Do political risks harm development of oil fields?

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Abstract

We examine the impact of political risks and financial development on investments in the petroleum industry utilizing a unique dataset of investments in individual oil and gas fields around the world. We find that the expected time to investment is shorter in countries that are politically stable, have solid property rights protection and more developed financial systems. Political risks have the strongest impact on multinational companies, whereas financial development matters only for domestic national oil companies. At the company level we find that expected time to investment is shorter for companies with higher valuation and lower debt. Moreover, companies are more likely to invest in countries where they invested recently and less likely to invest in countries where their competitors invested recently.

keywords: investments, oil and gas, political risks, financial development
JEL codes: F21, O13, O43, Q32

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1 Introduction

Understanding how companies make investment decisions and which factors influence these decisions is extremely important. Since investments are a necessary precursor of economic growth, this knowledge is important for various economic agents, including policy makers, and has potential to benefit the whole society. We investigate how investments in petroleum extraction are influenced by political risk and financial development in the countries in which oil and gas fields are located.

There are several reasons why the petroleum industry in particular is conducive to studying the impact of political risks on investments. First, crude oil and gas have been our primary energy sources for the better part of the last 60 years. The close link between politics and crude oil and gas suggests that political factors may be particularly important in oil and gas investment decisions.

The second reason is that the sensitivity to political risks depends on capital intensity (Bohn and Deacon, 2000). The petroleum industry is a typical example of a capital intensive industry, and it is therefore particularly suitable for studying this question.

The process of oil and gas extraction involves three separate but closely interrelated activities: exploration, development, and extraction. In most cases, development requires a large investment, which makes this decision particularly interesting to investigate. We therefore examine how the decision to develop is influenced by political stability and property rights protection.

Moreover, since investment decisions play such a major role for oil companies and since they are made repetitively, these companies are very likely to put a lot of time and resources into investment decisions. This is confirmed by Horn et al. (2015) who find that advanced methods for evaluating investments, such as real options, are most frequently used by decision makers in the energy sector.

Last, it is useful, in analyzing investment decisions, if decision problems are similar, recorded, and available to the researcher. This is not the case for most companies. A typical company faces investment decisions of various types. Moreover, there is usually no available recorded history of individual decisions. Most of the literature therefore study investments as reported in accounting statements, which is necessarily aggregated (usually over a year-long period) and is not particularly suitable for studying investment timing. On the contrary, the petroleum industry is a very convenient exception. We use unique a dataset which enables us to study development decisions for individual oil fields.

Petroleum exploration and field development have been the subjects of economic research for decades. Researchers have investigated the influence of oil prices and oil price volatility (Favero et al., 1994; Hurn and Wright, 1994; Mohn and Osmundsen, 2008; Kellogg, 2014; Berntsen et al., 2018), geological variables (Osmundsen et al., 2010), strategic interaction (Lin, 2009, 2013; Levitt, 2016), as well as environmental protection (Lewis, 2015).

These studies are all based on datasets from one particular country.[1] However, in order to investigate the impact of political risks and financial development, a multi-country dataset is needed. There is a long history of research on how polity and political factors affect wealth and investments, but very few researchers conduct cross-country analyses based on micro-level data.

We find that expected time to investment of petroleum companies is shorter for politically less risky and financially more developed countries. The conclusion that investments respond to such risks is in accordance with Cooray et al. (2017), who find that benefits from trade openness are more pronounced in less risky countries.

Moreover, there are significant differences across company types. Political risks most strongly impact major multinational companies, whereas financial development matters only for domestic national oil companies. We further find that expected time to investment is shorter for companies with higher relative valuation (Tobin's Q) and lower indebtedness. Moreover, companies are more likely to invest in countries where they have previously invested, yet are less likely to invest in countries where their competitors have invested. Our data set on oil and gas assets is unique and has not been subject to any similar kind of analysis prior to this study.

To our knowledge, there have been no studies analyzing the impact of financial development on petroleum investments, and there are only two studies based on detailed micro-level data investigating the impact of political stability and property rights protection on oil and gas investments. Bohn and Deacon (2000) investigate the forestry and petroleum industries, and find that property rights significantly impact the extraction of these natural resources. Cust and Harding (2017) estimate the effect of institutional quality on the location of oil and gas exploration. They use data on the location of exploration wells and national borders and find that exploration and production companies drill on the side of a national border with better institutional quality. They also investigate the variation of this relationship across company types and find that the impact of institutional quality on investments is stronger for multinational oil companies than for national oil companies and smaller specialized ex-

[1] Favero et al. (1994) Hurn and Wright (1994) study data from the U.K. Continental Shelf, Mohn and Osmundsen (2008), Osmundsen et al. (2010) and Berntsen et al. (2018) study data from the Norwegian Continental Shelf, Lin (2009) and Lin (2013) study data from U.S. federal lands in the Gulf of Mexico, Lewis (2015) studies date from Wyoming, U.S., and Levitt (2016) studies the data from Alberta, Canada.

ploration and production companies.

Our research question is most closely related to Cust and Harding (2017). However, there are many differences between our studies. First, they use different dataset than we do. Second, Cust and Harding (2017) study investment location, whereas we study investment timing utilizing duration analysis[2]. Third, Cust and Harding (2017) utilize only time-invariant measures of institutional quality, whereas our analysis is based on institutional quality varying over time. Fourth, we also investigate the role of financial development.

Lastly, the studies by Bohn and Deacon (2000) and Cust and Harding (2017) are based on observed outcomes, i.e. observations where the whole process of investment was completed. Unlike these studies, we focus particularly on the second part of the investment process, i.e. the decision to develop the field following the discovery of oil. Since petroleum exploration is very costly, it is likely that companies already consider political risks in this early stage. It is therefore a priori not obvious whether political risks also play an important role in the decision to develop a field once the oil was found. Interestingly, our results regarding political risks are in line with Cust and Harding (2017)'s results.

The remainder of this paper is organized as follows. Section 2 describes the data, Section 3 outlines the methodology, Section 4 presents our results and discusses the findings, and Section 5 concludes.

[2]Duration analysis has previously been applied across scientific fields and in the analysis of investment behaviour. With regard to research on the oil and gas industries, hazard rate models have been used to study petroleum refineries (Dunne and Mu, 2010) and the development of oil and gas fields (Favero et al., 1994; Hurn and Wright, 1994).

2 Data

2.1 Data on Oil and Gas Assets

We study micro-level data on oil and gas reservoirs (assets) located worldwide and discovered between January 1970 and the end of December 2015. The data are obtained from Rystad Global Upstream Oil an Gas Database UCube[3], which contains information on more than 28,000 oil and gas reservoirs. Due to missing data, the sample studied in this paper consists of 13,269 assets.

The database provides asset discovery dates and the dates of approval for assets approved for development.[4] In our data, 81% of all assets have been approved for development while the remaining 19% are discoveries.

Additional information about fields is utilized in our study in order to mitigate the problem of heterogeneity across assets. Particularly relevant is information about the location of the field, because it has significant impact on the cost of extraction. Our dataset provides five categories: onshore, offshore shelf, offshore midwater, offshore deepwater and arctic area. In addition, we also include variables capturing both the fiscal regime and whether the asset contains primarily oil or natural gas.

We use the discovery and approval dates[5] to calculate the appraisal lag, which is simply the time difference between these dates, denoted in months. The appraisal lag in our study ranges from one month to 538 months (45 years) for approved assets, while the appraisal lag varies from two months to 552 months (46 years) for discovered but unapproved assets. More than 60% of the assets are however approved within four years after discovery. Figure 1 shows the distribution of the time lag from discovery to approval for approved assets. For unapproved assets, the time lag from discovery until the end of December 2015 is shown.

[3]The database is owned and operated by the Norwegian oil and gas consultancy and research firm Rystad Energy. The data is proprietary, and has been released for the purpose of this paper only.

[4]Before oil companies can develop a discovered field, authorities of the country to which the asset belongs must usually approve a plan for the development of the petroleum deposit.

[5]Ideally, the date on which the decision to develop a field was taken would have been used. However, this date is not available. The approach in this study, as well as in previous studies, e.g. Favero et al. (1994) and Hurn and Wright (1994), is to use the date on which an oil company receives approval from the government to develop a field. The time lag from discovery date to approval date is an approximation of the time an oil company spends considering whether to invest. It includes the time spent by the government reviewing the development application, but we assume this additional time lag is approximately the same for all applications such that it cancels out across the appraisal lags.

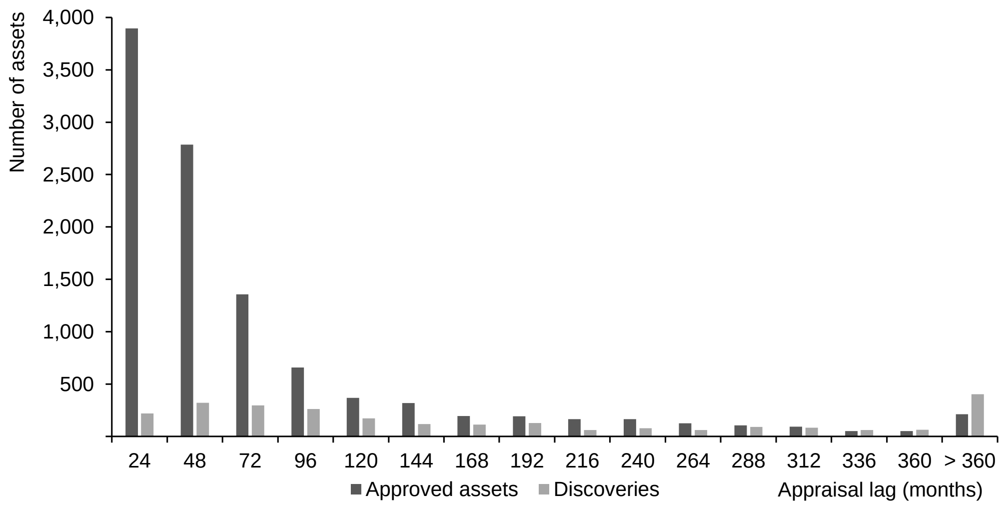


Figure 1. Appraisal lag for approved and censored assets

The oil and gas data covers assets belonging to 115 countries. The large variations in geographical and geological conditions introduce considerable heterogeneity across the assets. From Table 1, we observe that one fourth of all assets are located in North America while Western Europe, Russia and South America each have assets constituting approximately 10% of the total assets. Table 1 also presents the occurrence of the oil and gas assets across various supply segments. It is worth noting that 99% of Russian and almost 90% of North American discovered assets are located either onshore or on offshore shelves, which are considered to be the most easily available.

