample. Clearly, the results show a distinct jump in backloading in 1971, immediately following a year in which the number of expropriations doubled from around 20 per year to more than twice that number as shown on the right y-axis. In particular, the number of years required to reach 66% of cumulative production and tax payments increased to 3-5 years in countries with weak institutions relative to those with strong institutions, and this results is clearly driven by the WGP firms, why there is no such evidence coming from firms headquartered outside the WGP. We limit our focus to the period up to 1980 due to the emergence of international arbitration cases in the early 1980s Delpeuch (2022). International arbitration can act as a substitute for a strong rule of law, thereby reducing the need for backloading.[26] While our preferred measure is physical production, in Figure C.6 we provide qualitatively and quantitatively similar results for our alternative measures such as different tax measures as well as operational and capital expenditures.

Our identification in the difference-in-differences framework (bottom panel of Figure 7) relies on the assumption that contracts in countries with strong institutions were consistently enforced by courts throughout the period 1960–1980, and that—had international coercion not become more costly after 1967 (thus increasing the risk of expropriation)—contract dynamics in countries with weak institutions would have evolved in parallel with those in countries with strong institutions. For many reasons, this is a strong assumption, since unobservable, country-specific, and time-varying factors may affect the

[26] Similarly, as documented in Figure 2, the expansion of US military presence since the early 1980s may have served as a substitute as well, diminishing the need for self-enforcing agreements and backloading.

Table 2: Triple - Difference: Delay in Production

	(1) Prod. Delay	(2) Prod. Delay	(3) Prod. Delay
Post1970 × Weak	4.049	0.453	
	(0.713)	(1.820)	
Post1970 × Weak × WGP			1.987
			(0.803)
N	1887	980	2677
R-sq	0.23	0.34	0.46
Sample	Western Great Powers	Others	All

Note: Sample consists of all fields that started production between 1960 and 1980 by multinational firms in countries with either weak or strong institutions. Controls are as in the baseline specification, including all necessary interactions. In columns 1 and 2, time and firm origin are captured only by a post-1970 dummy and a WGP-headquartered dummy. Columns 3 and 4 include the full set of interactions between firm headquarters, start year, and country. The triple-difference coefficient is in line with our baseline estimate on the full sample. Standard errors are clustered by country and year.

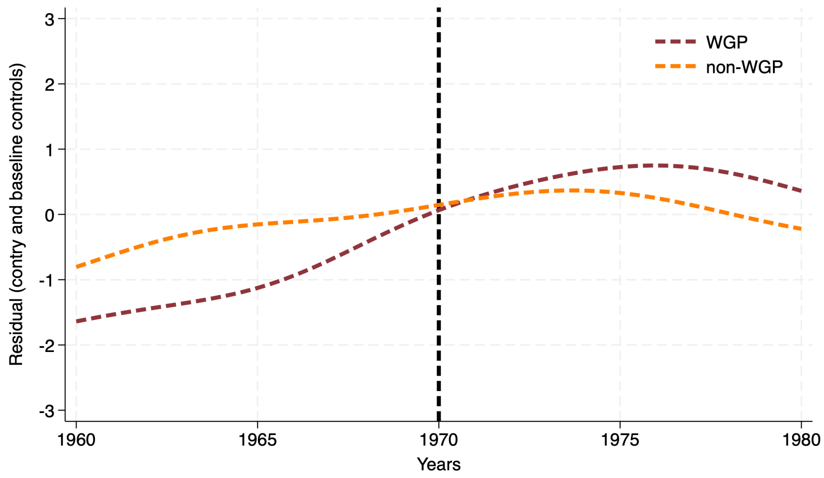
results.[27] To address this concern, we additionally estimate the following triple-difference specification, which accounts for η_{jc}, θ_{ct}, and λ_{jt} which denote firm-by-country, country-by-time, and firm-by-time fixed effects, respectively:

$$y_{fc} = \gamma \cdot Post_{1970} \cdot \text{Weak}_c \cdot \text{WGP}_j \ + \eta_{jc} \ + \theta_{ct} \ + \lambda_{jt} \ + X_f'\delta \ + \varepsilon_{fc}, \tag{6}$$

Columns 1 and 2 of Table 3 present results from a simplified difference-in-differences specification using $Post_{1970}$ (equal to one from 1970 onwards for countries with weak institutions) and the results confirm the patterns shown graphically in the top two panels of Figure 7. Column 3 reports the triple-difference estimate, γ, which is around 2. Interestingly, when we estimate a two-way fixed effects model with country and period fixed effects restricted to the pre-1967 period in weak-institution countries, and include a dummy equal to one if the firm is headquartered in a WGP country, we find that firms headquartered outside WGP countries were already backloading contracts before the structural break in 1967 (Table **??**). The results in Table **??** and Table 3 therefore suggest that WGP firms simply caught up with other multinationals, backloading contracts by roughly two additional years after 1967.

[27] For instance, the oil price increase of 1973–74, shown in Figure B.4, may have affected developing and developed countries differently. Similarly, the emergence of backloading after 1967 could reflect uncertainty associated with the structural break in coercion in some countries but not others. Finally, there are numerous country-specific and time-varying confounders—such as corruption, historical borrowing costs, and shifts in bargaining power between governments and multinationals—that are difficult or impossible to measure accurately.

Figure 8: Backloading in Countries with Weak institutions *before 1967*



Note: Sample consists of all fields which were started between 1960 and 1980 by multinational firms in countries with only weak institutions. Controls are as in the baseline specification. Standard errors are clustered by country.

To test **Hypothesis 1b**, we estimate equation (5) for the dependent variable represented by a dummy, which switches from 0 to 1 in the earliest period of the field's life in which taxes are paid. The results are documented in Figure **??** and confirm that the start of tax payments in countries with weak institutions is delayed by around 5 years since 1971 relative to countries with strong institutions.

What are the economic consequences of these adjustments for resource-rich economies? A back of the envelope calculation suggests that a 3 year delay in oil and gas production resulted in an average loss of more than 1 bln US$ in revenues per country and year.[28] At the same time, the share of oil rents accruing to governments in economies with weak institutions increased by approximately 20 percentage points relative to those with strong institutions. This shift enabled governments in countries with weak institutions to balance the financial impact of lost revenues, potentially undermining incentives for

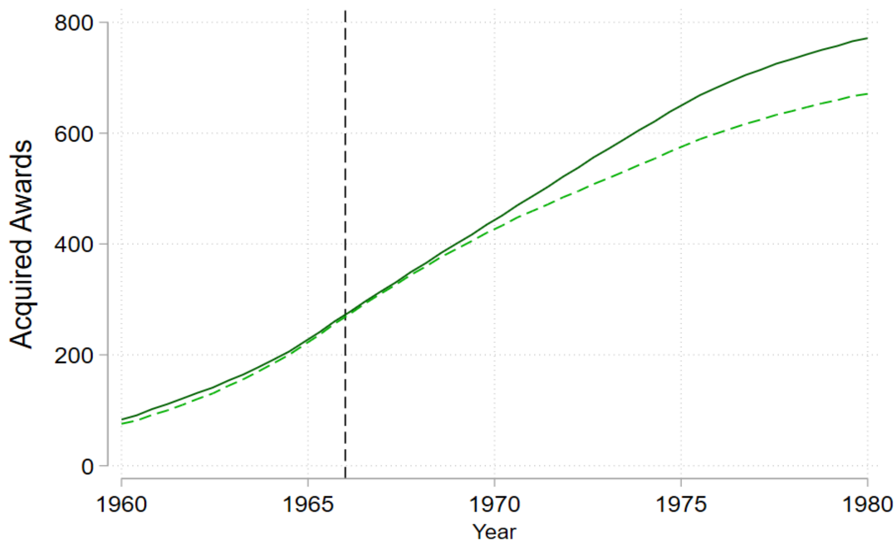
[28] One way to interpret 3 years delay is to consider that fields in countries with weak institutions produce on average for 33 years; were they to be located in countries with strong institutions, it would take them 3 years less. Using strong-country production dynamics, we allocate total output of fields in countries with weak institutions to individual periods, accounting for the 3-year difference in the lifetime. The price of the resource and the interest rate are assumed to be constant over space and time and equal to USD 75 and 10%, respectively. As a result, the counterfactual NPV of a field in countries with weak institutions is 13. 5% higher than the actual one. Since the average NPV of field level revenues in countries with weak institutions is around 2 Bln US$, the delay implies that the country would have gained on average 270 Mln US$ more revenues per field without a delay. This translates into more than 1 Bln US$ of lost revenues per country and year since oil multinationals start on average just above 4 fields per year in countries with weak institutions.

Table 3: Triple - Difference: Delay in Beginning of Tax Payments

	(1) Tax Delay	(2) Tax Delay	(3) Tax Delay
Post1970 × Weak	5.006	3.078	
	(1.250)	(1.751)	
Post1970 × Weak × WGP			2.712
			(2.576)
N	1895	990	2533
R-sq	0.39	0.29	0.60
Sample	Western Great Powers	Others	All

Note: Sample consists of all fields which were started between 1960 and 1980 by multinational firms in countries with either weak or strong institutions. Controls are as in the baseline specification, including all necessary interactions. In columns 1 and 2, the variation in time and the origin of firms is limited to a dummy (1 for the period after 1970, and 1 for firms headquartered in the WGPs). The specification in columns 3 and 4 includes all possible interactions between firm headquarters, the year in which production starts, and countries. The triple-diff coefficient is in line with our baseline estimate on the full sample. Standard errors are clustered by country and year.

Figure 9: Cumulative awards



institutional improvement.

