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Taking Control of the Upstream

A Quantitative Study of the effect of Oil Price Shocks on Ownership and Control Structures in Petroleum

Master's thesis in Political Science

Trondheim, December 2015

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Abstract

Why do some states opt for increased control over their natural resources? What makes state leaders change petroleum policy, and what makes state ownership and control over petroleum a viable option for some, but not others? This thesis uses an established typology of petroleum ownership and control in order to look at variations over time. The period of study is 1960-2010, with a focus on petroleum-exporting states, and I use a longitudinal data set on the evolution of ownership models to pinpoint determinants to both what causes the variation, and what makes the states' models change over time. To make inferences, I employ both multinomial and regular logistic regression with random effects. The empirical evidence presented in the thesis shows that: 1) Oil price shocks makes it more likely for states to transition towards a model of state ownership; and that 2) these transitions are more likely to take place in "waves", when a similar transition has happened in other countries previously. However, assumptions regarding the effect of regime types and democracy, based on previous studies on related subjects, are refuted. Altogether, the findings are consistent but not very robust: The results may be biased because of problems with rare-event data and lack of variation in the outcome variable. However, the implications from the empirical results mostly fit with the existing scholarship on the subject of petroleum policy as well as ownership and control.

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«How is it we have so much information, but know so little?»

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Chapter 1: Introduction

State sovereignty over natural resources has been a common theme throughout the age of petroleum, and has become the default option among oil producing countries. Here, oil is the most obvious exception to the international rules of globalized trade and investment, and an outlier in an otherwise liberal (for the most part) international economy. These governments have effectively set up uncompetitive monopolies in their own backyards, often barring investment or outright banning international companies from entering. However, this has not been the case since the beginning: Early ventures into petroleum gave rise to the concessionary system, which allowed international oil companies to control the resources. State ownership only truly began to unfold in the last five decades.

The first national oil company, *Petroleos Mexicanos*, saw the light of day in 1938, following the expropriation of all foreign and domestic oil companies and their assets in the country (Mexico). Unhappy with the unjust treatment by the hands of the international oil majors, the Mexican authorities chose to take control of their resources by themselves. Since then, state-controlled oil has made empires and political billionaires built by dictators and state leaders: Saddam Hussein nationalized the Iraqi national oil industry that today is the world's fifth largest; states such as Russia and Venezuela have gone through waves of resource nationalism that have strongly increased their economic gains, fortifying the importance of petroleum revenue in their economies while simultaneously making the economic environment less inviting for international oil companies, occasionally keeping private actors out entirely.

Many petroleum-producing states wish to maintain a stronghold on the upstream resource sector on their land. Rather than leave the technical and commercial elements of the business in the hands of private oil companies, states will instead participate themselves, often through state-owned companies that have been termed national oil companies (NOCs). The alternative, which is to gather revenue through measures like taxation, and to control the direction of the sector through regulatory institutions and resource law, is widely considered to be preferable from the viewpoint of economists and the viewpoint of private actors, but has lost ground in later years.

While heavy privatization trends in other sectors of the economy have occurred worldwide in recent years, the oil and gas sector have yet to experience a similar trend, and seems to avoid it altogether. States are easily the dominant actors in the petroleum scene, controlling at least 73 percent of the total global oil reserves available (Victor *et al.* 2012).

Meanwhile, even with the drop in oil price and the oversaturation in the petroleum market as of 2015, many new states have entered the sector with the same intention as the existing players: Maximizing revenue from their own natural resources, while potentially maintaining political control over the sector. Many of these countries have as of 2014 yet to choose a style of ownership to go along with their growing petroleum sector: Ghana, Kenya and the Ivory Coast from the African continent and Suriname and Guyana from South America are a few examples of states in the midst of choosing and implementing institutional, juridical and economic frameworks for petroleum (Mahdavi 2014: 239). Meanwhile, hydrocarbon resources are still being discovered and developed, and countries like Liberia developed a petroleum regulatory framework and established a national oil company withholding mandatory shares even before the resources themselves were fully developed (Temple & Desgranges 2014: 113). Whether or not they will pick an ownership model with a state that has control over such elements as development, production and refinement, and what factors will be decisive in explaining this, will be an important question in the future. Likewise, the current position of “state oil” and the development of the position of the international oil companies in an ever-changing environment is also important. Considering the position that states and their national oil companies have in the present day petroleum market, this question is of great importance to the evolution of the sector in the future.