Figure 2 highlights the variations in the appraisal lag of assets in the different geographical regions. We observe that assets in North America on average seem to be developed at a higher pace than assets in Western Europe and Russia, which are the other regions with a large number of assets, even though shale plays are excluded from our study due to significant differences in cost structure, development procedures and the refining process.

Table 1. Summary: Oil and Gas Data

The left part of the table displays the number of oil and gas assets located in each geographical region as well as the number of countries through which they are distributed. The percentage in brackets gives for each region the proportion of the assets in this region to total assets studied. The percentages shown in the right part of the table denote for each region the proportion of assets located in the different Supply segment categories.

Geografical region	Number of countries	Number of assets	Supply segment				
			Onshore	Offshore shelf	Offshore midwater	Offshore deepwater	Arctic
North America	3	3,324 (25.0%)	27.4 %	60.3 %	6.0 %	5.5 %	0.8 %
Western Europe	8	1,402 (10.6%)	20.6 %	56.3 %	20.1 %	0.8 %	2.2 %
Russia	1	1,331 (10.0%)	98.1 %	1.4 %	0.2 %	0.0 %	0.3 %
South America	12	1,299 (9.8%)	74.9 %	9.5 %	6.5 %	9.1 %	0.0 %
South East Asia	8	913 (6.9%)	33.5 %	60.2 %	4.4 %	1.9 %	0.0 %
West Africa	16	846 (6.4%)	28.7 %	41.3 %	10.6 %	19.4 %	0.0 %
North Africa	6	759 (5.7%)	73.9 %	17.9 %	7.2 %	0.9 %	0.0 %
Middle East	12	697 (5.3%)	82.2 %	15.9 %	0.7 %	1.1 %	0.0 %
Oceania	3	653 (4.9%)	55.0 %	22.8 %	15.9 %	6.3 %	0.0 %
East Asia	5	537 (4.0%)	64.2 %	30.9 %	4.1 %	0.7 %	0.0 %
South Asia	4	468 (3.5%)	74.6 %	19.7 %	3.4 %	2.4 %	0.0 %
Eastern Europe	9	398 (3.0%)	91.7 %	7.8 %	0.5 %	0.0 %	0.0 %
Central Asia	7	274 (2.1%)	86.9 %	10.6 %	2.6 %	0.0 %	0.0 %
Southern Europe	8	216 (1.6%)	51.9 %	39.8 %	7.4 %	0.9 %	0.0 %
East Africa	7	103 (0.8%)	60.2 %	2.9 %	5.8 %	31.1 %	0.0 %
Central America	4	31 (0.2%)	83.9 %	12.9 %	3.2 %	0.0 %	0.0 %
South Africa	2	18 (0.1%)	22.2 %	50.0 %	27.8 %	0.0 %	0.0 %
Total	115	13,269	52.9%	35.0%	7.1%	4.5%	0.5%

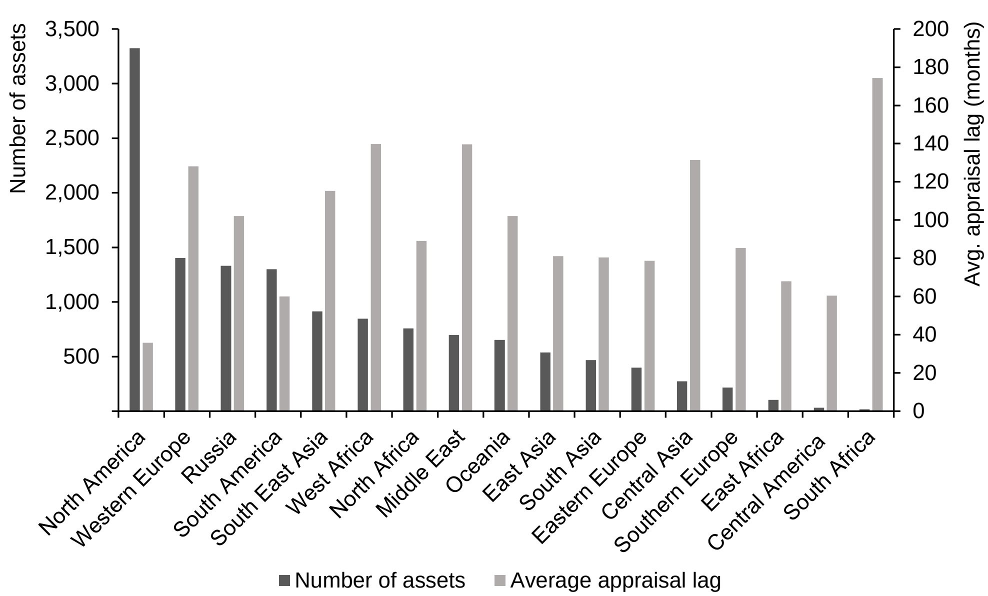


Figure 2. Average appraisal lag and number of assets by region

2.2 Crude Oil Price

The price of crude oil depends on its quality, which differs across producing regions.[6] Brent Crude is a major trading classification of high quality, sweet light crude oil that serves as a major benchmark price for purchases of oil worldwide. The Brent Crude price is used as a proxy for worldwide oil prices in this paper. Other oil price benchmarks are highly correlated with the Brent Crude price.

The Brent Crude price is retrieved from Reuter's EcoWin Pro database and covers the period from 1970 to 2015. For years prior to 1970, we assume the 1970 Brent Crude price. Oil was however not traded actively before the end of the 1970s. Prior to this, prices were based on tariffs set by the Organization of Petroleum Exporting Countries (OPEC). Hence, there are periods spanning several months prior to 1978 over which the price remains constant. The Brent Crude price during the period under study is plotted in Figure 3. Note that several price shocks occurred, the most recent being the oversupply in 2014 and the financial crisis in 2008.

The relevant oil price for the field development decision is the future expected oil price. Price of oil futures contracts are sometimes used as an expected future price. However, oil futures prices are not available for a large part of the period we study. We therefore use the spot price of oil in our analysis. Moreover, Alquist and Kilian (2010) show that an oil futures price is a less accurate predictor than a current spot price. Additionally, they consider the use of long term futures prices and conclude that the low liquidity limits the practical use of these contracts as a predictor of long term spot prices. As the spot price is an adequate predictor of the expected future oil price and is easily obtained, it is often used in practice.

The *Oil price* variable is the real price of oil[7] recorded at a monthly frequency.

[6] Quality is determined based on the gravity and sulphur level of the oil. The American Petroleum Institute provides a gravity measure based on how heavy or light a petroleum liquid is, compared to water: if the gravity is greater than 10, it is lighter and floats on water; if less than 10, it is heavier and sinks. Furthermore, when the total sulfur level in the oil is more than 0.5% the oil is called "sour", and is generally sold at a discount.

[7] Real oil price is obtained by adjusting nominal price for inflation using the approach employed by the US Energy Information Agency in which the price is adjusted with respect to the American Consumer Price Index.

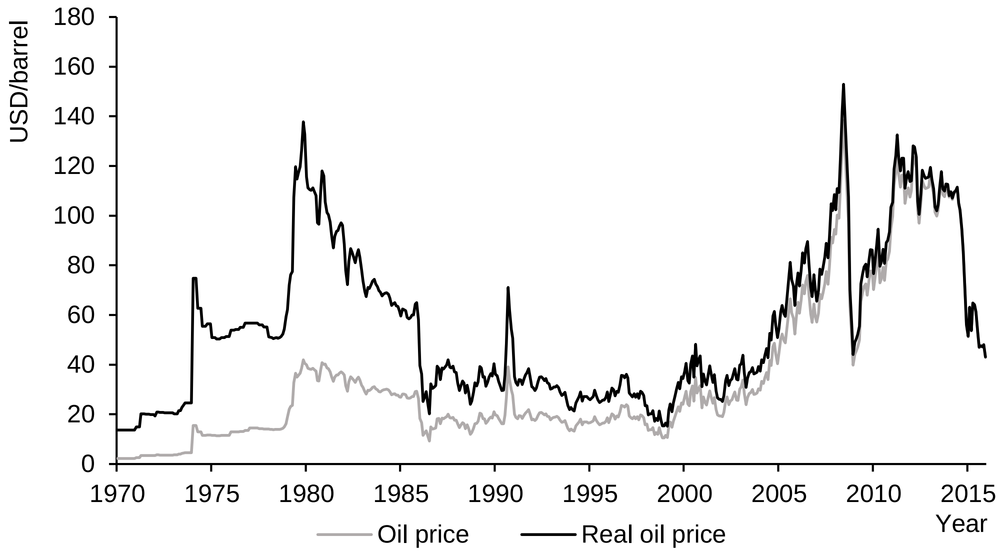


Figure 3. The Brent Crude price

2.3 Country-level data

Our main source of institutional data is The Political Risk Service's International Country Risk Guide (ICRG). The ICRG Political Risk Components are available for 146 countries in total, including 109 of the 115 countries in our study. Different political characteristics of each country are assessed and given a risk rating in which the highest value is awarded to the lowest risk and the lowest value to the highest risk.

To measure the strength of property rights we follow the same approach as Knutsen and Fjelde (2013) in employing the risk components of *Investment Profile* and *Law and Order*. In Investment Profile, factors related to government actors that might affect the risk of an investment are assessed.[8] To measure risk to property rights imposed from other sources than the government we use the Law and Order component. This measure consists of two sub-components: a law component assessing the strength and impartiality of the legal system, and an order component which assesses popular observance of the law. Both sub-components are rated from zero to three, hence Law and Order ranges from zero to six.

To evaluate the effect of political stability, corruption and the risk of conflict, we employ the ICRG components *Government Stability*, *Corruption* and *Internal Conflict*. The variable *Corruption* ranges from zero to six, with zero corresponding to most corrupt country.

Both *Government Stability* and *Internal Conflict* consist of three sub-components scored

[8]The category has three sub-components that each are scored between zero and four, giving a total Investment Profile score ranging from zero to twelve. The three sub-components include risk of expropriation and contract viability, profits repatriation and the risk of payment delays.

between zero and four, giving scales for the total risk components ranging from zero to twelve. Government Stability consists of government unity, legislative strength and popular support. Hence, the risk component assesses both the government's ability to carry out its declared program as well as its ability to stay in office. Internal Conflict consists of civil war, terrorism and political violence, and civil disorder. Ideally, the ICRG component *External Conflict* would have been included in our analysis as well. However, we see it unfit for our purpose, as it records conflict for all part-taking countries including those that take no physical damage. Instead, we supplement our data set with measures of external conflict and political uncertainty from other sources.