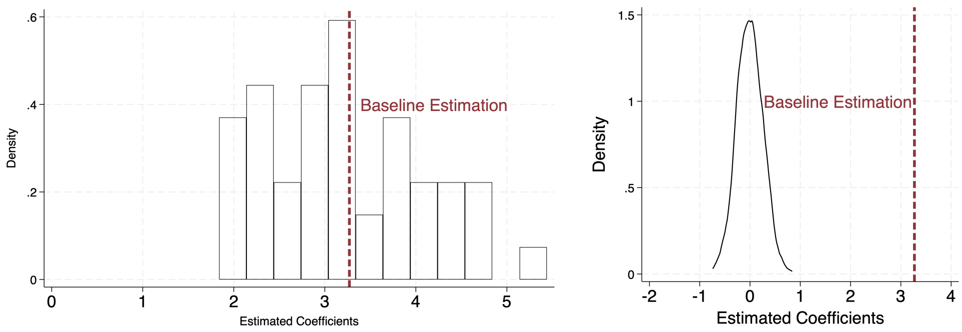
The left panel of Figure B.5 shows that the frequency of fields starting production is initially balanced between countries with strong and weak institutions. This pattern changes towards the end of the sample period where there is a consistently higher number of fields starting production in countries with strong institutions. The right panel of Figure B.5 tracks the cumulative number of awards granted for field exploitation. Until the structural break in military interventions in 1967, the trend and number of licenses granted for extraction are comparable in both groups of countries but diverge thereafter. This divergence aligns with the findings documented by Cust and Harding (2020), who show that exploration drillings around a national border are more likely to occur in the country with the relatively stronger institutions.

5.2 Robustness and confounding factors

Robustness. We perform a battery of robustness tests by focusing on physical production as our preferred measure. We present and discuss the distribution of the coefficient of interest resulting from a variety of such tests rather than reporting them separately. Specifically, we simplify the flexible specification in (5) by replacing the first term in the RHS with $\gamma \times 1\{t >= 1971\} \times \text{Weak}_c$. This modification allows us to estimate a single γ per specification, capturing the average increase in backloading in countries with weak institutions relative to those with strong institutions from 1971 onwards, across a number of specifications discussed in detail below.

For our baseline backloading measure (bottom panel in 7), which represents the number of years needed to reach 66% of cumulative physical production over a 35-year period, we estimate γ to be 3.3 (as shown by the vertical line in Figure 10). However, backloading can be measured in various ways. On the one hand, we can adjust the 66% threshold, e.g., by either increasing it to 75% or decreasing it to 50%. Moreover, since the average field lifetime is shorter than our baseline 35-year period, we can limit the production period to 30 or even 25 years when calculating the extent of backloading to ensure that we are not exceeding the typical field lifetime for most fields. Further, instead of using Polity IV to determine whether a country has strong institutions, we can classify countries as having strong institutions if they joined the OECD by 1973, since only a selected group of highly developed countries did that. With all these variations in mind, we can estimate the

Figure 10: Robustness



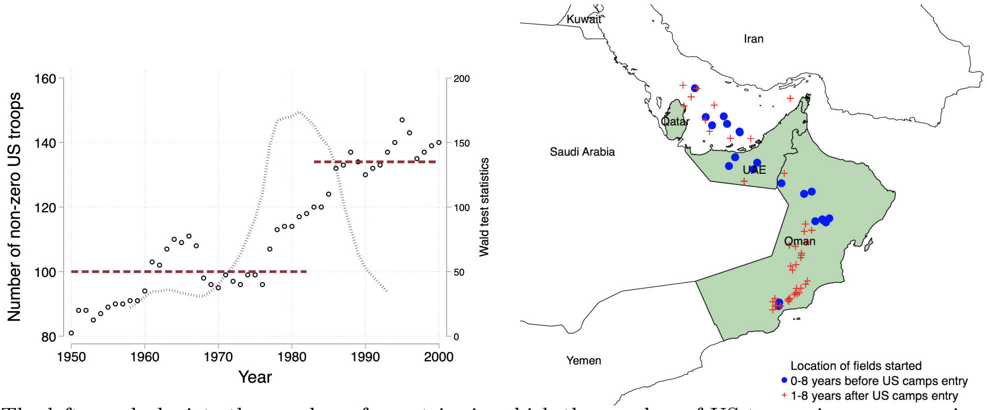
Note: On the LHS we conduct a robustness test in which we allow for different measures of backloading (45 different measures). On the RHS we conduct randomization inference, randomly reshuffling and matching the treatment variable from a two-way fixed effect model to different countries and years.

difference in our backloading measures across countries conditional on firm fixed effects and a variety of geological and geographical observable measures which we account for in our baseline specification in Figure 7. Or, we can simply control for country and the year of production start fixed effects, excluding all additional controls. Finally, we can also allow for country specific or firm specific linear trends to account for trending unobservable confounder on the country and firm level respectively. In total, these variations in the measures and specifications provide us with 45 different estimates of γ for both our physical production measure and our tax payment measure, which we plot in the left panel of Figure 10. Two things are noteworthy. First, our baseline result is located in the middle of the distribution as indicated by the vertical line. Second, all our estimates are positive and significantly different from zero on the 10% level, implying that our results are robust to changes in the backloading measures and the specification.

In the right panel, we show the distribution of 500 estimated γ values generated by randomly reshuffling the treatment dummy (identifying countries with weak institutions post-1971) across countries and years. As expected, the distribution of these placebo γ estimates is centered around zero, and none of the placebo estimates come close to the size of the true effect, confirming that our results are unlikely to be driven by chance.

Additional Explanations In Online Appendix C, we address several additional concerns, which we summarize here: In theory, one might expect that governments and firms reacted to the structural break by changing the fiscal regime-shifting from concessions to production sharing agreements. We show in Figure C.8 that this did not happen. In

Figure 11: Military activity and expropriations



Notes:The left graph depicts the number of countries in which the number of US troops is non-zero using data from Allen, Flynn and Martinez Machain (2022). In the background , we present the Wald Test results for the endogenous structural break and the dashed horizontal lines represent the averages for the periods before and after the breaks suggested by the Wald tests. The right graph depicts the countries which experiences the arrival of military camps following the 1979 Iranian Revolution.

addition, our results could be influenced by financial constraints faced by multinationals. Yet, in the top row of Figure C.9, we show that both operational and capital expenditures increased in countries with both strong and weak institutions, with significantly faster growth observed in countries with strong institutions. Together, the right panel in Figure B.5 and the bottom row of Figure C.9 suggest that the divergence in OPEX and CAPEX was driven by multinationals' greater willingness to develop more fields—and more capital-intensive fields—in countries with strong institutions, which is perfectly in line with (Bohn and Deacon, 2000). Due to the use of our triple-diff estimation, we control for many country-time specific confounders, which could have biased our results. However, even without the use of the triple difference, in section C.2 we discuss how the main confounder such as high interest rates, changes in bargaining power and changes in corruption should not have biased our estimates upwards, but result in a lower bound of our estimates. We also consider two alternative explanations consistent with the emergence of backloading under asymmetric information (Kranton, 1996; Fujiwara-Greve and Okuno-Fujiwara, 2009; Ghosh and Ray, 1996). We argue that neither theory aligns with the public sector nature of operations in the oil and gas industry.

6 Increase in external enforcement: A Case Study

Background. While the use of military interventions in international policy decreased significantly since the late 1960s, the number of non-invasive US military deployments around the world, including countries with weak institutions, has been on the rise since the late 1970s as is shown on the left of Figure 11 using data from Allen, Flynn and Martinez Machain (2022). The positioning of US troops in other countries requires a diplomatic agreement between the US and the receiving government since *"the majority of countries that host US troops in any given year do so consensually."* At the same time, receiving US troops *"serves as a crucial microfoundation for the provision of security and alliance guarantees to other states"* (Allen, Flynn and Martinez Machain, 2022), and hence is expected to decrease the probability of extreme economic actions such as expropriations, thereby improving contract enforcement.

The deployment of US troops is likely to be influenced by a variety of factors that are correlated with the activity in the oil and gas industry within host countries. To minimize this concern, we focus on a specific historical episode. Following the 1979 Iranian Revolution, US troop deployments to Middle Eastern countries had the primary purpose to serve as a base for the Rapid Deployment Joint Task Force (RDJTF), while being uncorrelated with the internal dynamics of the host countries.

Prior to 1979, the US policy in the Middle East *"relied on the "Twin Pillars" of the Shah of Iran and the Kingdom of Saudi Arabia to keep the region relatively stable"* (Harbridge, 2015). In 1979, the Shah of Iran unexpectedly fell[29] *"and the West's framework toppled with him. This motivated some of the initial programs that would be associated with the RDJTF"* (Davis, 1982). The RDJTF was tasked with developing diplomatic initiatives and organizing increased military presence to create a *"mobile task force"* to respond to crises. Indeed, the *"creation of the RDJTF, the search for military bases in the region, expanded security assistance, and the initiation of the strategic consensus concept all signaled a significantly greater reliance on the military instrument of policy to preserve our interests"* (Lawrence, 1984). Unlike the "gunboat diplomacy", these deployments had the explicit approval of host countries. In Section 5, we exploit these deployments as a proxy for enhanced contract enforcement to identify if they reduce the reliance on

[29] In December 1977, President Jimmy Carter declared Iran to be an "island of stability" and only in November 1978 (two months before the fall), did Washington become aware that the *"regime in Tehran was faltering* (Donovan, 1997).

self-enforcing agreements.