State-owned oil production tools and institutions is more or less the norm today: Only the US and Canada are the exceptions. *State-controlled* oil production also has a strong presence historically, a presence that has grown in later years. However, it is usually associated with a lesser performance than private actors. There are two aspects to this. First, the petroleum market is somewhat uncertain by itself, with significant capital required for relatively uncertain investment, coupled with a volatile price uncertainty. Ultimately, a petroleum structure like this involves taking potentially huge risks in exchange for potentially huge rewards. If the state wants

to play along in this business, it adds political factors to the mix. More specifically, a strong link between big business and the ruling elites of a state means that the state-owned companies working in the sector not only need to strive towards economic goals but may also work to fulfill political goals. This is affecting the investment decisions that these companies make. It also might result in a commercial environment controlled by politicians and bureaucrats with less experience than private counterparts, but with the political and competitive advantages that come with being a state-owned company (Bremmer 2009). Much of the previous research on state-owned oil performance suggests that national oil companies perform much worse than similar, privately owned companies (Wolf 2009, Victor 2007). While economically rational wisdom would suggest that states choose the form of ownership that maximizes the economic benefit from the resources they have available, the popularity of state-owned oil companies says otherwise. The persistence of state oil companies and state control over resources is somewhat contradictory in this sense.

Second, state-owned oil has traditionally been associated with the presence of the resource curse to a much greater degree. The resource curse literature is a branch of research that suggests a strong negative effect of hydrocarbon resources upon the host economy: Stagnation and increasing corruption that is frequently present in oil exporting countries, is particularly prevalent in the types of countries where the petroleum sector has been nationalized, or otherwise is controlled by the state (Ross 2000, Luong & Weinthal 2010, Karl 1997). The result has more often than not been an increase in authoritarian tendencies, corruption, fiscal depression, unbalanced economic growth and/or an unstable state. This view has been so prevalent in the literature that the assumption of a curse is almost regarded as a universal truth (Luong & Weinthal 2010: 1) and especially so in the types of states where the authorities is strongly involved in the petroleum sector.

Regardless, the growth of "state oil" has not shown any sign of stopping. A question that arises is why many states choose to maintain ownership of their petroleum production assets when the vast majority of scholars, as well as the tangible economic revenue gained from these resources, all point towards the superiority of private companies? Furthermore, while privatization of petroleum sectors previously held by states has occurred, it is less frequent. What makes these

states change their tactics and go for private ownership instead? Pinpointing possible determinants for states and their leaders choosing state ownership and control instead of private ownership is the main ambition of this thesis.

1.1 The research question

My contribution to the literature is to test previous research on upstream petroleum ownership structures, across time and with different data material than the rest of the scholarship. Little attention has been given to the difference between ownership and control in the rest of the scholarship: I seek to remedy this shortcoming. A different dependent variable than most of the existing literature is used, which adds variations in ownership between state and private, as well as differences in control between different petroleum exporters. The variable used is designed to measure intention from state leaders to change petroleum governance structure, through creation of legislation or similar. This is different from most studies, which use actual presence of ownership structure (such as presence of NOC or similar governance arrangements). In short, this allows me to analyze the timing of when state leaders choose to change their ownership and control structure, and assess the independent variables at this point in time to find pinpoint possible determinants. The ultimate goal is to find out if the probability of petroleum governance policy changes can be determined by the national and international economic and political context.