Data on war and conflicts is obtained from The Correlations of War Project. We used both the COW War Data v4 database (Sarkees and Wayman, 2011) and Territorial Change v5 (Tir et al., 2015).[9] From this data we created the dummy variable *War*, which equals one only if warfare took place in a respective country in a given year. Hence, we have excluded war participants that did not see significant damage to their country during war.[10] We also include the dummy variable *Loss of territory*, which equals one if a country has been involved as the losing side in a territorial exchange in a given year. We consider both variables to measure risk of conflict.

We employ data on national elections back to 1978 with the same purpose. The data were collected by Julio and Yook (2012) and used in their analysis of the effect of political uncertainty on investment. The data set provides information on election years in 48 countries and covers 40 of the countries in our study. The monthly *Election Year* dummy equals one in all the twelve months preceding an election, and zero otherwise.

Due to the strong dependence of oil and gas extraction on advanced technology and facilities as well as on extensive infrastructure, we seek to account for the degree of development in and wealth of a country by using *GDP per capita*. This macroeconomic data has been compiled from two sources. The Penn World Table (database 7.1) provides data on GDP at purchasing power parity per capita in constant 2005 USD from 1970 until 2010. Data from the World Bank is used to cover the last part of our study period.[11] The data covers 113 out

[9]For observations in 2015 we assume similar values as for 2014, which is the last reported year in most databases. We follow this approach throughout the paper.

[10]For instance, the USA has been recorded as a participant in war in the later years, due to their activity in Iraq. The country has however not suffered physical damages from the war and is therefore excluded with the goal of having the variable capture the effect of war happening within a specific country.

[11]The World Bank provides data from 1990–2014 on purchasing power parity adjusted GDP per capita, in constant 2011 USD. The two databases were merged based on the assumption of a multiplicative relationship between them. The overlapping years (1990–2010) were used to calculate an average ratio between the estimates in the two databases. This ratio was then used to calculate GDP estimates for the four missing years in the Penn World Table, from 2011–2014.

of the 115 countries we consider. We use the logarithmic transformation of GDP per capita because we expect a diminishing marginal impact of the level of this variable.

Financial development variable was obtained from the World Bank's Global Financial Development Database. This database contains various measures of financial development. In this paper, we use the ratio of bank deposits to GDP as a measure of financial development. We choose to use bank deposits to GDP as a measure of financial developement because it is one of the most commonly used measures of financial development (Arestis and Demetriades, 1997; Rajan and Zingales, 2003; Aggarwal et al., 2011) and also because it has the least amount of missing observations for our data sample.

Table 2 provides a data summary for all of the country-specific data, aggregated to the regional level. Table 3 provides summary statistics based on monthly observations for all but the dummy variables. Correlations between country-level variables are presented in Table 13 in the Appendix.

Table 2. Country-level data: regional data summary
The table presents the average value within each region over all years for the four ICRG risk measures and the macroeconomic variables. For War, Loss of Territory and Election, the number of incidents within the region over all years, are given. The dash indicates no available observations.

	ICRG					COW		Elections	Macroeconomics	
Geographical region	**Law and Order**	**Investment Profile**	**Government Stability**	**Control of Corruption**	**Internal Conflict**	**War**	**Loss of Territory**	**Election Year**	**GDP per Capita**	**Financial Development**
Central America	3.00	6.00	7.20	1.92	8.60	12	0	–	11,488	26.82
Central Asia	3.90	8.10	10.10	2.34	9.30	14	2	–	4,347	15.08
East Africa	2.90	5.80	7.00	2.12	6.30	72	1	–	806	21.88
East Asia	4.30	8.20	7.90	2.46	10.70	2	0	19	13,396	37.97
Eastern Europe	4.30	7.40	7.60	2.87	10.60	1	4	21	10,044	29.32
Middle East	3.80	7.30	8.00	2.34	8.20	66	17	16	19,438	30.01
North Africa	3.30	6.70	8.00	2.25	7.50	41	2	–	5,548	46.1
North America	4.70	9.30	8.00	4.63	10.30	0	6	22	23,975	65.43
Oceania	4.80	8.40	7.70	2.07	10.60	4	1	20	17,989	33.18
Russia	3.60	6.10	7.30	2.76	8.50	10	4	5	12,009	19.4
South Africa	3.40	8.10	8.00	3.98	8.50	4	2	7	5,029	49.03
South America	3.10	6.80	7.10	2.76	8.20	17	0	38	7,227	27.49
South Asia	2.70	6.10	6.80	2.35	6.60	52	6	15	1,335	39.68
South East Asia	3.80	7.40	8.00	2.50	9.00	85	2	25	12,576	59.44
Southern Europe	4.20	7.90	7.60	3.17	9.70	11	10	36	14,721	59.8
West Africa	2.30	5.90	7.30	1.84	7.40	86	5	–	2,174	15.11
Western Europe	5.70	9.30	8.00	5.12	11.00	3	17	67	27,929	58.8
Total	3.80	7.30	7.70	3.08	8.90	480	79	291	11,178	39.42

2.4 Company-level data

In order to investigate differences across companies, we perform a sub-analysis of the 29 largest companies in our data set.[12] These companies have been grouped and categorized either as a Major, a national oil company (NOC) or an exploration and production (E&P) company. Majors include the seven largest publicly-traded international petroleum companies

[12]Size measured as the number of assets operated.

Table 3. Country-level data: summary statistics

The table presents summary statistics of the monthly recorded data set for all continuous variables.

Variable	Mean	Median	Standard Deviation	Skewness	Kurtosis	Observations
Law and Order	4.05	4.00	1.45	−0.16	1.99	962,638
Investment Profile	7.57	7.50	2.49	0.03	2.28	962,638
Government Stability	7.85	7.83	2.23	−0.36	2.52	962,638
Control of Corruption	3.18	3.00	1.45	0.29	2.02	962,638
Internal Conflict	9.15	9.00	2.06	−0.88	3.76	962,638
GDP per capita	15,993	11,151	14,317	1.15	4.40	1,143,517
Financial development	41.21	35.9	27.37	1.09	4.39	1,092,518

often referred to as "Big Oil" or "Supermajors", and includes BP, Chevron, ConocoPhillips, Eni, ExxonMobil, Royal Dutch Shell and Total. Eleven companies are categorized as NOCs, all national oil companies fully or majority owned by a national government. Finally, the E&P group is composed of eleven local or international E&P companies. These are smaller companies that primarily focus on oil and gas exploration and production.[13] The three types of companies are likely to have various strategies and goals, and may therefore behave differently in investment decisions. A complete list of all companies included in the three categories is found in Table 11 in the Appendix.

We employ the *Tobin's Q* measure as well as the *Debt to assets ratio*[14] to investigate firm-specific characteristics. Accounting data on the 29 companies is obtained from the Capital IQ database and includes income statements and balance sheets from the years 1990 to 2014. To calculate the Tobin's Q we divide the market value of a company by the book value of company's assets. The market value of the company is the sum of the value of equity and debt. If Tobin's Q is larger than one, firms have an incentive to increase their capital stock, hence invest, because capital once invested is priced higher by the market than its cost. This is usually the case for companies with future potential for growth, hence Tobin's Q is often used as a measure of growth opportunities. The debt to assets ratio is used as an indicator of financial leverage and is calculated by dividing total debt by the total book value of assets, see Table 4.

[13] E&P is a specific sector within the oil and gas industry. Companies operating in this sector focus on finding and producing different types of oil and gas. The sector is often considered to involve high risk and high reward (Deutsche Bank, 2013). In our categorization, the E&P group consists of companies that are not super-majors or national oil companies, but is instead a more heterogeneous group with smaller companies.

[14] Please note that we use the word "asset" with two different meanings. Most of the time it refers to actual areas of land with potential for oil and gas production. However, whenever we talk about debt to asset ratio, we refer to assets as an accounting category. We apologize for any confusion this may cause, but the word asset is commonly used in both of these ways and we do not want to invent our own terminology.

Table 4. Company group data summary

	Number of Companies	Total Number of Assets	Average Tobin's Q	Average Debt/Assets
Majors	7	1,877	1.43	0.18
NOC	11	1,638	1.22	0.19
E&P	11	861	1.39	0.26

Since these measures are calculated from accounting data, they are available only at yearly frequency, at the end of the year. Therefore, employing the value from the previous calendar year would mean that for the January observation we would use the variables from one month prior. This would not be consistent with other variables, for which values from one year ago are employed in the model. For *Tobin's Q* and *Debt to assets ratio* we therefore employ values from the fiscal year two years ago. This means that, on average, these variables are from one and half years ago. However, this choice is actually quite suitable since the *Debt to assets ratio* in particular, but also *Tobin's Q*, might be endogenous with respect to investments. Lagging them by one and half years on average mitigates this problem.

3 Methodology

We use duration analysis to explain the appraisal lag and investigate the impact of various variables on investment decisions. The dependent variable in duration analysis, duration, is assumed to have a continuous probability density function *f(t)*. We denote the associated cumulative distribution function as *F(t)*. The survival function is defined as the probability that the duration will be *at least* t:

$$S(t) = 1 - F(t) = Prob(T \geq t). \tag{1}$$

The Kaplan-Meier estimate of the survival function is specified as

$$\hat{S}(t) = \prod_{j=1}^{k} (\frac{n_j - d_j}{n_j}). \tag{2}$$

The hazard rate is the probability that an object will experience the event of interest at time t conditional on not having experienced the event already. The hazard rate is defined as

$$h(t) = \frac{f(t)}{S(t)}. \tag{3}$$

In our case, hazard rate is the probability that a firm will invest at time t given that it has not yet invested. In order to analyse the effect of different explanatory variables on duration we use the Cox (1972) regression model with several covariates. The model has the following form

$$h(t, x) = h_0(t) e^{x\beta}, \tag{4}$$

where x is a vector of covariates and β is a vector of parameters.

The vector of parameters covers variables of interest which capture stability and macroeconomic conditions at country level and company-specific characteristics (Tobin's Q and Debt/Assets ratio). The link between the hazard rate h and variables of interest is controlled for the influence of other variables such as oil price, fiscal regime, supply segment, and whether oil reserves consist mainly of crude oil or gas. All these variables are discussed in detail in Section 2. The empirical specification also contains country-fixed effects to control for time-invariant unobservable country characteristics.