Results. To test whether Hypotheses 1 and 2 also hold following an increase in external contract enforcement, we explore if the timing of the arrival of US troops impacts our backloading and rent-sharing measures. If US military deployments were random, we could simply estimate a staggered Difference-in-Differences specification comparing how our measures develop in countries that have just received troops relative to those that have not yet received any. However, troops are typically deployed or withdrawn for country- and time-specific reasons.[30] Therefore, we choose to focus on deployments to the Middle East following the Iranian revolution for identification. We examine the contractual arrangements in the oil and gas industry across three countries—Oman (1980), the United Arab Emirates (1982), and Qatar (1994)—which are highlighted in green on the map in Figure **??** and the years in brackets indicate when US troops were deployed. These countries sequentially agreed to serve as bases for US forces.[31] By comparing the contract dynamics in the fields which started production just before and just after the arrival of the troops, we provide additional evidence on the diminishing need for self-enforcing agreements when external enforcement is provided through foreign military presence.

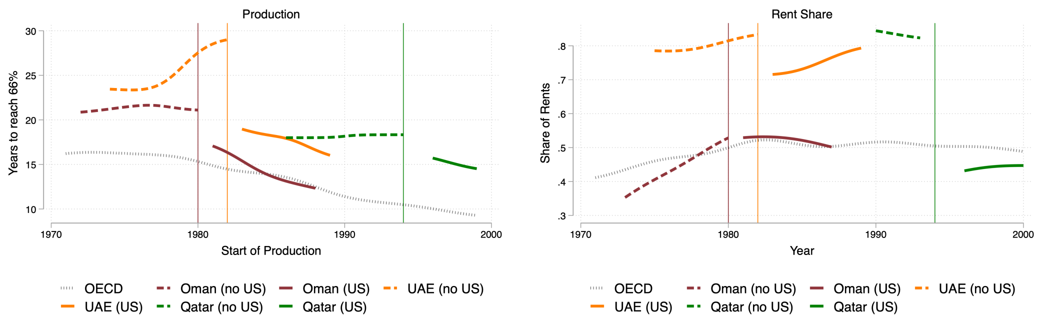
Our identification strategy, focusing on these three cases, is inspired by a staggered Difference-in-Differences design, though subject to data limitations. We use a local polynomial smoother with a bandwidth of 2 years to graph the average contract backloading in Oman, the UAE, and Qatar for fields that began production just before (dashed lines) and just after (solid lines) the arrival of US troops, marked by vertical lines in Figure 12.[32] For reference, the blue solid line represents the average level of backloading in OECD countries, which may be thought as the efficient benchmark. Compared to OECD dynamics, the results suggest that backloading was present in the Middle East before US troop arrivals. However, the number of years required to reach 66% of cumulative production, significantly and discontinuously decreases immediately following the arrival of US troops, as expected theoretically. This suggests that the troop presence may have

[30]For instance, political instability may prompt multinationals to backload, while the US government might decide to deploy troops to this country to ensure stability. Such a mechanism would create a positive correlation between the presence of US troops and the degree of backloading, which should not be interpreted as being causal.

[31]US troops have been allocated to other countries in the Middle East as well. However, only these three countries have had active multinationals in the oil and gas sector before and after the arrival of the troops, such that a comparison of contract dynamics before and after the arrival of troops is possible.

[32]We use local polynomials because field-level production by multinational companies in these countries does not follow consistent yearly intervals.

Figure 12: Friendly Coercion in the Oil Industry



Note: Sample consists of all fields which have been started by multinational firms up to 8 years before and up to 8 years after US troops in Oman, UAE and Qatar. We use local polynomials with a bandwidth of two for our main backloading measures. The number of years necessary to reach 66% of cumulative production over a period of 35 years in the top panel and the number of years necessary to reach 66% of cumulative tax payments (government take) over a period of 35 years in the middle panel. In the bottom panel, we show the share of rents going to respective governments. The estimates indicate a distinct discontinuity just after the arrival of US troops.

triggered an increase in external contract enforcement, reducing the need for backloading. Finally, the right chat in Figure 12 confirms that the share of profits going to host governments discontinuously declines following the arrival of US troops, as predicted by our theory. This decline is consistent with the presence of US troops increasing external contract enforcement and making self-enforcing agreements less important.

7 Conclusion

We study and empirically document the historical evolution of international contract enforcement in the oil and gas sector, identifying three distinct periods. Initially, until the late 1960s, "gunboat diplomacy" was used to enforce contracts, where the threat or use of military power by the Western Great Powers ensured compliance with international agreements, particularly in countries with weak institutions. This eliminated the need for self-enforcing agreements and backloading. Starting in the early 1970s, the decline of military interventions created a power vacuum, leading to an increase in expropriations. WGP multinational companies responded by developing self-enforcing agreements, as there was no external force to guarantee contract compliance. This period saw the rise of backloading in countries with weak rule of law. Finally, in the early 1980s, the deployment of US troops in parts of the developing world, particularly the Middle East, reintroduced a form of external contract enforcement, though it was based more on cooperation than coercion. This reduced the reliance on self-enforcing agreements and backloading.

Our findings suggest that in a geopolitically fragmented world without a well-functioning international court, and where countries cannot or will not use military force to enforce contracts, backloaded self-enforcing contracts should naturally emerge. These contracts can support cross-border investments in industries that require large upfront spending and have long life cycles. For instance, these insights carry important implications for mineral-extraction industries critical to the green transition. Many of these projects are concentrated in the Global South—regions that may lack robust institutions raising the risk of a new "green colonialism" (Manahan, 2024).

References

Abrahamian, Ervand. 2013. *The coup: 1953, the CIA, and the roots of modern US-Iranian relations.* The New Press.

Acemoglu, Daron, Michael Golosov, and Aleh Tsyvinski. 2008. "Political economy of mechanisms." *Econometrica*, 76(3): 619–641.

Ahlvik, Lassi, Jørgen Juel Andersen, Jonas Hveding Hamang, and Torfinn Harding. 2022. "Quantifying supply-side climate policies."

Albuquerque, Rui, and Hugo A Hopenhayn. 2004. "Optimal lending contracts and firm dynamics." *The Review of Economic Studies*, 71(2): 285–315.

Aldashev, Gani, Heikki Rantakari, and Giorgio Zanarone. 2023. "Governance in the Wild: A Theory of State vs. Private Firms under Weak Institutions." *Mimeo.*

Allen, Michael A, Michael E Flynn, and Carla Martinez Machain. 2022. "US global military deployments, 1950–2020." *Conflict Management and Peace Science*, 39(3): 351–370.

Andersen, Jørgen J, and Michael L Ross. 2014. "The big oil change: A closer look at the Haber–Menaldo analysis." *Comparative Political Studies*, 47(7): 993–1021.

Anderson, Soren T, Ryan Kellogg, and Stephen W Salant. 2018. "Hotelling under pressure." *Journal of Political Economy*, 126(3): 984–1026.

Angrist, Joshua D, and Jörn-Steffen Pischke. 2014. *Mastering'metrics: The path from cause to effect.* Princeton university press.

Antràs, Pol, and C. Fritz Foley. 2015. "Poultry in Motion: A Study of International Trade Finance Practices." *Journal of Political Economy*, 123(4): pp. 853–901.

Asker, John, Allan Collard-Wexler, and Jan De Loecker. 2019. "(Mis) allocation, market power, and global oil extraction." *American Economic Review*, 109(4): 1568–1615.

Berger, Daniel, William Easterly, Nathan Nunn, and Shanker Satyanath. 2013. "Commercial imperialism? Political influence and trade during the Cold War." *American Economic Review*, 103(2): 863–896.

Bohn, Henning, and Robert T Deacon. 2000. "Ownership risk, investment, and the use of natural resources." *American Economic Review*, 90(3): 526–549.

Bornstein, Gideon, Per Krusell, and Sergio Rebelo. 2023. "A world equilibrium model of the oil market." *The Review of Economic Studies*, 90(1): 132–164.

Brown, Martin, Armin Falk, and Ernst Fehr. 2004. "Relational contracts and the nature of market interactions." *Econometrica*, 72(3): 747–780.

Brugues, Felipe. forthcoming. "Take the goods and run: Contracting frictions and market power in supply chains." *American Economic Review.*

Calzolari, Giacomo, Leonardo Felli, Johannes Koenen, Giancarlo Spagnolo, and Konrad O Stahl. 2021. "Relational Contracts and Trust in a High-Tech Industry."

Cust, James, and Torfinn Harding. 2020. "Institutions and the location of oil exploration." *Journal of the European Economic Association*, 18(3): 1321–1350.

Davis, Paul K. 1982. "Observations on the rapid deployment joint task force: origins, direction, and mission." *International Studies Association.*

De Long, J Bradford, and Lawrence H Summers. 1991. "Equipment investment and economic growth." *The Quarterly Journal of Economics*, 106(2): 445–502.

Delpeuch, Samuel. 2022. "Investor-State Disputes and Tax Advantages in the Energy Sector." *Mimeo.*

Djankov, Simeon, Rafael La Porta, Florencio Lopez-de Silanes, and Andrei Shleifer. 2003. "Courts." *The Quarterly Journal of Economics*, 118(2): 453–517.

Donovan, Michael. 1997. "National intelligence and the Iranian revolution." *Intelligence and National Security*, 12(1): 143–163.

Dube, Arindrajit, Ethan Kaplan, and Suresh Naidu. 2011. "Coups, corporations, and classified information." *The Quarterly journal of economics*, 126(3): 1375–1409.

Easterly, William, and Sergio Rebelo. 1993. "Fiscal policy and economic growth." *Journal of monetary economics*, 32(3): 417–458.

Eaton, Jonathan, and Mark Gersovitz. 1983. "Country risk: Economic aspects." *Managing international risk*, 75–108.

Fong, Yuk-fai, and Jin Li. 2017. "Relational contracts, limited liability, and employment dynamics." *Journal of Economic Theory*, 169: 270–293.

Fuchs, William, Brett Green, and David Levine. 2022. "Optimal arrangements for distribution in developing markets: Theory and evidence." *American Economic Journal: Microeconomics*, 14(1): 411–50.