Measuring ownership and control change using NOCs could be argued to be a logical step, seeing as NOC establishment is used as a nationalization proxy in previous studies. However, as I will show, this is a less precise approach because the establishment of an NOC does not necessarily correlate with the establishment of state control. For instance, NOCs can be established before the international oil companies are actually expropriated, or before the industry is formally nationalized. Furthermore, the establishment of NOCs does not mean that the country has full control over the sector, and control does not necessarily imply full ownership (Warsaw 2012). Also, the creation of an NOC is a one-time only event: Once an NOC has been created, it is unlikely that it will disappear in the event of a privatization, and it will not be

created a second time¹. A categorical variable that distinguishes between state ownership with and without control allows for ownership as well as control to be observed.

The main independent variable used in the thesis will be shocks in the oil prices. Price shocks refers to a sudden rise or drop in the price of crude oil, likely to break the current trend of price: The "size" of the shock is determined by the size of the gap between expected prices according to the trend, and the actual price: i.e the error of estimation. One typical aspect of the petroleum sector is that there are very high *potential* returns, but also very unstable price levels: There are also potentially huge losses involved. Ultimately I wish to explore the relationship between price levels, more specifically price shocks, and the presence of state ownership and control structures. The idea that oil prices have an effect on policy, strategy and ultimately the emergence of institutions in petroleum is well established, with arguments indicating that large economic returns make it easier for states to control as well as make sure that the most of the gains fall back to the state, or that high oil prices give the states the upper hand in the bargaining with private companies, leading to a shift in the power structure of the state-company bargain mechanism. Meanwhile, price shocks have previously been connected to the emergence of NOCs as well as increased expropriation of private oil assets (Guriev *et. al* 2009, Mahdavi 2014). This will be elaborated upon in the next chapter as well.

To make my argument, I argue that the presence of an NOC, while itself can be an indicator of state ownership with control, is not necessary for the latter to take place, and therefore insufficient to capture changes in ownership and control structure. However, incentives towards creating an NOC, as well as incentives to expropriate, are related to an increase in state control while not the entirely similar phenomena (Sarbu 2014). I therefore wish to move the focus away from the existence of NOCs to the nature of the ownership structure. However, the literature on NOC creation is relevant to my hypotheses, so this will be used alongside the literature on petroleum nationalization and expropriation to find determinants as well as possible control variables on ownership and control structures. Ultimately, the theoretical bottom line is that

¹ This is unless the country has more than one NOC, as is the case in China. However, more than one NOC does not necessarily entitle a change of policy towards increased control in the same manner as the first NOC creation, and more than one NOC happens infrequently, anyway.

states and state leaders are affected by both international and domestic circumstances that help shape goals and expectations; and ultimately, policy and institution strategy.

The focus on NOCs in the literature is not without its problems. One such problem is the usage of “national oil company”, and the lack of consistency between the companies that share this designation. The use of this terminology and its position in the literature fails to separate distinctly different types of NOCs, with differences including, but not limited to operatorship, financial strength and privatization of assets. Direct comparisons between NOCs have been shown to be difficult. In a descriptive study of the NOC members of the Organization of Petroleum Exporting Countries (OPEC), one author considers the various companies to be “as diverse as the member countries themselves” (Hartshorn 2011: 165). Some NOCs have regulatory objectives exclusively; some serve as development agencies and others yet are administrators for state participation as operators (Nolan & Thurber 2010: 20). The only real criterion that is shared between all NOCs in theory is some degree of state control. In short, the role of an NOC is defined by the state and will vary widely according to the goals and ambitions of its leaders. Although some attempts at making some generalized categories of NOC types have been made, this thesis will not make such an attempt².

The outcome of interest in this thesis will be changes in ownership and control structures over time. To operationalize this, I propose a revised measure from Luong and Weinthal (2010) in order to capture the difference between state and private ownership, as well as state and private control. The variable used to measure this has three observable categories: 1) Private ownership, 2) State ownership without control, and 3) State ownership with control. Ownership is determined by whether state-owned or private actors enjoy a majority share of a country's petroleum assets; Control is related to development and operatorship in the sector, which may or may not be fully controlled by the state. The differences between the categories will be further elaborated on in the theory section of chapter 2.