The issue of possible endogeneity arises in the case of political risks (ICRG variables) as well in economic outcomes (macroeconomic conditions and company characteristics). To mitigate a bias in estimated coefficients $\hat{\beta}$ due to the potential endogeneity of covariates, we use their values lagged by one year. However, we are not able to completely rule out endogeneity issues due to the nature of our data.

We use the procedure suggested by Lin and Wei (1989) to compensate for possible heteroskedasticity in standard errors estimates. The Cox proportional hazard model assumes the hazard ratio to be constant over time. We test this assumption for variables of interest using ph-test. The test does not reject at 5% level the validity of the Cox model's assumption of proportionality. For the sake of brevity we do not report the results of the PH-test in this paper.

4 Results

In this section, our empirical findings are presented and discussed. We begin with nonparametric duration analysis, followed by the estimation of a Cox hazard regression of the baseline model, controlling for field-specific conditions and oil price. The baseline model is then extended to investigate the effect of political risk on investment. Next, we exploit variation in the sensitivity of investment to country-specific characteristics across firm types. Finally, we examine firm characteristics (Tobin's Q and indebtedness) as investment determinants.

4.1 Nonparametric duration analysis

Figure 4 displays the estimated Kaplan-Meier curve. The graph shows the estimated survival rate at each time t, meaning the proportion of discovered fields that are unapproved. The curve begins at 1.00, indicating that none of the discovered fields have been approved. With assets being approved the survival rate decreases as a stepwise function.

Looking at Figure 4 we observe that at time $t = 40$ months, approximately 50% of the assets have been approved. This point is therefore the median of the data set, and its exact value is 37 months. The estimated mean is 86 months, but since the largest observed appraisal lag is censored, the mean is underestimated.

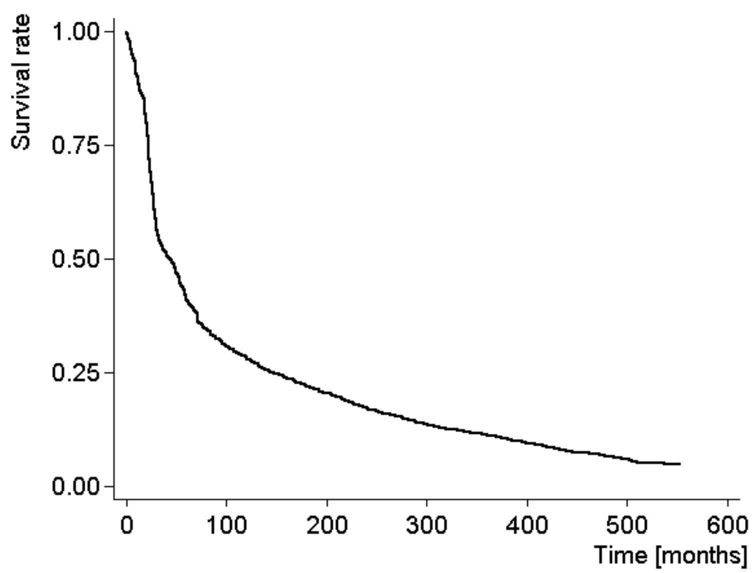
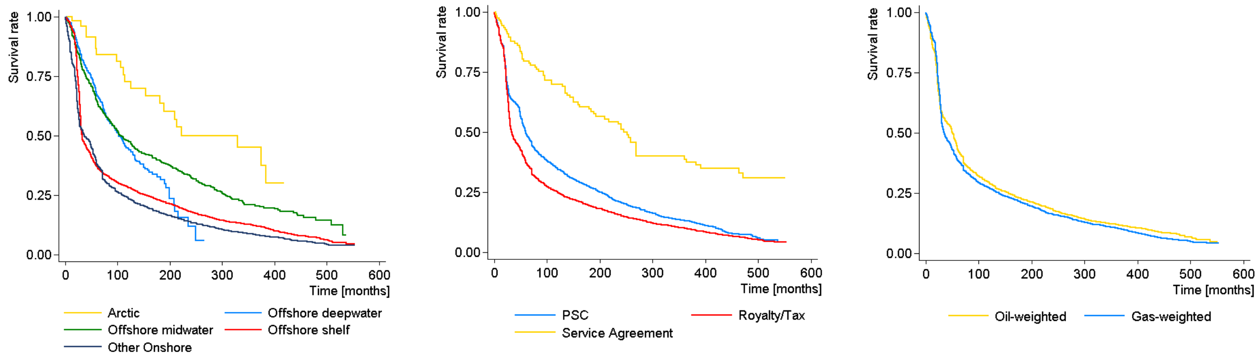


Figure 4. Kaplan-Meier estimate

We include the categorical variables *Supply segment*, *Fiscal regime* and *Oil-weighted* to capture heterogeneity across the oil and gas assets. To compare the survival time of the different categories within these variables, we calculate the Kaplan-Meier estimate for each variable, grouping by these categories. Looking at Figure 5*a*, we observe expected time to approval has been shorter for onshore assets than for offshore assets, and assets located on offshore shelves have been developed quicker than those located in areas defined as offshore midwater, deepwater and arctic. Assets in arctic areas have clearly had the slowest development. The differences in the development period are likely related to how easily oil and gas may be extracted from a reservoir. More inconvenient locations and rougher climate can make oil and gas extraction more difficult. Hence, the extraction of assets in arctic areas likely entail higher risks and larger costs. More advanced and costly technology and possibly new and extensive infrastructure may be needed. This may contribute to explaining the longer development period for these assets.

Figure 5*b* exploits survival rates for the different categories of the Fiscal regime variable. The most common taxation contracts are royalty/tax (concession) and production-sharing contracts (PSC). Under a royalty/tax agreement, an oil and gas company is granted exclusive rights to exploration and production of the concession area. This means that the company owns the oil and gas produced, receives all income from this production, and typically pays royalties and corporate income tax. When using a PSC, an NOC or a host government enters into a contract directly with an oil and gas company, which then finances and carries out all exploration and production operations. To recover its costs, the company receives an amount of the oil or gas, as well as a share of the profits. For the third category, the Service Agreement, a company performs a well-defined job for a host country's national oil company, often with a fixed duration and receiving a fixed fee per barrel, on top of reimbursement of the costs it incurs. Thus, with this agreement, the operating company does not receive any of the oil or gas it produces (Deutsche Bank, 2013).

Oil production in OECD countries and countries with a long history of oil production tend to work on the basis of concessions (e.g. the US, UK, Venezuela and the UAE), whilst those in the developing world tend to be based on PSCs or Service Agreements (Deutsche Bank, 2013). From Figure 5*b*, we observe that Service Agreement is the category with the highest survival rate. This agreement is generally less attractive than most concessions and PSC agreements (Deutsche Bank, 2013). Figure 5*c* exploits the Kaplan-Meier estimate for oil-weighted and gas-weighted assets. We observe that expected time to development is marginally shorter for asset reservoirs for which more than half of the resources is oil. This would be the expected result as oil extraction has historically been more profitable than gas extraction.



(a) Assets split on supply segment

(b) Asset split on fiscal regime in country

(c) Asset split on the categories of the Oil-weighted variable

Figure 5. Kaplan-Meier estimates for categorical variables

Log rank tests on the suggested categorical variables confirm significant differences in duration between the observations falling into the categories of the *Supply segment*, *Fiscal regime* and *Oil-weighted* variables. In other words, the appraisal duration of assets belonging to different supply segment groups differ, as it does for assets subject to different types of fiscal regimes and oil- or gas-weighted assets. For more details on the log rank tests, see Table 12 in the Appendix.

The smoothed hazard estimate is displayed in Figure 6.[15] We limit the plotting range to $t \in [0, 360]$ months as there is not enough data to determine a precise hazard rate beyond this range. The hazard rate is approximately 1.5% at $t = 50$ months and decreases quickly to 0.50% at $t = 100$. After this point it slowly decreases towards 0.3%. From these results we can see that the decision to develop an asset is mostly made within the first 100 months (8 years) after discovery.

[15]Gaussian kernel smoothing with a width of 15 months is used to obtain these results, which requires averaging values over a moving data window. At the endpoints of the plotting range, these windows contain insufficient data for accurate estimation, and so these results are said to contain *boundary bias* and is therefore not plotted in the graph.

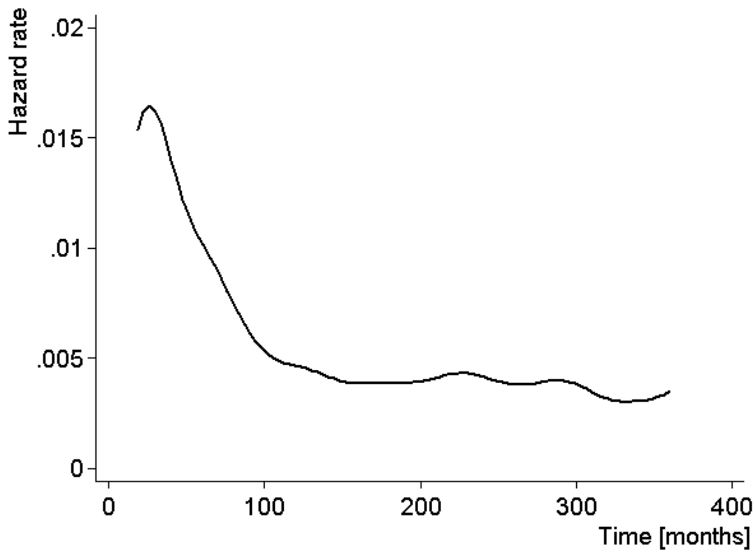


Figure 6. Hazard rate of global oil and gas development data

4.2 Cox hazard regression

4.2.1 Baseline model

First we estimate a baseline model, which includes explanatory variables *Oil price*, *Oil-weighted*, *Fiscal regime*, *Supply segment*, *Past approvals of the same operator* and *Past approvals of other operators*. Variables *Oil price*, *Oil-weighted*, *Fiscal regime*, *Supply segment* capture heterogeneity across the assets in our data set.

Variables *Past approvals of the same operator* and *Past approvals of other operators* are included because there could be a time-dependence between assets developed by the same company or even within the same country by different companies. In other words, the fact that several assets have been developed in the previous period could affect the decision to develop the asset today. History of past developments might also matter because of strategic interactions in investments (Brosch, 2008; Trigeorgis, 1993). The *Past approvals of the same operator* and *Past approvals of other operators* variables are both equal to one if a company/its competitor developed at least one field during the previous 36 months. We also considered other time windows (one year and five years), but the results were very similar.

Unobserved country-specific characteristics are captured by including country-fixed effects.[16] All subsequent models are extensions of this model.