Fujiwara-Greve, Takako, and Masahiro Okuno-Fujiwara. 2009. "Voluntarily separable repeated prisoner's dilemma." *The Review of Economic Studies*, 76(3): 993–1021.

Ghosh, Parikshit, and Debraj Ray. 1996. "Cooperation in community interaction without information flows." *The Review of Economic Studies*, 63(3): 491–519.

Ghosh, Parikshit, and Debraj Ray. 2022. "The Social Equilibrium of Relational Arrangements." *Mimeo.*

Gil, Ricard, and Giorgio Zanarone. 2017. "Formal and Informal Contracting: Theory and Evidence." *Annual Review of Law and Social Science*, 13(1).

Guriev, Sergei, Anton Kolotilin, and Konstantin Sonin. 2011. "Determinants of nationalization in the oil sector: A theory and evidence from panel data." *The Journal of Law, Economics, and Organization*, 27(2): 301–323.

Hajzler, Christopher. 2012. "Expropriation of foreign direct investments: sectoral patterns from 1993 to 2006." *Review of World Economics*, 148(1): 119–149.

Hamang, Jonas. 2024. "Economic development and known natural resource endowment: Discovery rate differentials of oil." *Journal of Development Economics*, 170: 103290.

Harbridge, James C. 2015. "Organizational Insecurity and the Creation of U.S. Central Command." *Strategic Studies Institute, US Army War College.*

Hotelling, Harold. 1931. "The economics of exhaustible resources." *Journal of political Economy*, 39(2): 137–175.

Jaakkola, Niko, Daniel Spiro, and Arthur A Van Benthem. 2019. "Finders, keepers?" *Journal of Public Economics*, 169: 17–33.

Keohane, Robert O, et al. 1972. "The multinational enterprise and world political economy." *International Organization*, 26(1): 84–120.

Kletzer, Kenneth M, and Brian D Wright. 2000. "Sovereign debt as intertemporal barter." *American economic review*, 90(3): 621–639.

Kobrin, Stephen J. 1980. "Foreign enterprise and forced divestment in LDCs." *International Organization*, 65–88.

Kobrin, Stephen J. 1984. "Expropriation as an attempt to control foreign firms in LDCs: trends from 1960 to 1979." *International Studies Quarterly*, 28(3): 329–348.

Kranton, Rachel E. 1996. "The formation of cooperative relationships." *The Journal of Law, Economics, and Organization*, 12(1): 214–233.

Krautkraemer, Jeffrey A. 1998. "Nonrenewable resource scarcity." *Journal of Economic literature*, 36(4): 2065–2107.

Lawrence, Robert G. 1984. *US policy in Southwest Asia: a failure in perspective.* Vol. 84, National Defense University Press.

Lucas, Robert E. 1990. "Why Doesn't Capital Flow from Rich to Poor Countries?" *The American Economic Review*, 80(2): 92–96.

Macchiavello, Rocco, and Ameet Morjaria. 2015. "The value of relationships: evidence from a supply shock to Kenyan rose exports." *American Economic Review*, 105(9): 2911–45.

Malcomson, James M. 2013. "Relational incentive contracts." *The handbook of organizational economics*, 1014–1065.

Manahan, Mary Ann. 2024. *The geopolitics of green colonialism: Global justice and ecosocial transitions.* Pluto Press.

Minor, Michael S. 1994. "The demise of expropriation as an instrument of LDC policy 1980–1992." *Journal of International Business Studies*, 25(1): 177–188.

North, Douglass C. 1991. "Institutions." *Journal of economic perspectives*, 5(1): 97–112.

Ray, Debraj. 2002. "The time structure of self-enforcing agreements." *Econometrica*, 70(2): 547–582.

Rose-Ackerman, Susan. 2008. "Corruption and government." *International peacekeeping*, 15(3): 328–343.

Ross, Michael. 2012. *The oil curse: How petroleum wealth shapes the development of nations.* Princeton University Press.

Stroebel, Johannes, and Arthur Van Benthem. 2013. "Resource extraction contracts under threat of expropriation: Theory and evidence." *Review of Economics and Statistics*, 95(5): 1622–1639.

Sullivan, Patricia L, and Michael T Koch. 2009. "Military Intervention by Powerful States, 1945—2003." *Journal of Peace Research*, 46(5): 707–718.

Thomas, Jonathan, and Tim Worrall. 1994. "Foreign direct investment and the risk of expropriation." *The Review of Economic Studies*, 61(1): 81–108.

Troya-Martinez, Marta, and Liam Wren-Lewis. 2023. "Managing relational contracts." *Journal of the European Economic Association*, 21(3): 941–986.

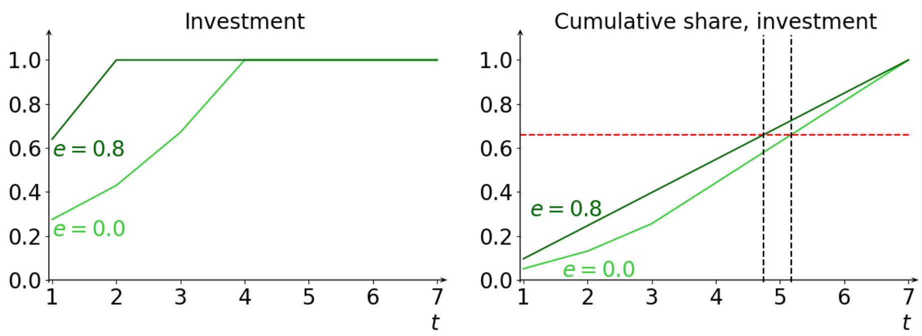
Watson, Joel. 1999. "Starting small and renegotiation." *Journal of economic Theory*, 85(1): 52–90.

Yergin, Daniel. 2011*a*. *The prize: The epic quest for oil, money & power.* Simon and Schuster.

Yergin, Daniel. 2011*b*. *The Quest: Energy, Security, and the Remaking of the Modern World.* New York:Penguin Press.

A Theoretical Appendix

Figure A.1: Investment with different levels of enforcement $e \in \{0.8, 0\})$ & $\delta = 0.8$



Proof of Proposition 1

We focus on the Subgame Perfect Equilibrium that maximizes the firm's discounted value at the start of the game $V_1 = V_{\min}$. The firm solves:

$$U(V_t) = \max_{I,\{V_{t+1}\},\{T_t\}} \{-I_t + r(I_t) - T_t + \delta U(V_{t+1})\} \tag{Fmax}$$

subject to the government's promise-keeping constraint:

$$V_t = T_t + \delta V_{t+1}, \tag{PK}$$

the government's self-enforcing constraint:

$$\delta V_{t+1} + T_t \geq (1-e)r(I_t) + eT_t, \tag{SE}$$

the government's and firm's limited liability constraints:

$$0 \leq T_t \leq r(I_t), \tag{LL}$$

and the firm's participation constraint:

$$U(V_{t+1}) \geq 0. \tag{PC}$$

The government's participation constraint and the firm's self-enforcing constraint never bind and are omitted.[33]

Before characterizing the Pareto frontier $U(V_t)$, we provide an informal description of its structure. Figure A.2 illustrates the Pareto frontier, which is divided into two segments. When V_t exceeds $\bar{V}$ (a value to be defined), the frontier enters the first-best (FB) region, where the self-enforcing constraint (SE) does not bind and $U(V_t)$ is linear. Conversely, when V_t is less than $\bar{V}$, the frontier corresponds to the second-best (SB) region where, (SE) binds and $U(V_t)$ becomes a decreasing piece-wise quadratic function, with its maximum at $V_t = V_1$.[34] For the reference, the black solid line in Figure A.2 represents the Pareto efficient frontier with perfect enforcement $e = 1$. Any point on the frontier constitutes a stationary contract, and the exact optimal contract depends on the bargaining power of the government. In particular, the agreement that maximizes the firm's utility gives the government $V_t = 0$. With weaker enforcement, (SE) binds, which makes the upper part of the efficient frontier unattainable. The firm under-invests and the Pareto frontier lies underneath the black solid line until V_t is high enough to prevent

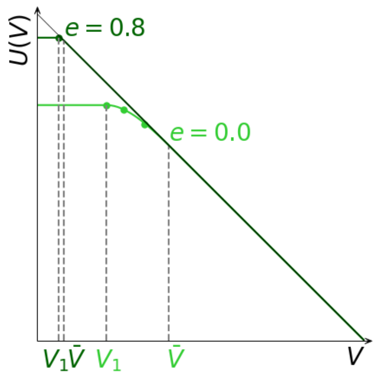
[33]The former follows from (LL). The latter is due to the assumption that, if the firm does not invest the agreed amount, the government expropriates the firm unless the courts uphold the initial contract with probability e. In either case, the relationship is terminated following a deviation. Thus, the best deviation is not to invest. The resulting self-enforcing constraint is:

$$-I_t + r(I_t) - T_t + \delta U(V_{t+1}) \geq e(-I_t + r(I_t) - T_t)$$

which never binds, since the firm outside option is zero.

[34]For simplicity, we restrict attention to parameters where the FB part is non-empty. This requires that $\delta \geq \dfrac{1-e}{2-e}$.

Figure A.2: Pareto Frontier ($\delta = 0.8$ & $e \in \{1, 0.8, 0\}$)



expropriation. The contract dynamics that maximizes the firm's profits for stronger ($e = 0.8$) and weaker ($e = 0$) enforcement are depicted by the dots along the feasible frontier in dark green and light green lines, respectively.