² Most of these typologies have been concentrated on the NOC at the firm level. For instance, PFC Energy proposed a five-category generalization that seeks to map out the differences in the competition they face, their business profile and the degree of commercial orientation (PFC Energy, as cited in Sarbu 2014: 34). This thesis will instead concentrate on the state level, which makes typologies less useful.

Observing changes between these three categories will be measured through a binary variable applied to a panel data set of countries across years, where a given change in ownership structure will be assigned as value one, whereas all other country-years will be given a zero. This will allow me to observe changes in both directions, towards increased state control, or the opposite, increasing private control. Unlike other studies that have been performed on nationalization, this variable also allows for more than one observed change per unit of observation, i.e. country. This means that once a country has changed its ownership structure for instance towards state ownership without control, there are three possible outcomes: 1) It may uphold this ownership structure; 2) It may further nationalize its oil sector and create state ownership with control; or 3) It could turn around and instead re-privatize back to the original structure. This use of ownership and control structures is similar to the study performed by Bianca Sarbu (2014) and Luong and Weinthal (2010), the latter of which the data material originates from. Unlike Sarbu, I propose that ownership and control structures can be measured as a dichotomous variable, as opposed to a continuous variable.

To measure oil shock, I use a formula originally developed by Guriev, Kolotilin and Sonin (2011), which can be applied to the price levels to pick up large deviations from the predicted trend, in order to measure price shocks. This approach will measure both positive and negative shocks. The data that is covered goes from 1960-2010. This is limited for two reasons: Before 1960, international oil companies dominated the activity worldwide. This period in time accounts for the turning point of the balance of power between IOCs and governments, around the early 1970s. The early 1950s saw the renegotiation of concessionary agreements in favor of host governments, and the 1960s saw the IOCs increasingly losing ground in the battle for control against the government³. Therefore, this is the most relevant object of study when looking for state ownership structures. A second reason it to limit the scope of the data to a manageable size while still maintaining a large-N data set.

1.2 Hypotheses

³ This period also accounts for the creation of OPEC (1960), which is considered a major turning point, setting precedence for state sovereignty and control of petroleum resources worldwide.

Following from the assumptions laid out in the introduction, it is hypothesized that the changes of state ownership and control policy takes place once significant economic gains are possible. I therefore posit that state control is more likely once the international price level of petroleum is high. I further suggests that changes in ownership, from private to state, will be more likely to happen following a sudden price shock. The focus will be on oil-*producing* countries as these countries are the most likely to achieve the level of rent from petroleum of such significance that the price levels will have an effect. Furthermore, the thesis will look into ownership and control in the upstream sector, as this is the sector where revenue towards companies and exporting countries is highest (Sarbu 2014) and likely most vulnerable to oil price shocks.

From this we can derive the main testable hypothesis of the thesis: A) *Oil-producing states will be more likely to change their petroleum ownership structure to state ownership following oil price shocks.*

A couple of remarks are in order to elaborate on this. First, oil-producing states only include domestic upstream oil producers. This does not account for whether the states are oil exporters or self-sufficient, this is unnecessary. Second, changes in state ownership and control structures are a result of a policy change, which is the result of state leadership decisions and ambition. The hypothesis follows from the argument that changes in ownership and control structure happen because the amount of perceived revenue gained from the resources is what ultimately decides whether states will choose a public or a private form of resource policy. The choice of policy is therefore an immediate reaction to the price level.

Two more outcomes are possible that are not accounted for in hypothesis A. There is little attention in the scholarship dedicated to why states might choose state ownership without control. While the debate about the dynamics between ownership and control in state owned corporations are well documented (Guriev *et al.* 2009), there has been very little attention dedicated to this in petroleum (Sarbu 2014). The most recent work on this is in *Ownership and Control of Oil* by Bianca Sarbu (2014): Her findings indicate that the oil price does not have any significant effect on control structures. She does not account for the potential effect of shocks. However, she does find that control increases in non-authoritarian states, i.e states with more

political control structures in place. Hypothesis B will therefore follow this argument and posit that authoritarian regimes will be less likely to choose state ownership with control.