The hazard rates estimated in the baseline model are presented in Table 5. When larger than one, the hazard rate indicates a positive effect of the covariate on the probability of

[16]The reader is referred to the Appendix for a list of these countries.

the subject under study to experience the event of interest. Thus, it indicates an increase in the probability of a shorter appraisal lag and hence in the probability of an oil field being developed. The model indicates a small positive impact of oil price on investment decision.

Interpretation of the hazard rates of the categorical variables differs from that of the continuous variable. For Oil-weighted, Supply segment and Fiscal regime, the first category is used as a reference category. The estimate of the hazard rate given for the other categories is the probability of event occurrence, relative to this reference category. Hence, we observe an increased probability of investment if the reservoir of an asset consists of more than 50% oil compared to those with a lower proportion of oil and correspondingly more gas. We observe that the interpretation of the hazard rate for the service agreement category is counter-intuitive, but note that it should be interpreted with caution due to service agreement assets amounting to less than 1% of total assets. The hazard rate increases when an oil and gas reservoir is located on more shallow ground. The baseline model indicates that onshore assets are almost six times more likely to be developed than assets located in arctic areas.

The *Past approvals of the same operator* variable is highly significant. Oil investments require high investment costs not only in terms of physical capital, but also in terms of understanding local formal and informal rules, possibly building relationship with the local government, etc. It is therefore not surprising that a company is much more likely to invest in a country where it has previously invested. On the other hand, the *Past approvals of other operators* variable does not seem to have significant impact on the expected time to investment.

The results from the literature about strategic interaction in oil exploration are mixed. Lin (2009) concludes that strategic interactions are not present in oil exploration and Lin (2013) find that firms interact strategically with their neighbors only in the few cases where the tract size is small. On the other hand, Levitt (2016) finds that firms' exploration rates are influenced by other firms' outcomes.

However, we should not make too strong of conclusions from the baseline model, as political risks, which are investigated next, may have an impact on the likelihood of investment. Since political risks influence other companies as well, variables capturing political risks might be correlated with past approvals, either a company's own or those of its competitors.

Table 5. Baseline Investment Regression

*This table presents estimates from a Cox hazard regression $h(t,x) = h_0(t)e^{x\beta}$ of the appraisal duration, where x stands for covariates Oil price, Oil-weighted, Fiscal regime, Supply segment. These are our baseline model variables. Country fixed effects are also accounted for. Robust standard errors of the coefficient estimates are given in brackets while *** indicates 1% significance, ** indicates 5% significance and * indicates 10% significance. A dash indicates which category is used as the reference category for a categorical variable.*

		Dependent variable: appraisal lag
		(1)
Oil Price		1.003***
		(0.000)
Oil-weighted	Oil-weighted	–
	Gas-weighted	0.726***
		(0.018)
Fiscal regime	PSC	–
	Royalty/Tax	1.111*
		(0.066)
	Service Agreement	2.235***
		(0.563)
Supply segment	Offshore arctic	–
	Offshore deepwater	1.484**
		(0.273)
	Offshore midwatter	2.239***
		(0.402)
	Offshore shelf	3.199***
		(0.561)
	Onshore	5.520***
		(0.974)
Past approvals of the same operator		1.580***
		(0.040)
Past approvals of other operators		0.974
		(0.042)
Country fixed effects		Yes
No. of observations (monthly)		1,092,518
No. of assets		12,015
No. of approvals		9,588

4.2.2 Cross-country analysis

Table 6 presents the results from extending the baseline model with country characteristic variables to investigate the impact of property rights protection and political stability on the investment decisions of oil and gas companies. Since we study 13,269 assets spread over 115 countries, a large number of the assets will be recorded with the same values for the country-level variables we wish to identify the impact of.

Since all these variables are capturing a country-level risk, although from various perspectives, these variables are quite correlated.[17] Therefore, similarly to Cust and Harding (2017), we test each country-level variable separately with the baseline model. Hazard rate estimates for a cross-country analysis are presented in Table 6.

Model (1) from Table 6 indicates a significant increase in the probability of an oil and gas company deciding to develop a discovered asset, given that the asset is located in a country with a strong and impartial legal system. Interpretation of the hazard rate shows that for a one unit increase in the risk rating of Law and Order, there is an 8.8% increase in the probability of investing from one month to the other.

We investigate the impact of property rights protection in Model (2) by estimating the effect of Investment Profile which captures essential risk factors such as the risk of expropriation and profits repatriation. Our findings indicate a highly significant impact of Investment Profile on the investment decisions of oil and gas companies. Improving the risk rating by one unit would increase the probability of investment by 3.4%. Together, Model (1) and Model (2) provide solid, consistent evidence that solid property rights promote investment in the oil and gas industry. This would be expected for investments in general, and the results are in line with research looking into the effects of property rights on more general measures of investment (e.g. Svensson (1998), Li and Resnick (2003) and Li (2006)). Theoretically, it may be particularly important in the oil and gas industry as this is a highly capital-intensive industry, often requiring large irreversible capital outlays.

Next, we estimate six models to investigate the effect of stability and corruption on oil and gas investment decisions. In Model (3), we find that countries with stable governments are more likely to attract investments to their oil and gas industry, as compared to countries that score lower on factors such as government unity and legislative strength. When improving the risk score of Government Stability, we find investment to be 3.8% more probable.

By estimating Model (4), we examine to what extent oil and gas companies are concerned with the risk of conflict in a respective country. Our findings indicate a significant negative causality from higher risk of internal conflict, including the risk of different types of disputes within the country's borders such as civil war and political violence, to oil and gas investment. The appraisal lag is significantly shortened when decreasing the risk of such conflicts; an improvement in the risk rating is found to increase the probability of investment by 3.4%. This may be explained by elaborating on the risks an investor faces in situations of domestic instability and civil war. Firstly, the profitability of operating in such a country may be reduced due to the possible impairment of domestic sales and exports. Secondly, there is an

[17] The correlation matrix is reported in Table 13 in the Appendix.

increased possibility of disrupted production or of facilities being damaged or destroyed. Also, the value of the currency in the host country is likely to be affected by political instability, which may reduce the value of investments as well as the value of future profits generated. These risks are also increased in situations of conflicts with neighbouring and other countries, which are examined next.

The link with corruption is investigated in Model (5). The estimated hazard rate suggests that lower corruption increases the expected time to development. This result contradicts the estimates for other institutional indicators. However, a more detailed analysis at the company level (see Section 4.2.3) shows that the influence of corruption is not robust and is driven mostly by investments made by E&P companies.

Model (6) and Model (7) provide insights into the impact of external conflicts on investments. Model (6) indicates that incidents of war, which are likely to turn the investment environment into a highly risky one, reduce the probability of investment. The War variable is however not significant at conventional levels. Looking back at Table 2, we observe that only a few incidents of war are recorded during our study period, which is likely to be an important reason why we obtain lower significance for this variable. In estimating Model (7), we obtain the hazard rate estimate of Loss of Territory, which implies that participating in disputes in which land areas are lost, not necessarily war, significantly negatively impacts investment rates. Hence, these findings are consistent with the results in Models (3) through (6), providing further insights into how political instability affect investments as well as robustness to our findings that these effects are negative.

Election Year is the last variable we investigate to analyze political instability and uncertainty effects. The hazard rate of Election Year indicates a smaller probability of oil and gas investments in the periods leading up to an election, which is what we would expect. This variable is however subject to somewhat similar conditions as War and Loss of Territory; the data covers a rather small selection of our countries and only roughly half of the assets are included in the analysis, which might cause the observed insignificance. While Julio and Yook (2012) find evidence that investments in general decrease before an election due to possible policy uncertainty related to the elections, our findings do not provide solid evidence of the manifestation this policy uncertainty in the investments of oil and gas operators. Due to low data coverage and significance, this variable is not included in further analysis.

Model (9) indicates a fairly strong and highly significant impact of GDP per capita on the decision to invest. As GDP per capita is a recognized measure of wealth and development in a country, our findings suggest higher probabilities of oil and gas investments in more developed countries. This is likely due to more developed countries having better infrastructure and other facilities such as high-skilled labor force availability, thereby decreasing the barriers for developing oil and gas fields.

The estimated coefficient of Financial development variable in Model (10) reveals that expected time to development is shorter in more financially-developed countries. However, it is important to note that the magnitude of this impact is economically small. This is not surprising, because financial development is likely to have the strongest impact on smaller companies. Petroleum companies are large companies which can obtain financing more easily than small companies.

All model estimations indicate a significant positive effect of the price of oil on the hazard rate. The estimated coefficients for categorical variables are fairly stable across all specifications, with effects similar to those indicated by the baseline model.[18] The main difference is the significance of the variable Past approvals of other operators. In the baseline model, which does not include any variable capturing political risk, this variable was not significant. The reason for this is that if a company is less likely to invest in a country where other companies have invested, but that all companies are more likely to invest in countries with low political risk, then omitting political risk from the model might preclude detecting the negative impact of investments by competing companies.

4.2.3 Variation in the impact of political risks across company types

Having found that oil and gas investments are systematically higher in countries with solid protection of property rights and a more stable political environment, we now deepen the analysis by investigating variations of this relationship across company types. We perform a sub-analysis of the 29 largest companies in our study, categorized into one of the three groups: Majors, E&P companies and NOCs. As discussed in Section 2.4, these types of companies are likely to have various strategies and goals, hence the sensitivity to the different country characteristics is assumed to vary across the different company types. We expect the most significant differences between the multinational Majors and NOCs due to particularly large differences between these groups. The E&P classification is more heterogeneous and less intuitive in terms of expected effects. The companies investigated in this section are recorded as operators of almost one third of the assets in our data set. Estimates for all models are presented in Table 7. Overall, the baseline variables are stable and indicate similar effects as seen in the cross-country analysis.

[18]Expected time to development is shorter for assets for which more than half of the resource is crude oil. Furthermore, expected time to development for assets located onshore and on an offshore shelf is substantially shorter than for assets in more challenging segments. For more details on the distribution of assets among supply segments, the reader is referred to Table 2.

The empirical findings in Model (1) suggest that Majors are more concerned with the quality of a country's legal system, as compared to the other two company groupings, and particularly compared to NOCs. Improving the risk rating of the Law and Order variable by one unit, makes it 17.3% more probable that a Major will invest from one month to another, while it only suggests a statistically insignificant increase in probability of investing of 3.9% for NOCs.