We proceed to the Pareto frontier characterization. Note that the right hand side of (LL) cannot bind, otherwise the firm incurs losses. Using (PK), (LL) is transformed into

$$T_t = V_t - \delta V_{t+1} \geq 0. \tag{LL'}$$

Using (PK), we substitute out T_t in the above problem. Let $r(I_t) = 2\sqrt{I_t}$ and $\lambda, \nu, \mu \geq 0$ be the Lagrange multipliers for (SE), (PC) and (LL'), respectively. Then the FOCs with respect to I_t and V_{t+1} are:

$$I_t = (1 - \lambda(1 - e))^2, \tag{7}$$

$$U'(V_{t+1}) = \frac{-1 - \lambda e + \mu}{1 + \frac{\nu}{\delta}}, \tag{8}$$

The envelope theorem applied to the problem above give us the following condition:

$$U'(V_t) = -1 + \lambda(1 - e) + \mu. \tag{9}$$

Thus, $-1 \leq U'(V_t) \leq 0$ for all relevant V_t, where the latter inequality follows from the Pareto-efficiency of the frontier.

When $V_t \in FB$, $\lambda = 0$ and from (7) the investment is set at the first-best level $I = I^* = 1$. By (8), $\mu = \nu = 0$ to ensure $U'(V_{t+1}) \geq -1$. Hence $U'(V_{t+1}) = U'(V_t)$ and

$U(V_t)$ is given by

$$U(V_t) = V^{\#} - V_t \text{ for } V_t \in [\bar{V}, V^{\#}], \tag{10}$$

where $V^{\#}$ is the discounted government utility when keeping all the surplus $V^{\#} = (r(I^*) - I^*)/(1-\delta) = 1/(1-\delta)$. $\bar{V}$ is the left end of the FB segment. We solve for the minimal $\bar{V}$ satisfying (SE) and (LL') in (11) to define the broadest set of V_t such that $I = I^*$:

$$\begin{aligned} &e\delta V_{t+1} - (1-e)(2-V_t) \geq 0, \\ &V_t - \delta V_{t+1} \geq 0 \\ &V_t, V_{t+1} \in [\bar{V}, V^{\#}]. \end{aligned} \tag{11}$$

Given the set of V_{t+1} for a given V_t described in (11), we set $V_t = \bar{V}$. This, combined with (LL'), implies that $V_{t+1} \leq V_t/\delta$, that is, V_t does $1/\delta$-step every period. Notice that the first inequality in (11) is more likely to hold for a large V_{t+1}. As a result, there are two possible cases depending on whether the maximum V_{t+1} is above or below $V^{\#}$.

Case 1. If $\bar{V} < \delta V^{\#}$, then $V_{t+1} = V_t/\delta$; substituting it into the system (11) we get $\bar{V} = \tilde{V} = 2(1-e)$. The condition relating $\bar{V}$ and $V^{\#}$ implies that this case takes place when $\delta \geq \dfrac{2-2e}{3-2e}$.

Case 2. If instead $\bar{V} \geq \delta V^{\#}$ then (PC) binds and the highest possible $V_{t+1} = V^{\#}$; then system (11) yields $\bar{V} = \tilde{\tilde{V}} = \dfrac{2(1-e)-(2-e)\delta}{(1-e)(1-\delta)}$. This case takes place when $\dfrac{1-e}{2-e} \leq \delta < \dfrac{2-2e}{3-2e}$, where the LHS of the inequality ensures the FB is achieved (see footnote 34).

Let us turn to the SB. When $V \in SB$, (SE) binds (i.e. $\lambda > 0$), and the investment level is suboptimal, $I < I^*$, so from (9)

$$U'(V_t) > -1, \tag{12}$$

and the Pareto set is no longer linear.

Assuming the function $U(\cdot)$ is strictly concave, $U'(V_t)$ is decreasing in V_t for $V_t \in SB$, and it follows from (8) and (12) and (LL') that

$$V_t \leq V_{t+1} \leq \frac{V_t}{\delta}. \tag{13}$$

Note that it is not possible to have $\mu = \nu = 0$ for $V_t \in SB$ as long as $e > 0$, since constraints (8) and (12) need to be satisfied. Hence, if $e > 0$ then either (LL) binds and $V_{t+1} = V_t/\delta$, or (PC) does and $V_{t+1} = V^{\#}$.

With this in mind, we proceed to recursively describe the SB. Start with the segment of the SB neighboring FB from the left.

In Case 1, the segments of SB, starting from the one neighboring FB from the left, and going towards smaller V_t, are determined as $S_1 = [\delta\tilde{V}, \tilde{V})$, $S_2 = [\delta^2\tilde{V}, \delta\tilde{V})$, ..., $S_k = [\delta^k\tilde{V}, \delta^{k-1}\tilde{V})$. For i-th segment, the Pareto frontier is determined by solving (Fmax) with (SE) equalized under $V_{t+1} = V_t/\delta$, and $U(V_{t+1}) = F_{i-1}(V_{t+1})$, $i = 1, ...k$, where $F_i(.)$ is an auxiliary function defined by functional form of U(.) on i-th SB segment, $F_i(V_t) = U(V_t)$ on S_i, and $F_0(V_t) = V^{\#} - V_t$. We obtain

$$U(V_t) = a_i V_t^2 + b_i V_t + c_i \tag{14}$$

where a_i, b_i, c_i can be determined recursively from the Bellman equation (Fmax):

$$a_i = \frac{a_{i-1}}{\delta} - \frac{1}{4(1-e)^2}, \quad b_i = b_{i-1} + \frac{1}{1-e}, \quad c_i = \delta c_{i-1}, \tag{15}$$

and

$$a_1 = -\frac{1}{4(1-e)^2}, \quad b_1 = \frac{e}{1-e}, \quad c_1 = \frac{\delta}{1-\delta}. \tag{16}$$

The level of investment at each segment is

$$I(V_t) = \left(\frac{V_t}{2(1-e)}\right)^2 = \left(\frac{V_t}{\tilde{V}}\right)^2. \tag{17}$$

The left bound of the Pareto frontier V_1 is reached at the maximum of $U(V_t)$, when $U'(V_t) = 0$ i.e.

$$V_1 = \frac{b_k}{-2a_k} \tag{18}$$

where k, the number of steps to reach the first best part of the Pareto frontier, is such that V_1 is between $\delta^k\tilde{V}$ and $\delta^{k-1}\tilde{V}$. Note that V_1 is positive since $b_k > 0$. At this point, the firm gets the largest profits.

In turn, k, is given by:

$$k = \left\lceil \frac{\ln\left(V_1/\bar{V}\right)}{\ln\delta} \right\rceil \tag{19}$$

In Case 2 the recursive procedure is the same as in Case 1, but at the first step – i.e., at the segment of the SB neighboring FB from the left, – $V_1 = \min(V_t/\delta, V^{\#})$. As our further analysis mostly concerns Case 1, we do not provide the solution of case 2 here, but it is available on request.

Proof of Proposition 2 For expositional clarity, we limit the analysis of this proof and that of Proposition 3 to Case 1. Most of the results of this section extend to Case 2 and the proofs are available on request.

In the first part of this Proposition, we want to establish that k, the number of periods needed to reach the first best part of Pareto frontier, is decreasing in e. The value of k is determined by the inequalities

$$\beta^k \leq \frac{V_1}{\tilde{V}} < \beta^{k-1}. \tag{20}$$

combining the definition of V_1 in (18), with (15) and (16), we obtain

$$V_1 = \frac{2(k-1+e)(1-e)(1-\delta)}{\delta(\delta^{-k}-1)} \text{ if } e_k \leq e \leq e_{k-1} \tag{21}$$

where

$$e_k = \sum_{i=0}^{k} \delta^i - k = \frac{1-\delta^{k+1}}{1-\delta} - k. \tag{22}$$

Here $[e_k, e_{k-1}]$ is the segment of e values satisfying $\delta^k \tilde{V} \leq V_1 \leq \delta^{k-1}\tilde{V}$.

Using (21), we obtain

$$\frac{V_1}{\tilde{V}} = \frac{\delta^{-1}-1}{\delta^{-k}-1}(e+k-1) \tag{23}$$

We need to show that k as determined by conditions (20) and (23)

$$\delta^k \leq \frac{\delta^{-1}-1}{\delta^{-k}-1}(e+k-1) < \delta^{k-1} \tag{24}$$

is decreasing in e. From (21) it follows that e_k is decreasing in k, as

$$e_k - e_{k-1} = \delta^k - 1 < 0.$$

Thus, a small increase in e that causes k to change can only be for e to move from a segment where it takes k steps to reach the frontier, $[e_k, e_{k-1}]$, to a segment where it takes $k-1$, $[e_{k-1}, e_{k-2}]$, for some k. That is, k decreases as e increases. In the second part of this Proposition, we prove that V_1 is decreasing in e. From equation (21) it follows that for $e_k \leq e \leq e_{k-1}$

$$\frac{dV_1}{de} = (2 - k - 2e)\frac{2(1-\delta)}{\delta(\delta^{-k} - 1)} \tag{25}$$

For $k \geq 2$ this derivative is trivially negative. For $k = 1$ we have from (22) $e_1 = \delta \leq e \leq e_0 = 1$. In turn, restrictions for Case 1 imply that $e \geq \frac{2-3\delta}{2-2\delta}$. As a result, for $k = 1$

$$e \geq \max\left\{\delta, \frac{2-3\delta}{2-2\delta}\right\} \geq \frac{1}{2} \tag{26}$$

and

$$(2 - k - 2e) = 1 - 2e \leq 0. \tag{27}$$

This, combined with the continuity of V_1 at e_k, yields the result for the (ii) part.

Proof of Proposition 3 This proposition follows from Lemmas 1 and 2.