This gives us the second hypothesis: B) *Democratic or non-authoritarian oil-producers will be less likely to develop state ownership with control.*

If states that experience periods with price shocks will be more likely to change their ownership and control form, then it is likely that the opposite can be observed as well. Once the oil price falls, governments will be hard pressed to keep their activity in the sector going, especially if it is no longer profitable to do so. However, there is little reason to expect that state ownership structures, which can be assumed to be fairly static, change as frequently as oil price levels do. What can be expected, however, is that the timing of these relatively rare events can be predicted by comparing them with unexpected changes in oil prices, or price shocks.

Measuring variation in ownership will be done by observing a set of oil producing states at a time of a certain price level, and controlling whether a major positive shift in the price level is followed by states shifting from one model of ownership to another, in the direction of increased state control. This allows controlling for not only the direction of change in ownership model (one can assume that a negative shift in price levels may express itself in a similar form, albeit in the direction of more private control), but also pinpointing if any certain form of ownership manifests through a certain international price climate. There are two observable forms of state ownership, which reflects the possibility that control may lie with the private companies. The third observable structure is private control, which includes both domestic and international firms⁴.

Similar to hypothesis A, this proposition not only implies that nationalizations will occur less frequently with a major negative shift in price levels, but that the ownership models of most states will tend towards the other side of the scale: towards private ownership. For states that

⁴ Luong and Weinhalt's original typology (2010) separates domestic private and foreign private firms. I use them both as private ownership, for the sake of parsimony: This also avoids the problem of domestic private ownership being much less frequent, with only two oil-producers falling into the category from 1960-2010. This is elaborated upon in chapter 3.

originally had state ownership with control, this may materialize through the development of state ownership, but without control. There is little research suggesting that this is the case, though Warshaw (2012) mentions this as a possibility, along with the suggestion that the opposite may also be the case: Countries privatizing their oil sector when prices are *high*, when they can get a higher price for their NOCs. Therefore the opposite effect, i.e that negative oil price shocks can increase the probability of changes toward private ownership, will also be tested.

I will proceed as follows. In the following section I will discuss previous literature on the subjects of petroleum nationalization, national oil companies and state-owned oil. I then explain the theoretical assumptions that lay the ground for the framework that creates my hypotheses. In section 3 follows a discussion of the data material and the research design along with a discussion of methods choices. Section 4 lays out the primary findings from this research, with section 5 discussing these findings in detail. Finally, section 6 includes possible shortcomings and further possibilities in this realm of research, along with concluding remarks.

1.3 Literature review

There is a well-developed literature seeking to explain such elements as state ownership policy and state-owned enterprises in the petroleum sector. However, little of this is dedicated to ownership and *control* structures. The difference therein lies in whether the states that produce have absolute monopolies over the oil production, which may or may not be the case. To illuminate this in the lack of research on ownership and control structures, these monopolies are a useful point of departure, because of the rich scholarship dedicated to nationalization of petroleum. This research can be divided into three different branches of research: 1) the NOC literature; 2) the nationalization and expropriation literature; and 3) the resource curse literature (Sarbu 2014). While all three can be separately discussed, this may be a difficult task, as they are highly interrelated. In truth, ownership structure is related to all three of these branches of literature. In this section, I summarize the different literatures and what kind of explanations they suggest for variation in ownership.