Further investigation of the impact of property rights protection is provided in Model (2). We find again that Majors are influenced by risks of expropriation and profits repatriation more seriously than NOCs. When increasing the risk rating of the Investment Profile component by one unit, Majors are 6.2% more likely to invest from one month to another. Investment profile does not have a significant impact on E&P companies and NOCs. Since national oil companies are majority owned by the state, they are likely less dependent on political risk and might not follow the same objectives as firms operating by market principles (Pirog, 2007). Together, Model (1) and (2) provide solid evidence that Majors are more concerned with the protection of their property rights when investing, particularly compared to NOCs.

In Model (3), we estimate how sensitive the three company types are to the stability of a country's government when considering whether to invest. We obtain the highest hazard rates for Majors, again indicating they are more sensitive than the other company groups to political risk. When increasing stability of the government by one unit as measured by the ICRG risk rating, Majors are 4.5% more likely to make an investment from one month to the next. While not significant at conventional levels, the model indicates a much smaller impact of Government Stability on NOCs than both other groups. Statistical tests indicate significant differences between the hazard rate of Majors and NOCs, and hence of the difference in sensitivity to Government Stability.

In Model (4) we examine the impact of several investor risks that may be present in situations of civil war and other internal disputes, as discussed in the cross-country analysis. We do not find statistically significant impacts on expected time to investment for either company type.

Estimates with Model (5) provide further insight into the relationship between corruption and investments. Corruption is only significantly linked with the investment decisions of the E&P when lower corruption prolongs the expected time to development. According to Deutsche Bank (2013), companies in the E&P sector tend to seek high-risk high-reward investments. Investing in corrupt countries may present such opportunities. However we treat the link estimated with caution as the E&P sector is internally very heterogeneous.

We investigate the effects on investment of external conflict and territorial disputes in Model (6) and Model (7), estimating the impact of War and Loss of Territory on Majors, E&P companies and NOCs. Together, these models exhibit somewhat ambiguous results. NOCs are estimated to be more sensitive to War than the other two company types, suggesting they are least likely to invest in a country with an ongoing war. As noted earlier, few incidents are recorded for this variable and even fewer are included when performing this sub-analysis. These may be important reasons as to why we do not obtain significant results. We therefore interpret the results indicated by War with caution. Estimated coefficients for Loss of Territory are not significant for either company category.

When it comes to the impact of GDP per capita, see Model (8), the results indicate that multinational companies are most impacted by the level of overall development in a country being considered for investment. However, since the coefficients are not significant for either company type, no conclusion can be drawn.

The effect of financial development on expected time to investment is significant only for NOCs, where the effect is positive. It is important to note that multinational oil and gas companies do not need to obtain financing in the country where they invest. Therefore, the result that only domestic companies are influenced by financial development in the country of investment is intuitive. However, it should again be emphasized that this effect is economically small.

Overall, our empirical findings clearly suggest that Majors are more concerned with property rights protection and political risk, particularly compared to NOCs. We discuss two possible explanations for this. Firstly, Majors may, as multinational companies operating by market principles, be subject to harder competition than NOCs. Secondly, being publicly traded, they may be more reliant on a solid reputation. These factors may contribute to making Majors more risk-averse compared to NOCs and hence more sensitive to political risk when deciding to invest. Specialised E&P companies, typically of smaller size than the other two company types, which could make the decision process simpler and quicker, may have owners willing to take on higher-risk projects. It is however more difficult to provide solid results for this group, as it is more heterogeneous. Our results are in line with the findings of Cust and Harding (2017) in that we find Majors to be generally more risk-averse.

4.2.4 Firm characteristics: Tobin's Q and indebtedness

Our final empirical analysis examines the effect of firm characteristics on the investment decisions of the 29 companies in our data subset. We employ Tobin's Q to estimate the impact of relative firm valuation. We also investigate how indebtedness affects the decision process and employ the ratio of debt to assets for this purpose.

Table 8 presents the results of models incorporating the effect of Tobin's Q. We find in Model (1) that increasing Tobin's Q by one unit makes oil and gas investment approximately 10% more likely from one month to the next. This indicates that oil and gas companies with higher relative valuation are more likely to invest. According to these results, oil and gas companies follow the Q theory of investment. Results from Model (2) and (3) also confirm this relation when accounting for risks related to property rights. The positive impact of Tobin's Q on investment is also confirmed for Models (4) through (8), which capture the effects of political stability and corruption, as well as Model (9), which accounts for the degree of overall development, and Model (9), which accounts for financial development in the host country.

Table 9 presents the results from investigating the impact of firm indebtedness. The estimated hazard ratios of the debt variable indicate, as expected, a decreased investment rate with increasing firm debt. The negative relation between high firm debt and investment is stable across all models. It is important to note that in general, there could be an endogeneity problem between company's investment decisions and company's debt to assets ratio. In particular, financing investments with new debt is not uncommon among companies. However, this particular relation between investment decisions and decisions to borrow money should lead to a positive relation between debt-to-assets ratio and investments. We instead find a negative relationship, and, if this mechanism is biasing our estimates, then the true effect is therefore even stronger than we estimate. Second, as previously mentioned, debt to assets ratio is the ratio from two years ago[19], which should also mitigate the endogeneity problems.

Effects estimated for all political risk measures in the models presented in Table 8 and Table 9 confirm our previous findings that oil and gas companies are highly sensitive to political risks. Hence, in addition to providing evidence of Tobin's Q and debt affecting investment activity in the oil and gas industry, these models confirm the previous findings in this paper.

We consider, in Model (9), the differences in the extent to which the three company types depend on their relative valuation when investing. The results indicate that Tobin's Q is a more important determinant of investment decisions for major multinational companies than for national oil companies. This may be seen as yet another indication of majors being more risk-averse than national oil companies. The impact of Tobin's Q is stable across Model (1) through Model (9), and, altogether, these models provide solid evidence that increasing

[19]More precisely, since we use accounting data from the end of the year, Tobin's Q and debt to assets ratio is on average lagged by 1.5 years.

Tobin's Q makes it more probable that an oil and gas firm will invest.

Next we investigate how the impact of debt to assets ratio and Tobin's Q depends on company type. Results are reported in Table 10. For debt to assets ratio we observe that it is significant for E&P and NOC companies, but not for major multinational oil companies. The explanation for this observation could be that major multinational companies have easy access to international financial markets, can easily obtain financing for any profitable project, and therefore their capital structure has lower impact on their investment decisions.

The previously documented positive impact of Tobin's Q on the expected time to investment is concentrated on Majors and NOC companies, whereas the impact on E&P seems to be negative, but only marginally significant (at 10% significance level).

Table 6. Cross-Country Analysis: Impact of Political Risk

*This table presents estimates from Cox hazard regressions $h(t,x) = h_0(t)e^{x\beta}$ of the appraisal duration, where x stands for political risk measures and the baseline covariates. Robust standard errors of the coefficient estimates are given in brackets while *** indicates 1% significance, ** indicates 5% significance and * indicates 10% significance. A dash indicates which category is used as the reference category for a categorical variable.*

		Dependent variable: appraisal lag									
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Law and Order	Investment Profile	Government Stability	Internal Conflict	Corruption	War	Loss of Territory	Election Year	GDP per Capita	Financial Development
Country characteristics		1.088***	1.034***	1.038***	1.034***	0.958**	0.954	1.025	0.985	1.352***	1.004***
		(0.021)	(0.007)	(0.006)	(0.010)	(0.018)	(0.043)	(0.049)	(0.032)	(0.054)	(0.001)
Oil price		1.005***	1.004***	1.005***	1.005***	1.004***	1.003***	1.003***	1.003***	1.002***	1.003***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Oil-weighted	Oil-weighted	–	–	–	–	–	–	–	–	–	–
	Gas-weighted	0.764***	0.770***	0.762***	0.768***	0.793***	0.726***	0.726***	0.773***	0.720***	0.741***
		(0.021)	(0.021)	(0.021)	(0.021)	(0.022)	(0.018)	(0.018)	(0.023)	(0.018)	(0.020)
Fiscal regime	PSC	–	–	–	–	–	–	–	–	–	
	Royalty/Tax	1.052	1.056	1.053	1.052	1.050	1.110*	1.110*	1.332***	1.083	1.094
		(0.065)	(0.065)	(0.065)	(0.064)	(0.065)	(0.066)	(0.066)	(0.148)	(0.065)	(0.066)
	Service Agreement	2.308***	2.315***	2.361***	2.339***	2.255***	2.245***	2.234***	3.967***	2.251***	4.051***
		(0.556)	(0.558)	(0.569)	(0.563)	(0.541)	(0.565)	(0.563)	(1.621)	(0.563)	(1.171)
Supply segment	Offshore arctic	–	–	–	–	–	–	–	–	–	–
	Offshore deepwater	1.285	1.242	1.229	1.266	1.245	1.484**	1.490**	1.412*	1.376*	1.615**
		(0.255)	(0.246)	(0.243)	(0.251)	(0.248)	(0.273)	(0.274)	(0.263)	(0.252)	(0.338)
	Offshore midwater	2.056***	2.066***	2.018***	2.062***	1.980***	2.239***	2.242***	2.225***	2.168***	2.450***
		(0.397)	(0.399)	(0.390)	(0.399)	(0.384)	(0.402)	(0.402)	(0.404)	(0.387)	(0.504)
	Offshore shelf	2.774***	2.783***	2.719***	2.782***	2.720***	3.201***	3.202***	3.215***	3.159***	3.544***
		(0.526)	(0.528)	(0.516)	(0.529)	(0.518)	(0.562)	(0.561)	(0.569)	(0.551)	(0.715)
	Onshore	4.693***	4.678***	4.596***	4.690***	4.543***	5.518***	5.525***	5.428***	5.386***	6.080***
		(0.889)	(0.886)	(0.871)	(0.891)	(0.865)	(0.973)	(0.975)	(0.967)	(0.944)	(1.236)
Past approvals of the same operator		1.529***	1.530***	1.526***	1.530***	1.505***	1.575***	1.575***	1.560***	1.561***	1.502***
		(0.043)	(0.043)	(0.043)	(0.043)	(0.044)	(0.040)	(0.040)	(0.049)	(0.039)	(0.042)
Past approvals of other operators		0.830***	0.822***	0.821***	0.814***	0.846***	0.955	0.955	0.753***	0.907**	0.915*
		(0.046)	(0.046)	(0.046)	(0.046)	(0.051)	(0.042)	(0.042)	(0.052)	(0.040)	(0.043)
Country fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations (monthly)		904,130	904,130	904,130	904,130	904,130	1,089,719	1,089,719	626,010	1,088,805	832,888
No. of assets		10,062	10,062	10,062	10,062	10,062	11,988	11,988	7,656	11,986	10,118
No. of approvals		7,642	7,642	7,642	7,642	7,642	9,570	9,570	6,355	9,569	7,807