Lemma 1. *The cumulative shares of investment $CS^I_{\bar{n}}$ and production $CS^r_{\bar{n}}$ increase in e for any fixed $\bar{n}$, N and δ.*

Proof of Lemma 1 We prove the result for investment, the proof for production is fully analogous. First, note that if both (SE) and (LL') bind then the investment is given by (17): $I(V_t) = \left(V_t/\tilde{V}\right)^2$. This means that for all $V_t \in [0, V^{\#}]$

$$I(V_t) = \min\left\{\left(V_t/\tilde{V}\right)^2, 1\right\}. \tag{28}$$

Note that on the SB part of the equilibrium path of V_t starting from $V_t = V_1$, V_t increases at a rate of $1/\delta$. Thus, if $n \leq k$ then the value of I is given by

$$I_n = \delta^{-2(n-1)}\left(V_1/\tilde{V}\right)^2. \tag{29}$$

Hence the cumulative share of investment $CS^I_{\bar{n}}$ defined by (2) is given by

$$CS^I_{\bar{n}} = \frac{d\left(V_1/\tilde{V}\right)^2 + f}{\sum\limits_{n=1}^{k}\delta^{-2(n-1)}\left(V_1/\tilde{V}\right)^2 + N - k} \tag{30}$$

where

$$\begin{cases} d = \sum_{n=1}^{\bar{n}} \delta^{-2(n-1)}, \ f = 0, & \text{if } \bar{n} \leq k, \\ d = \sum_{n=1}^{k} \delta^{-2(n-1)}, \ f = \bar{n} - k, & \text{if } \bar{n} > k. \end{cases}$$

In both ranges of $\bar{n}$,

$$d(N-k) > f \sum_{n=1}^{k} \delta^{-2(n-1)}$$

for all $\bar{n} = 1, \ldots, N-1$, so $CS_{\bar{n}}^{I}$ is increasing in $V_1/\tilde{V}$.

To prove that $CS_{\bar{n}}^{I}$ increases in e it suffices to establish two things: 1) that $V_1/\tilde{V}$ increases in e on each segment $[e_k, e_{k-1}]$ where k is constant, and 2) that $CS_{\bar{n}}^{I}$ is continuous in e at each threshold e_k where k changes.

The first part is trivial - from (23) it follows that $V_1/\tilde{V}$ is continuous and increasing in e on each segment $[e_k, e_{k-1}]$.

Now show that both the numerator and denominator of $CS_{\bar{n}}^{I}$ are continuous at the thresholds. Start with the denominator and show that the difference between the values of it to the left and to the right of e_k is zero. Using the expression (23) for $V_{\min}/\tilde{V}$ to the left and to the right of of e_k and the expression (22) for e_k, we get

$$\begin{aligned} &\left(\sum_{n=1}^{k+1} \delta^{-2(n-1)} \left(\frac{\delta^{-1}-1}{\delta^{-k-1}-1}(e_k+k) \right)^2 + N - k - 1 \right) \\ &- \left(\sum_{n=1}^{k} \delta^{-2(n-1)} \left(\frac{\delta^{-1}-1}{\delta^{-k}-1}(e_k+k-1) \right)^2 + N - k \right) \\ &= \left(\sum_{n=1}^{k+1} \delta^{-2(n-1)} - \sum_{n=1}^{k} \delta^{-2(n-1)} \right) \left(\delta^k\right)^2 - 1 = 0. \end{aligned}$$

Regarding the numerator, if $\bar{n} < k$, the difference between its values to the left and to the right of e_k is trivially zero. If $\bar{n} \geq k$, the proof proceeds similarly to the one for the denominator.

Lemma 2. *(a) Taxes are zero until the path reaches FB, and the number of such periods decreases in e. (b) There exist equilibria in which the cumulative share of taxes $CS_{\bar{n}}^{T}$ increases in e for any fixed $\bar{n}$, N and δ.*

Proof of Lemma 2 Result (a) follows from the proof of part (i) of Proposition 2. Let us establish result (b). As discussed earlier, unlike investment or production, the tax schedule may depend on the choice among multiple solutions in the first-best segment.

Consider the equilibrium that originates at V_1, reaches efficient frontier at V_1/δ^k, then proceeds to $V_{t+1} = \tilde{V}/\delta$ and stays there stationary.[35]

Then T_n is zero in periods $n \leq k$. At period $k+1$ the tax is

$$T_{k+1} = V_t - \delta V_{t+1} = V_1/\delta^k - \tilde{V},$$

and for $n > k+1$ it is given by

$$T_n = (1-\delta)\tilde{V}/\delta.$$

As a result, $CS_{\bar{n}}^T = 0$ if $\bar{n} < k+1$, while for $\bar{n} \geq k+1$ it is given by

$$\begin{aligned} CS_{\bar{n}}^T &= \frac{(V_1/\delta^k - \tilde{V}/\delta) + (\bar{n} - k - 1)(1-\delta)\tilde{V}/\delta}{(V_1/\delta^k - \tilde{V}/\delta) + (N - k - 1)(1-\delta)\tilde{V}/\delta} \\ &= 1 - \frac{(N - \bar{n})}{\delta^{-k+1}\left(V_1/\tilde{V}\right) - 1 + (N-k-1)(1-\delta)} \end{aligned}$$

Since $V_1/\tilde{V}$ increases in e, $CS_{\bar{n}}^T$ increases in e for each k (that is, on each segment $[e_k, e_{k-1}]$). The proof that $CS_{\bar{n}}^T$ is continuous in e at each threshold e_k follows the above approach using (22) and (23) and the definition of β. As a result, $CS_{\bar{n}}^I$ is increasing in e.[36]

[35]Notice that a stationary equilibrium satisfying (SE) constraint implies $\delta V_t - (1-e)(2 - V_t + \delta V_t) \geq 0$ or equivalently $V_t \geq \frac{2(1-e)}{1-e(1-\delta)}$. This implies that when $e > 0$, a stationary equilibrium is impossible at $\tilde{V} = 2(1-e)$, but can take place at $\tilde{V}/\delta$.

[36]Note that this result may depend on equilibrium selection. For example, it can be shown that the reverse is true in an equilibrium that originates at V_1, reaches efficient frontier at V_1/δ^k, then proceeds to, and stabilizes at, $V^{\#}$.

B ONLINE APPENDIX:

Data Appendix

This Appendix provides a detailed description of the variables in the dataset:

Year of award and start of production: Year in which the exploration license is granted. Following a discovery of a field, we also have the year in which production starts. We exclude the fields which were not discovered.

Ownership: All the fields in our sample are at least partially owned by a multinational headquartered in an OECD country. For almost all of our fields, a multinational is also the company that started production.

Physical production: For each field, we observe yearly physical production measured as the average thousands of barrels for liquids (or barrels of oil equivalent for gas) per day, and we convert it into cumulative yearly figures. If the field is jointly operated by several companies, we observe their levels of production (and the other financial variables) from this field separately.

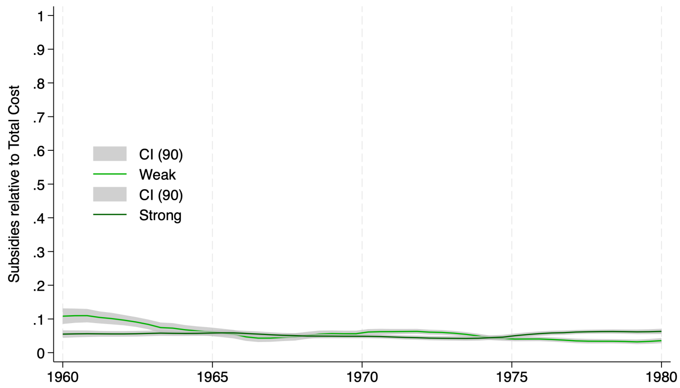
Profits: For each field, yearly profits are the free cash flow determined by the total revenues minus the total costs and are reported in millions of current USD. To make it comparable across time, we use the US CPI and transform the nominal values into real 2018 USD.

Operational and capital expenditure: For each field, we observe yearly well CAPEX (CAPital EXpenditure), which is defined as capitalized costs related to well construction, including drilling costs, rig lease, well completion, well stimulation, steel costs and the purchase of necessary materials. We also observe yearly OPEX (OPerational EXpenditure), which contains costs related to materials, tools, maintenance, equipment leases and salaries. Both are denominated in millions real 2018 US dollars.

Tax payments (government take): For every field and year, the tax payment variable consists of all cash flows destined to the authorities and land owners, including royalties, government profit oil (PSA equivalent to petroleum taxes), export duties, bonuses, income taxes and profit taxes. It is denominated in millions of real 2018 US dollars.

Revenues: For each field, we calculate the revenues as a sum of CAPEX and OPEX, taxes and profits. In practice, revenue is the physical amount produced by the field

Figure B.3: Subsidies in Oil and Gas Extraction



multiplied by the sale price. Note that prices can vary due to the heterogeneity in the type and the quality of the hydrocarbon. Thus, two fields that produce the same amount may generate different revenues.

Fiscal regime: The total amount and the structure of tax payments in the framework of an agreement are typically referred to as a fiscal regime. In our analysis, we only use the feature associated with the type of ownership of the field. The regime can be that of: 1) a concession where the firm is granted 100% ownership of the product extracted; 2) a service contract where the firm is granted 0% ownership; and 3) a production-sharing agreement where the firm is granted between 0% and 100% ownership. In general, the fiscal regime and the exact share of the revenues and profits received by both parties vary greatly across and within countries, and depend on the country's petroleum laws, regulations and the geological features of the fields.