The *NOC* literature takes ownership structure as a constant and has sought to explain its effect on NOC economic performance. Why NOCs are created, however, are mostly neglected because of their close relation to the nationalization/expropriation literature, and thus has limited relevance to my thesis. However, the NOC literature does map out the historical role and relevance of NOCs, which helps determine why NOCs exist (and thus why oil producers seek increased control over their resources). The *resource curse* scholars, on the other hand, have only associated with the theory of ownership structures recently: Luong and Weinthal (2010) and Sarbu (2014) have sought to explain how ownership and control structures can explain the outbreak of the resource curse, as well as bring such structures into the wider context of the resource curse literature. Finally, the *nationalization and expropriation* literature is the most relevant in this thesis, because it treats changes in ownership (that is a change towards state *monopolies*) as a dependent variable. In short, this research branch examines why countries choose to nationalize. According to Sarbu, nationalization is entirely different, because “while nationalization involves coercion and it is seen as an involuntary divestment, increase in control may be associated with a market-based transaction”, and that “nationalization have a disruptive character for foreign direct investments” (2014: 13).

As previously mentioned, I use the framework developed by Bianca Sarbu in *Ownership and Control* (2014) to argue that the variation (and change) that is observable in petroleum ownership and control can be explained through all three scholarships: Creation of NOCs, nationalization/expropriation and ownership/control. Sarbu uses elements from all three branches of the literature to examine the variation. I argue that the literature on all three of these actions can help to illuminate the research question: What makes state leaders choose state ownership and control over private ownership and control, and what drives them to change it?

1.3.1 Nationalization/expropriation literature

The most frequently applied determinant for explaining variation in ownership and control is economic, and numerous scholars have argued that the level of the global oil price has an effect on the variation of ownership structures in petroleum-exporting states. The primary incentive for oil exporters to own the production in the sector through the state apparatus is to increase its

direct short-term economic benefit from the resources. Early research on nationalization in the realm of energy includes Kobrin (1980) and Guriev, Kolotilin and Sonin (2011), the latter who suggests that nationalization and expropriation of petroleum is more likely to occur in periods of high oil prices, more specifically following oil price shocks. These findings are present even when controlling for country-specific effects, as well as the total GDP and possible changes in government structure, such as regime changes. Their study also estimates controls for various spurious causes of both nationalization and oil shocks, such as the Yom Kippur war and subsequent oil embargos in the Middle East – where similar results are found. The causal argument laid out suggests that nationalization happens following oil shocks because of the possibilities of increased short or medium-term revenues for the state in this period. Nationalizing the oil sector allows states to potentially collect all the profits from resource extraction, rather than having to split its shares with private operators such as IOCs. Once the prices are high enough, the potential costs of nationalizing will ultimately be outweighed by the benefits of revenue maximization. If the nationalization process also includes expropriation of foreign assets, it involves transferring output and physical assets from private companies to the state, giving leaders a large economic windfall that is likely to be larger with higher oil prices. In the literature, evidence points to a correlation between the number of expropriations and oil prices (Guriev *et al.* 2011, Duncan 2006), and state ownership are observed more frequently in periods where the oil prices are high (Luong & Weinthal 2010).

Scholars have also found that public sentiments and perceived ownership rights (a form of "resource nationalism") may provoke nationalization. Nationalization may take place in order to increase national pride, which may strengthen the position of the leadership in that country (Warshaw 2012). This type of nationalism has been coined "legacy nationalism" (Bremmer & Johnston 2009) or "business nationalism" (Domínguez 1982) by the scholarship. While not explicitly related to economic gains, this type of nationalization is ultimately the result of state leaders attempting to retain power through increased autonomy over the resources. If the leadership has control over the development of the resources, it gives them the ability to channel the income into political goals that are favored by the public, ensuring investment in domestic channels such as welfare projects, subsidizing domestic prices, and befesting their position in the

minds of the voters or (in the case of autocratic states) general public (McPherson 2003, Warshaw 2012).

There is also an observed correlation between nationalization and the belief that private actors are cheating the oil-exporters out of the revenue they are entitled to. These sentiments are present in other economies that are dominated by foreign actors (Stevens 2008), and especially following decolonization and creation of new states, where the previous colonies struggled for economic independence from foreign actors of Western origins (Taverne 2008). If the petroleum exporting countries feel that private oil companies are taking too much of the returns, this can increase the probability of nationalization. This has not been extensively tested (Mahdavy 2014), but has been recognized through a variety of case studies (Berrios et. al 2011, Smith 2007, Solberg 1979). Mahdavy refers to such sentiments of unfair sharing of revenue as a combination of economic and political reasons for nationalization (2014: 230). Ultimately however, if the public feels cheated out of their resource income, such feelings are bound to come more frequently to the surface the larger the returns from the industry, and the higher the oil price. This will especially be the case in situations where the fiscal regimes designed to tax private oil companies fail to account for very high sudden rates of return, i.e oil price shocks or windfall profits.