Table 7. Impact of political risk: variation across company types

*This table presents estimates from Cox hazard regressions $h(t,x) = h_0(t)e^{x\beta}$ of the appraisal duration, where x stands for the interaction between political risk measures on country level and company type, as well as the baseline covariates. Robust standard errors of the coefficient estimates are given in brackets while *** indicates 1% significance, ** indicates 5% significance and * indicates 10% significance. A dash indicates which category is used as the reference category for a categorical variable.*

		Dependent variable: appraisal lag								
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Law and Order	Investment Profile	Government Stability	Internal Conflict	Corruption	War	Loss of Territory	GDP per Capita	Financial Development
Country characteristic × Company type	Majors	1.173***	1.062***	1.045**	1.042	0.987	0.989	1.145	1.126	0.999
		(0.058)	(0.019)	(0.020)	(0.027)	(0.048)	(0.143)	(0.226)	(0.150)	(0.003)
	E&P	1.123*	1.025	1.073**	1.026	0.879**	0.816	0.990	1.050	1.000
		(0.075)	(0.025)	(0.032)	(0.037)	(0.054)	(0.153)	(0.242)	(0.157)	(0.003)
	NOC	1.039	0.952*	1.026	1.057	1.002	0.464***	0.991	1.012	1.012**
		(0.066)	(0.028)	(0.033)	(0.042)	(0.064)	(0.117)	(0.396)	(0.127)	(0.005)
Oil Price		1.005***	1.004***	1.005***	1.005***	1.004***	1.004***	1.005***	1.004***	1.004***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Company type	Majors	–	–	–	–	–	–	–	–	–
	E&P	1.785**	1.923***	1.119	1.681	2.261***	1.445***	1.437***	2.844	1.483**
		(0.501)	(0.488)	(0.353)	(0.638)	(0.493)	(0.118)	(0.116)	(2.386)	(0.275)
	NOC	1.455	2.145***	1.030	0.781	0.913	0.913	0.883	2.375	0.587***
		(0.388)	(0.581)	(0.333)	(0.332)	(0.189)	(0.084)	(0.081)	(1.813)	(0.121)
Oil-weighted	Oil-weighted	–	–	–	–	–	–	–	–	–
	Gas-weighted	0.779***	0.786***	0.777***	0.784***	0.791***	0.784***	0.783***	0.785***	0.743***
		(0.043)	(0.044)	(0.043)	(0.044)	(0.044)	(0.044)	(0.043)	(0.044)	(0.045)
Fiscal regime	PSC	–	–	–	–	–	–	–	–	–
	Royalty/Tax	0.825*	0.813*	0.825*	0.822*	0.820*	0.817*	0.824*	0.825*	0.845
		(0.095)	(0.093)	(0.095)	(0.094)	(0.094)	(0.094)	(0.095)	(0.094)	(0.097)
	Service Agreement	2.601	2.654	2.467	2.435	2.275	2.496	2.505	2.454	5.084**
		(1.849)	(1.924)	(1.778)	(1.776)	(1.688)	(1.807)	(1.817)	(1.775)	(3.774)
Supply segment	Offshore arctic	–	–	–	–	–	–	–	–	–
	Offshore deepwater	1.057	0.981	1.024	1.048	1.050	1.053	1.046	1.037	1.465
		(0.323)	(0.301)	(0.317)	(0.322)	(0.326)	(0.323)	(0.321)	(0.318)	(0.599)
	Offshore midwater	1.766*	1.737*	1.753*	1.780*	1.758*	1.764*	1.770*	1.770*	2.504**
		(0.532)	(0.524)	(0.535)	(0.539)	(0.538)	(0.534)	(0.535)	(0.535)	(1.014)
	Offshore shelf	1.983**	1.949**	1.988**	2.015**	2.072**	2.019**	2.006**	1.988**	2.627**
		(0.589)	(0.580)	(0.598)	(0.601)	(0.625)	(0.602)	(0.597)	(0.592)	(1.056)
	Onshore	2.596***	2.515***	2.620***	2.653***	2.678***	2.643***	2.652***	2.619***	3.678***
		(0.778)	(0.755)	(0.795)	(0.799)	(0.816)	(0.796)	(0.798)	(0.788)	(1.483)
Past approvals of the same operator		1.358***	1.353***	1.358***	1.368***	1.334***	1.370***	1.377***	1.371***	1.282***
		(0.096)	(0.095)	(0.096)	(0.096)	(0.095)	(0.096)	(0.096)	(0.097)	(0.098)
Past approvals of other operators		0.938	0.964	0.931	0.948	1.052	0.916	0.944	0.920	0.907
		(0.116)	(0.117)	(0.114)	(0.115)	(0.145)	(0.113)	(0.115)	(0.112)	(0.117)
Country fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations (monthly)		267,802	267,802	267,802	267,802	267,802	267,802	267,802	267,291	236,613
No. of assets		2,979	2,979	2,979	2,979	2,979	2,979	2,979	2,975	2,740
No. of approvals		1,984	1,984	1,984	1,984	1,984	1,984	1,984	1,981	1,796

Table 8. Firm Characteristic: Tobin's Q

*This table presents estimates from Cox hazard regressions $h(t,x) = h_0(t)e^{x\beta}$ of the appraisal duration, where x stands for the Tobin's Q and the baseline covariates (Model 1), also including the country characteristic variables in Model (2) - Model (10). Standard errors of the coefficient estimates are given in brackets. *** indicates 1% significance, ** indicates 5% significance and * indicates 10% significance. A dash indicates which category is used as the reference category for a categorical variable.*

		Dependent variable: appraisal lag									
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Baseline	Law and Order	Investment Profile	Government Stability	Internal Conflict	Corruption	War	Loss of Territory	GDP per Capita	Financial Development
Country characteristics			1.110**	1.034**	1.041***	1.037*	0.967	0.801*	1.123	1.033	1.001
			(0.052)	(0.016)	(0.016)	(0.022)	(0.043)	(0.091)	(0.167)	(0.124)	(0.003)
Tobin's Q		1.114**	1.097*	1.104**	1.077	1.112**	1.095*	1.118**	1.114**	1.114**	1.117**
		(0.055)	(0.055)	(0.055)	(0.055)	(0.055)	(0.055)	(0.055)	(0.055)	(0.055)	(0.058)
Oil Price		1.004***	1.005***	1.004***	1.005***	1.005***	1.004***	1.004***	1.004***	1.004***	1.005***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Oil-weighted	Oil-weighted	–	–	–	–	–	–	–	–	–	–
	Gas-weighted	0.770***	0.768***	0.770***	0.765***	0.768***	0.768***	0.766***	0.770***	0.770***	0.727***
		(0.043)	(0.042)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
Fiscal regime	PSC		–	–	–	–	–	–	–	–	–
	Royalty/Tax	0.785**	0.788**	0.784**	0.792**	0.785**	0.784**	0.783**	0.785**	0.785**	0.804*
		(0.090)	(0.091)	(0.090)	(0.091)	(0.090)	(0.090)	(0.090)	(0.090)	(0.091)	(0.093)
	Service Agreement	3.714*	3.639*	3.827*	3.528*	3.805*	3.837*	3.770*	3.718*	3.698*	8.551***
		(2.606)	(2.555)	(2.682)	(2.481)	(2.669)	(2.691)	(2.646)	(2.608)	(2.594)	(5.966)
Supply segment	Offshore arctic	–	–	–	–	–	–	–	–	–	–
	Offshore deepwater	1.161	1.174	1.140	1.136	1.161	1.132	1.166	1.164	1.163	1.515
		(0.367)	(0.370)	(0.363)	(0.361)	(0.366)	(0.357)	(0.369)	(0.367)	(0.368)	(0.598)
	Offshore midwater	1.953**	1.958**	1.962**	1.938**	1.955**	1.893**	1.960**	1.954**	1.957**	2.610**
		(0.608)	(0.608)	(0.614)	(0.606)	(0.607)	(0.588)	(0.610)	(0.607)	(0.609)	(1.022)
	Offshore shelf	2.262***	2.273***	2.269***	2.249***	2.260***	2.271***	2.273***	2.263***	2.264***	2.748***
		(0.693)	(0.695)	(0.699)	(0.693)	(0.691)	(0.694)	(0.696)	(0.692)	(0.694)	(1.064)
	Onshore	2.905***	2.898***	2.893***	2.862***	2.895***	2.873***	2.907***	2.906***	2.916***	3.725***
		(0.900)	(0.896)	(0.901)	(0.891)	(0.895)	(0.888)	(0.901)	(0.899)	(0.903)	(1.451)
Past approvals of the same operator		1.351***	1.341***	1.349***	1.338***	1.347***	1.312***	1.349***	1.352***	1.354***	1.265***
		(0.093)	(0.093)	(0.093)	(0.093)	(0.093)	(0.092)	(0.093)	(0.093)	(0.094)	(0.092)
Past approvals of other operators		0.965	0.968	0.958	0.954	0.963	1.057	0.958	0.964	0.950	0.928
		(0.118)	(0.120)	(0.117)	(0.117)	(0.118)	(0.145)	(0.118)	(0.118)	(0.117)	(0.118)
Country fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations (monthly)		264,820	264,747	264,747	264,747	264,747	264,747	264,747	264,747	264,236	234,095
No. of assets		2,961	2,959	2,959	2,959	2,959	2,959	2,959	2,959	2,955	2,721
No. of approvals		1,965	1,964	1,964	1,964	1,964	1,964	1,964	1,964	1,961	1,777

Table 9. Firm characteristic: Indebtedness

*This table presents estimates from Cox hazard regressions $h(t,x) = h_0(t)e^{x\beta}$ of the appraisal duration, where x stands for the ratio of debt to assets and the baseline covariates (Model 1), as well as regressions also including the country characteristic variables in Model (2) through Model (10). Robust standard errors of the coefficient estimates are given in brackets while *** indicates 1% significance, ** indicates 5% significance and * indicates 10% significance. A dash indicates which category is used as the reference category for a categorical variable.*