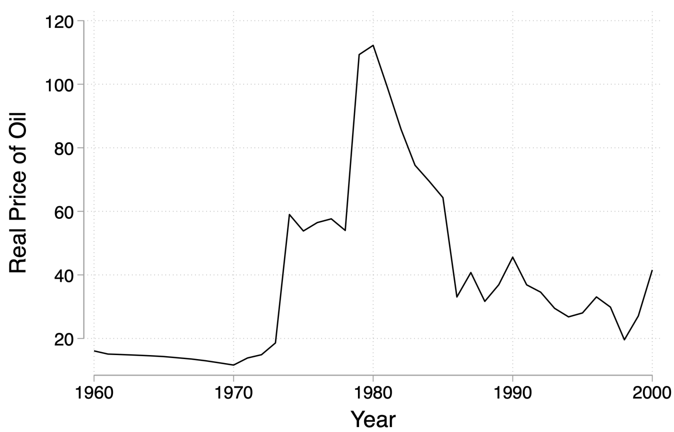
Reserves, types and location: Reserves are defined in the data as the remaining economically recoverable physical quantities of fossil fuels. We use reserves at the beginning of field's production as a measure for field size. We also have information on the type of hydrocarbon (oil or gas), and the location of the field.

Table B.1: Additional Descriptive Statistics

Country	First	Last	Fields	Weak	Country	First	Last	Fields	Weak
Albania	1967	1987	206	1	Slovakia	1981	1981	57	1
Algeria	1962	1999	1716	1	Slovenia	1961	1961	37	1
Angola	1979	1999	2645	1	South Africa	1991	1991	148	1
Argentina	1960	1999	12735	1	Spain	1977	1997	504	0
Australia	1964	1999	19239	0	Syria	1978	1997	1640	1
Austria	1960	1992	919	0	Tajikistan	1962	1989	389	1
Azerbaijan	1997	1997	294	1	Thailand	1981	1999	4142	1
Bahrain	1980	1980	56	1	Trinidad&Tobago	1972	1999	1687	0
Bangladesh	1960	1999	252	0	Tunisia	1966	1998	976	1
Barbados	1971	1996	1281	1	Turkey	1961	1998	2261	0
Bolivia	1967	1999	1488	1	Turkmenistan	1963	1972	201	1
Brazil	1993	1994	264	1	Ukraine	1964	1995	652	1
Brunei	1988	1999	897	0	UAE	1973	1995	4848	1
Cameroon	1977	1999	1873	1	United Kingdom	1967	1999	22110	0
Canada	1960	1999	5117	0	United States	1960	1999	58323	0
China	1978	1991	169	1	Uzbekistan	1974	1974	98	1
Colombia	1962	1999	2767	1	Venezuela	1961	1999	1657	1
Romania	1960	1999	10252	1	Vietnam	1998	1998	55	1
Russia	1968	1999	929	1	Yemen	1996	1999	184	1

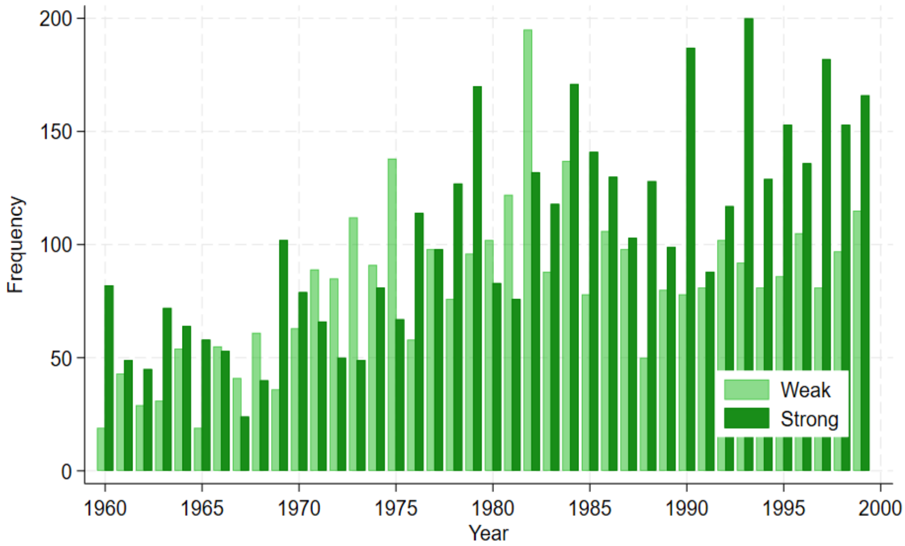
Note: Additional descriptive statistics, disaggregated by countries.

Figure B.4: Real Oil Price



Note: The real price of oil as provided by BP in the Statistical Outlook.

Figure B.5: Timing of the start of production



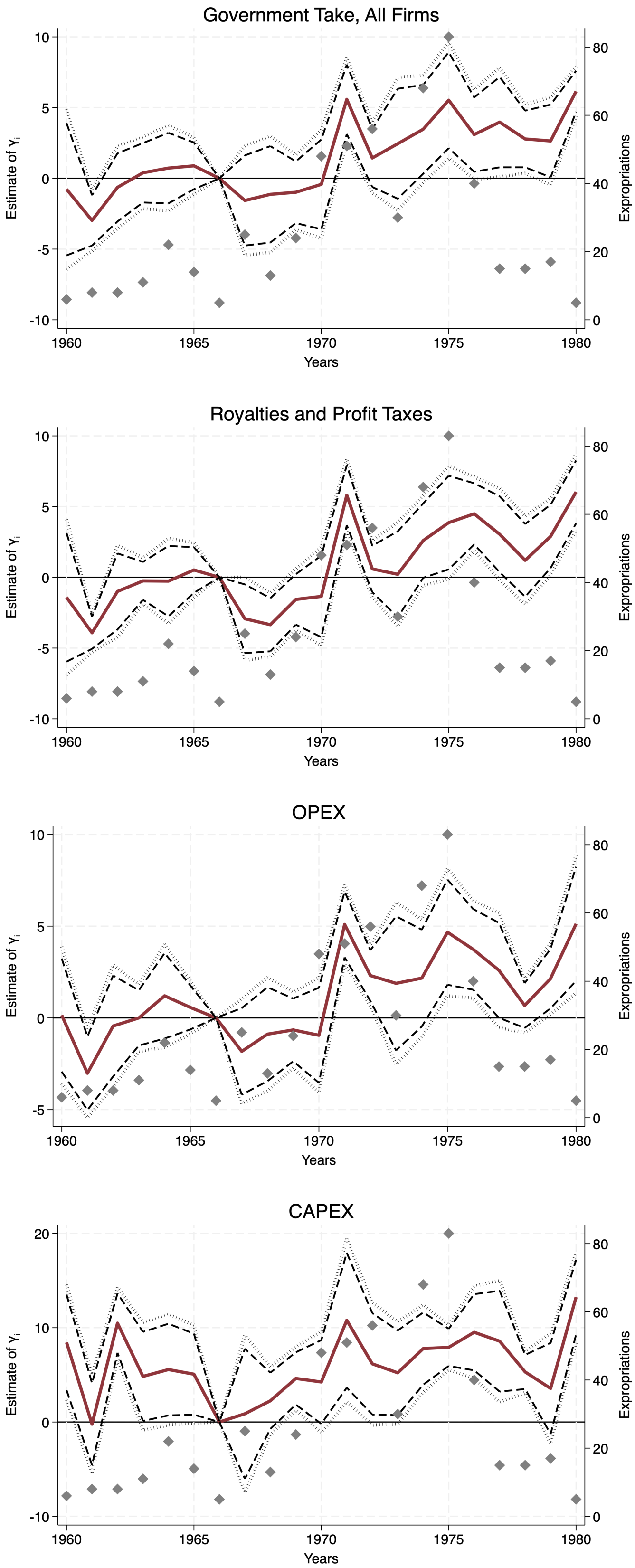
C ONLINE APPENDIX: Additional Empirical and Theoretical Results

C.1 Empirical arguments

Oil price: While an increase in the oil prices (see Figure B.4) can serve as an additional incentive to expropriate in countries in weak institutions (Guriev, Kolotilin and Sonin, 2011; Stroebel and Van Benthem, 2013), we argue that it is unlikely to be the reason behind the emergence of self-enforcing agreements and backloading that we document. Were it to be the case, it should have affected fields operated in countries with weak institutions by both firms with headquarters in Great Powers and by other OECD firms alike. However, our heterogeneity analysis suggests that it is only the former group of fields that exhibited an increase in their relative backloading, while the latter group's relative backloading has not changed following an increase in oil prices.

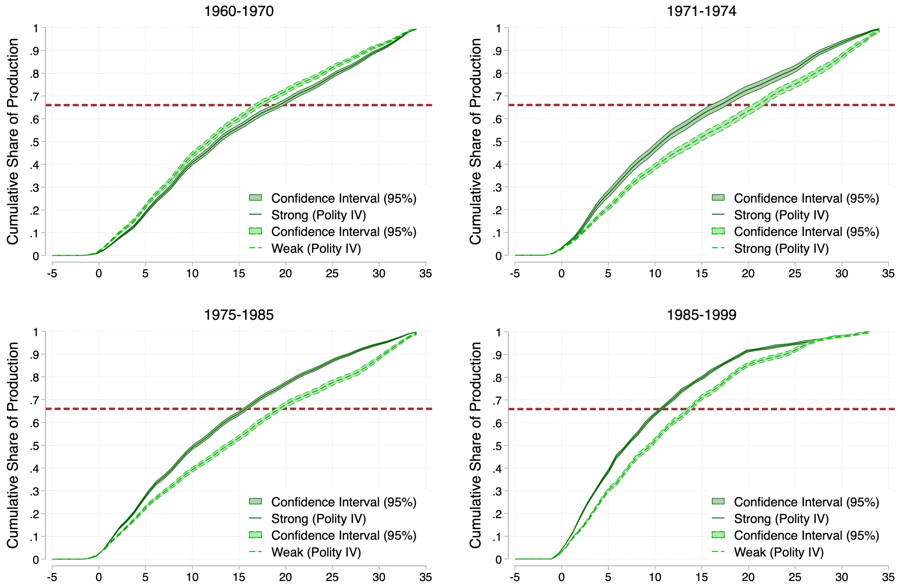
Uncertainty: Similarly, our heterogenity analysis suggests that backloading that we document could not have been driven by temporary uncertainty triggered by the global transition that occurred from 1967 to 1973. Again, were this the case, both firms with headquarters in Great Powers and other OECD firms would be affected, which is not what we document. Further, if this were the case, backloading should have disappeared

Figure C.6: Backloading in the Oil Industry



Note: Sample consists of all fields which have been started between 1960 and 1980 by multinational firms. In the top and second panel we show the results of estimating a specification in which the dependent variable is the number of years necessary to reach 66% of cumulative Goverment Take or Royalites and Profits Taxes over a period of 35 years. In the third panel, the dependent variable is the number of years necessary to reach 66% of cumulative operational expenditures (equivalent to variables costs) over a period of 35 years. In the bottom panel, the dependent variable is the number of years necessary to reach 66% of cumulative capital expenditures (equivalent to fixed costs) over a period of 35 years.