1.3.2 NOC literature

As mentioned previously, the NOC literature has focused more on the performance of the companies in relation to private firms. NOCs have previously been used as proxy indicator of nationalization (Mahdavi 2014). This branch is less relevant for the research question at hand, and therefore will mostly be bypassed. However, some findings can be argued to show that NOCs have grown in popularity following increased revenue from petroleum operations.

Nolan and Thurber argue that the average oil price level in the previous five years has a significant positive effect on whether states choose NOCs to explore new oil wells. However, their findings are contingent on time: They show that this is only the case in a single time period, of 1990-1999, and they are unable to find statistical significance for any other period in time between 1970 and 2008 (which is their focus of research). There is also an exception in the

period 1970-1979, where leaving out outliers of Statoil and Sonangol (the NOCs of Norway and Brazil, respectively) also yields a small positive effect similar to the one observed for 1990-1999 (Nolan & Thurber 2010: 35). When applying the same methods to the entire time period, there is a significant effect between oil price and NOC activity, where we might suggest several possible explanations: either that oil prices have only periodic effects, and that the international level has a stronger effect on the choices that states make; that a certain level or “shock” in the price must be present in the sector for it to have any effect on reforming a state’s oil sector; or that states choosing NOC are made to do so by other variables altogether, price only being relevant on an anecdotal basis. In any case, the evidence of price having an effect on the frequency of NOC activity is considered inconclusive by Nolan & Thurber’s analysis (2010: 37).

Finally, Victor, Hults and Thurber in *Oil and Governance* (2012) make the extensive argument that revenue is what ultimately ensures that NOCs still exist as force with a substantial presence in the international petroleum scene. By extension, the argument also seeks to explain why state involvement in the petroleum arena persists in this same form (Victor *et al.* 2012). The main answer they suggest is that NOCs exist primarily for the governments of oil exporting countries to “control through direct ownership what is usually the most lucrative source of revenue in the country” (Victor *et al.* 2012: 889). They thus argue that there are both political and economic incentives for state control.

1.3.3 What about *control* structures?

To my knowledge, only two other scholars use quantitative methods to analyze the determinants to state ownership and control, both of which feature prominently in this thesis. Sarbu (2014), with data on state control of oil in the time period 1987-2010, uses Tobit regression to *refute* the hypothesis that high state control occurs in periods with high oil prices. No relation between the two is found. Rather, the opposite is observed: The period where state control is measured at its highest in Sarbu's study is the end of the 1990s, where oil prices were relatively low. This relationship is observed even when controlling for different model specifications. To explain this, the author argues that the relationship between price and control structure is no longer

observable once the period of frequent nationalizations (the 1960s and 1970s) are removed from the sample. This is a point that should be taken into account when performing similar analyses.

Studies have also shown that the inverse effect may be the case. This implies that less state control is more likely to happen in environments of low oil prices. As long as oil prices remain high, it is theoretically possible for governments to uphold the same state controlled policy framework over time, because of the high returns. Steady, relatively high stream of income allows the state leaders to both expand their international influence and sustain their domestic popularity (Bremmer & Johnston 2009). In periods where the oil price drops, this framework will no longer be sustainable, because it fails to meet long-term goals of acquiring intelligence, expertise and technology that is usually only possible through foreign dealings. In theory, it would be difficult (not to mention unprofitable) to sustain a state-owned petroleum policy system in a climate of perpetually low oil prices, or following an oil crisis.