		Dependent variable: appraisal lag									
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Baseline	Law and Order	Investment Profile	Government Stability	Internal Conflict	Corruption	War	Loss of Territory	GDP per Capita	Financial Development
Country characteristic			1.121**	1.030**	1.044***	1.031	0.969	0.718***	1.015	1.120	1.000
			(0.052)	(0.016)	(0.016)	(0.022)	(0.043)	(0.080)	(0.121)	(0.167)	(0.003)
Debt / Assets		0.506**	0.498**	0.549**	0.551**	0.517**	0.576*	0.503**	0.352***	0.510**	0.549*
		(0.145)	(0.143)	(0.160)	(0.159)	(0.148)	(0.167)	(0.144)	(0.096)	(0.147)	(0.169)
Oil price		1.004***	1.004***	1.003***	1.004***	1.004***	1.004***	1.004***	1.003***	1.004***	1.004***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Oil-weighted	Oil-weighted	–	–	–	–	–	–	–	–	–	–
	Gas-weighted	0.772***	0.770***	0.772***	0.767***	0.771***	0.770***	0.768***	0.766***	0.772***	0.726***
		(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.042)	(0.043)	(0.044)
Fiscal regime	PSC	–	–	–	–	–	–	–	–	–	–
	Royalty/Tax	0.778**	0.780**	0.778**	0.782**	0.779**	0.778**	0.777**	0.773**	0.779**	0.799*
		(0.091)	(0.091)	(0.090)	(0.091)	(0.091)	(0.091)	(0.090)	(0.089)	(0.091)	(0.093)
	Service Agreement	3.187*	3.153	3.322*	3.129	3.268*	3.377*	3.223*	2.743	3.170*	7.556***
		(2.226)	(2.205)	(2.319)	(2.193)	(2.284)	(2.239)	(2.255)	(1.919)	(2.214)	(5.241)
Supply segment	Offshore arctic	–	–	–	–	–	–	–	–	–	–
	Offshore deepwater	1.140	1.157	1.122	1.120	1.140	1.114	1.144	1.204	1.142	1.483
		(0.360)	(0.365)	(0.357)	(0.356)	(0.360)	(0.352)	(0.362)	(0.377)	(0.361)	(0.584)
	Offshore midwater	1.960**	1.968**	1.965**	1.943**	1.960**	1.896**	1.966**	1.982**	1.963**	2.602**
		(0.610)	(0.611)	(0.615)	(0.609)	(0.609)	(0.589)	(0.612)	(0.612)	(0.611)	(1.017)
	Offshore shelf	2.300***	2.316***	2.301***	2.283***	2.295***	2.300***	2.309***	2.288***	2.301***	2.777***
		(0.704)	(0.707)	(0.709)	(0.704)	(0.701)	(0.703)	(0.708)	(0.695)	(0.705)	(1.073)
	Onshore	2.847***	2.854***	2.837***	2.822***	2.840***	2.820***	2.848***	2.869***	2.857***	3.636***
		(0.880)	(0.881)	(0.882)	(0.878)	(0.877)	(0.870)	(0.881)	(0.881)	(0.884)	(1.412)
Past approvals of the same operator		1.352***	1.341***	1.349***	1.336***	1.348***	1.314***	1.349***	1.346***	1.355***	1.263***
		(0.094)	(0.093)	(0.094)	(0.093)	(0.094)	(0.093)	(0.094)	(0.093)	(0.094)	(0.093)
Past approvals of other operators		0.964	0.968	0.957	0.952	0.962	1.053	0.957	0.997	0.950	0.926
		(0.118)	(0.120)	(0.117)	(0.116)	(0.118)	(0.144)	(0.117)	(0.121)	(0.116)	(0.118)
Country fixed effects		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations (monthly)		262,694	262,621	262,621	262,621	262,621	262,6211	262,621	262,621	262,110	232,327
No. of assets		2,960	2,958	2,958	2,958	2,958	2,958	2,958	2,958	2,954	2,720
No. of approvals		1,948	1,947	1,947	1,947	1,947	1,947	1,947	1,947	1,944	1,761

Table 10. Company characteristics: Baseline model with interactions

This table presents estimates from Cox hazard regressions $h(t, x) = h_0(t)e^{x\beta}$ of the appraisal duration, where covariates x are listed in the first column of the table. Robust standard errors of the coefficient estimates are given in brackets while $***$ indicates 1% significance, $**$ indicates 5% significance and $*$ indicates 10% significance. A dash indicates which category is used as the reference category for a categorical variable.

Dependent variable: appraisal lag			
		(1)	(2)
		Debt / Assets	Tobin's Q
Company characteristic	Majors	0.586	1.226**
× Company type		(0.252)	(0.115)
	E&P	0.168***	0.836*
		(0.102)	(0.081)
	NOC	0.200***	1.339***
		(0.104)	(0.102)
Oil price		1.004***	1.004***
		(0.001)	(0.001)
Company group	Majors	–	–
	E&P	2.032***	2.379***
		(0.357)	(0.478)
	NOC	1.121	0.866
		(0.164)	(0.164)
Oil-weighted	Oil-weighted	–	–
	Gas-weighted	0.804***	0.818***
		(0.045)	(0.046)
Fiscal regime	PSC	–	–
	Royalty/Tax	0.772**	0.759**
		(0.091)	(0.088)
	Service Agreement	1.907	2.183
		(1.391)	(1.613)
Supply segment	Ofshore arctic	–	
	Offshore deepwatter	1.028	1.053
		(0.315)	(0.324)
	Offshore midwatter	1.753*	1.765*
		(0.529)	(0.535)
	Offshore shelf	2.037**	2.025**
		(0.606)	(0.606)
	Onshore	2.586***	2.682***
		(0.776)	(0.810)
Past approvals of the same operator		1.347***	1.355***
		(0.094)	(0.095)
Past approvals of other operators		0.952	0.953
		(0.118)	(0.118)
Country fixed effects		Yes	Yes
No. of assets		2,960	2,961
No. of observations (monthly)		262,694	264,820
No. of approvals		1,948	1,965

5 Conclusion

This paper analyzes a unique micro-level dataset addressing the investment decisions of oil and gas companies around the world. In particular, we study the expected time to development for oil fields where petroleum companies have found oil or natural gas.

We document that oil and gas investments are sensitive to the conditions in the countries where they invest, in particular to political risk. The protection of property rights and the political stability in a host country increase the probability of investment. A one-unit increase in the Law and Order rating (scaled zero to six) and in the Investment Profile rating (scaled zero to four) increases the probability of oil and gas investment by 8.8% and 3.4%, respectively. Oil and gas investments are also significantly affected by government stability, within-border conflicts, and external conflicts, altogether documenting a negative impact of political risk on investment. Financial development has a positive impact on oil and gas investment, but the magnitude of this effect is much smaller than the effect of political risk.

We also examine variation in the impact of these variables across company types, focusing on the differences between major international companies and domestic national companies. We find particularly large differences in the sensitivity to property rights protection. When increasing the risk score of Law and Order by one unit, major multinational companies are 17.3% more likely to invest, while there is no observed significant impact on the investment decisions of national oil companies. Considering Investment Profile, we find that majors are 6.2% more likely to invest when the risk measure increases by one unit. Interestingly, this variable indicates that national oil companies are more likely to invest in circumstances of less secure property rights. Since state controls national oil companies, they are likely less dependent on political risks and might not follow the same objectives as firms operating by market principles. Overall, we conclude that major multinational companies are more sensitive to political risk when investing, as compared to the other two company types studied. This is in line with the findings in Cust and Harding (2017).

We find opposite results for financial development. National oil companies are more likely to invest in countries with more developed financial systems, whereas financial development does not impact multinational oil and gas companies. Multinational companies have better access to international financial markets and they should be therefore less affected by local financial development.

Firm characteristics also affect investment decisions. The expected time to investment is shorter for oil and gas companies with higher relative valuation (Tobin's Q) and those with lower debt.

Lastly, we also find that companies are more likely to invest in countries in which they have previously invested and are less likely to invest in countries in which their competitors have previously invested. The impact of a company's past investments is very strong and robust, whereas the impact of competitors' past investments is weaker and less robust.

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6 Appendix

Country sample

Afghanistan, Albania, Algeria, Angola, Argentina, Australia, Austria, Azerbaijan, Bangladesh, Barbados, Belarus, Belize, Bolivia, Brazil, Brunei, Bulgaria, Cambodia, Cameroon, Canada, Chad, Chile, China, Colombia, Congo, Cote d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Democratic Republic of Congo, Denmark, Ecuador, Egypt, Equatorial Guinea, Ethiopia, Falkland Islands, France, French Guiana, Gabon, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Guyana, Hungary, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyzstan, Liberia, Libya, Lithuania, Malaysia, Mauritania, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Netherlands, New Zealand, Niger, Nigeria, Norway, Oman, Pakistan, Papua New Guinea, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Senegal, Serbia, Sierra Leone, Slovakia, Somalia, South Africa, South Korea, South Sudan, Spain, Sudan, Syria, Taiwan, Tajikistan, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, United Arab Emirates, Uganda, Ukraine, United Kingdom, United States, Uzbekistan, Venezuela, Vietnam, Yemen

Table 11. *Categorization of the 29 companies in our data subset into three company types: national oil companies (NOC), major multinational companies (Majors) and exploration and production companies (E&P).*

Majors	**NOC**	**E&P**
BP	CNOOC	Anadarko
Chevron	Gazprom	BG
ConocoPhillips	MOL	Gazprom Neft
Eni	OMV	Hess
ExxonMobil	ONCG	Lukoil
Royal Dutch Shell	Pertamina	Noble Energy
Total	Petrobras	Repsol
	PetroChina	Stone Energy
	Sinopec	Vermillion Energy
	Statoil	W&T Offshore
	YPF	Woodside

Table 12. *Results from log-rank tests on the categorical variables we employ.*

Variable	P-value	Categories
Supply segment	*0.000*	Arctic Offshore deepwater Offshore midwater Offshore shelf Onshore
Fiscal regime	*0.000*	PSC Royalty/Tax Service Agreement
Oil-weighted	*0.002*	Oil-weighted Gas-weighted

Table 13. Correlation between country-level variables.

	Law and Order	Investment Profile	Government Stability	Corruption	Internal Conflict	War	Loss of Territory	Election Year	GDP per Capita
Law and Order	1.000								
Investment Profile	0.426	1.000							
Government Stability	0.298	0.487	1.000						
Corruption	0.614	0.238	−0.011	1.000					
Internal Conflict	0.682	0.417	0.393	0.434	1.000				
War	−0.209	−0.210	−0.145	−0.125	−0.368	1.000			
Loss of Territory	−0.004	−0.041	0.000	0.003	−0.030	0.030	1.000		
Election Year	0.050	0.003	0.004	0.046	0.037	0.012	−0.013	1.000	
GDP per Capita	0.562	0.500	0.178	0.434	0.408	−0.171	0.015	0.047	1.000