Figure C.7: Backloading across years (start of production is shown in the title)



Note: Using the cumulative production of oil and gas from 155 firms operating in fields that began production between 1960 and 1999, we plot the cumulative share of production on the field level for countries with weak and strong institutions. We differentiate between 4 different time periods, before and after a change in the oil world order. The results indicate the presence of backloading in countries with weak institutions compared to those with strong institutions from 1970 onward, even during periods of low oil prices.

Figure C.8: Bad Control

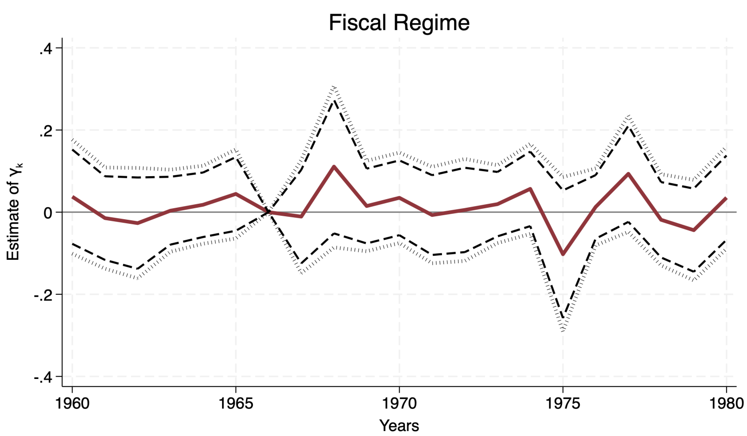
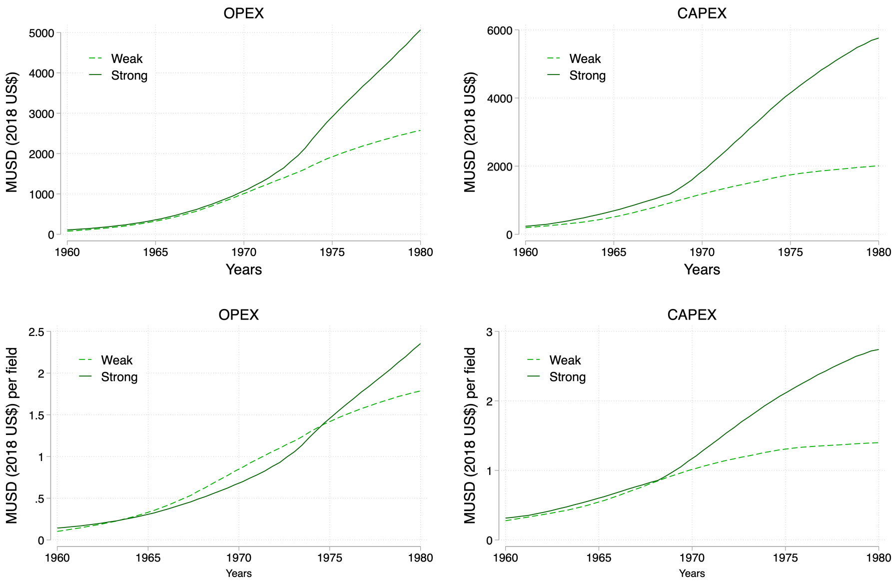


Figure C.9: OPEX AND CAPEX



Note: In the top row, we plot total CAPEX and total OPEX of the multinational going into countries with strong and weak institutions. In the bottom row, we plot CAPEX and OPEX per field in countries with weak and strong institutions.

once the general uncertainty was resolved. However, the bottom panel of Figure C.7 shows how backloading persisted over time.

Bad control: Our baseline results in Figure 7 could be biased due to the inclusion of the fiscal regime, which could be considered a "bad control".[37] Specifically, we hypothesize that the weakening of contract enforcement may have incentivized multinationals to adopt Production Sharing Contracts (PSC) when dealing with countries with weak institutions. Expropriating fields that operate under a PSC would, by design, yield smaller returns. Thus, the use of PSCs could be strategically employed by multinational firms. We test this hypothesis by reestimating equation (5), replacing the left-hand side variable with a dummy for PSCs, presenting the results in Figure C.8. We find no evidence for this mechanism to be at play.

Financial Constraints: Alternatively, our results may reflect the fact that multinationals have been operating under strict financial constraints. In such a scenario, the reallocation of spending from the South (countries with weak institutions) to the North (countries with strong institutions) following the discoveries in the North Sea and Alaska

[37] Variables that are themselves affected by the increased threat of expropriation (i.e., outcome variables), influencing firms' decisions (Angrist and Pischke, 2014).

in the late 1960s would naturally lead to a reduction in investments in countries with weak institutions. However, Figure C.9 shows that both operational and capital expenditures increased in countries with both strong and weak institutions. This suggests that overall investment had been rising, and the reallocation of capital to Northern countries did not mechanically decreased investments in countries with weak institutions.

C.2 Theoretical arguments

We provide three theoretical augments which suggest that our main results in 7 provide a lower bound estimate. In addition, we argue why other theories that predict backloading are unlikely to explain our results.

High interest rate: According to Hotelling's Rule, a higher interest rate should lead to faster extraction of a scarce resource, with the resource price adjusting to reflect increased scarcity (Hotelling, 1931; Krautkraemer, 1998; Anderson, Kellogg and Salant, 2018). Intuitively, the resource owner faces two choices: either extract the resource today, deposit the generated rents in the bank, and collect interest in the next period, or leave the resource underground for one more period to benefit from potential price increases. If the interest rate is high relative to the expected price increase, the owner has an incentive to accelerate extraction, and vice versa.

Interest rates are a confounding factor, as they are country-specific and change over time. Beyond Hotelling's logic, there is evidence that newly independent, resource-rich countries may seek to extract resources quickly to avoid borrowing from international markets at high interest rates. As Yergin (2011*a*) highlights regarding the post-WWII petroleum order: "Royalties on oil were or would soon become the major source of revenue for Gulf countries. As a result, those countries would continually pressure companies—often through threats, veiled or otherwise—to increase production and, in turn, royalty revenues." Thus, while we expect that country-specific interest rates (whether for saving or borrowing) may influence investment, production, and tax dynamics, they likely lead to front-loading, especially for countries with weaker institutions that face higher interest rates. Therefore, our results likely represent a lower bound.

Change in bargaining power: In Section 4.1, we assumed that firms held all the bargaining power relative to governments. Under this assumption, weaker institutions lead to relatively more backloaded agreements. However, if governments held all the bargaining power, weaker institutions would not be associated with contract backloading, as governments would already capture all profits and have no incentive to expropriate firms. In reality, bargaining power is often shared, and it may shift over time. During the transition to a new world oil order, for instance, governments' bargaining power likely increased, resulting in larger profit shares for governments in countries with weak institutions. Theoretically, this would reduce the extent of backloading (see Ray (2002) and footnote 22). Therefore, we estimate the lower bound of the backloading effect triggered by the transition to the new oil order. Had the bargaining power of countries with weak institutions remained unchanged, the extent of backloading would likely have been even more severe.

Corruption: Corruption tends to be more severe in countries with weak institutions than in those with strong institutions (Rose-Ackerman, 2008), and its extent may vary over time at the country level. If oil firms pay bribes to governments, Troya-Martinez and Wren-Lewis (2023) show that the government's commitment problem is relaxed. Indeed, governments becomes less willing to expropriate for fear of losing future bribes from firms and consequently, the contracts should be less backloaded. Hence, as long as corruption increased in countries with weak institutions, our results are likely to represent a lower bound.

Alternative theories: Two other theories also predict contract backloading. First, backloading may emerge in anonymous markets where relationships are restarted after opportunistic behavior occurs, and such behavior is unobserved by new partners. In this scenario, backloading serves as a mechanism to make switching to a new relationship more costly, thus reducing incentives for opportunistic behavior (see Kranton (1996) and Fujiwara-Greve and Okuno-Fujiwara (2009)). Unlike this context, expropriations (the opportunistic behavior) in the oil and gas industry are public information. Alternatively, backloading can also occur in environments with asymmetric information about whether a player is opportunistic, as in Ghosh and Ray (1996) and Watson (1999). In this theory, if a government can be opportunistic (i.e., consistently expropriates) or not, the firm initially enters the relationship on a smaller scale, using this initial phase to screen the government's type. Opportunistic relationships terminate, while non-opportunistic ones progress to fully cooperative levels. One could imagine that the reduction in external contract enforcement in the late 1960s created a scenario where the "type" of government became more relevant in countries with weak institutions. According to this theory, once the government is revealed to never expropriate, the firm would have no reason to provide additional rents to the government. Instead, in Figure **??**, we document that the government's rents increase over time, which is consistent with predictions of the model in Section 4.1.