Chapter 2: Theory

The decision to change ownership and control structures in the petroleum industry ultimately lies with the state leadership. Behind the cause of this decision is the assumption that state ownership will be more beneficial to the state than private ownership will be. The benefits are then weighed along with the possible costs, which include the risk and repercussions associated with nationalization. Ultimately, the main benefit of state ownership is the economic benefit. The theoretical framework that I establish assumes that state leaders have at least some control over the direction of policy. This is not unusual: In most countries, the industry is of vital importance to the producer country's economic well being, as well as the world's energy supply. Therefore, the objectives that are set for any petroleum sector are usually set at the highest level of government (Sarbu 2014). However, the state leaders are also subject to certain institutional constraints, and politicians in most countries are simply not given free reign over the direction of important economic sectors. Therefore, the question of whether a country will choose state ownership and state control of their oil sector or not is a delicate balance between the perceived benefits and the restrictions the leadership faces when making a decision.

There are two major factors that have been frequently used as explanation for changes in ownership structure. The first, and arguably the one used the most, can be summarized as the incentives for change in ownership. The second is the institutional factors that limit the ability for change in ownership to take place. Both of these will be controlled for when performing the empirical analysis.

To make the ambitions of the analysis clearer, a few terminologies need clarification. To separate these concepts and analyze only one of them separate from the others can be a difficult task, and overlapping between them makes it all the more confusing. In this section I will therefore explain the conceptualization of both ownership and control in petroleum sector policy. I will also briefly explain the concepts of nationalization as well as expropriation. However, most of this section will be dedicated to explaining why international petroleum prices affect ownership and control

structures, and how alternative factors both within (over time) and between these countries may explain this connection.

As explained above, I argue that by using the arguments originally proposed by Sarbu (2014) that the theoretical concepts from both the nationalization/expropriation literature and the NOC literature can be used to explain variation in ownership and control structures. Since the scholarship on ownership and control structures is notably absent compared to the aforementioned topics, this chapter will mostly draw upon these. I argue that the incentives that states have for increasing control over their resources may overlap with the incentives to establish NOCs or nationalize the industry, and the incentives to expropriate foreign actors from the sector. Ultimately, nationalization is the act of changing ownership models to one of state sovereignty, and possibly state control. However, there are important differences that should be addressed. Nationalization is considered a "one-time" event, rarely occurring more than once and is seen as involuntary. Usually, the difference between forced divestments (nationalization through expropriation) and "lawful" increase of control is whether the private companies are appropriately compensated for the state's actions.⁵ The latter can be observed through policy change and over longer periods in time. Meanwhile, nationalization is just considered as "one option for gaining control over foreign direct investors" (Kobrin 1984: 329). In this thesis I will not account for this difference in the empirical analysis, as my ambition is to explain state leader's choice of ownership model, regardless of the context or tools used to implement this policy: In many cases the changes in ownership and control structure may very well be through nationalization. The literature on both nationalization and expropriation will thus be used extensively, as it serves as the origin for the explanatory variables in the thesis as well as the basis for the hypotheses: What makes state leaders pursue policies of state ownership and state control.

2.1 Why state control? The rise of resource nationalism

⁵ According to Sarbu (2014), the literature uses nationalization and expropriation interchangeably, to describe the same concept.

What are the drivers for politicians and state leaders to consolidate their control over natural resources? Economic drivers are served as the main motivation for changing governance structures. Bremmer and Johnston (2009: 149) refer to this as "resource nationalism" driven by economic factors, or *economic resource nationalism*. This is argued to be the most common form and arguably the most frequent. This form of nationalism is commonly a consequence of the host country wanting to increase its revenue from the resources. Economic nationalism also takes shape as a simple overturn of assets from international private actors to the state, without necessarily taking control over the projects as well. Bremmer and Johnston argues that governmental reforms in states such as Kazakhstan exemplify this form of nationalism: The state renegotiated the service agreements with the international companies in order to ensure a bigger share of the petroleum-based assets and subsequently the fiscal revenue, but left the control over the projects still in the hands of the companies. This is unlikely to take place in frontier-market petroleum states, because these hosts will want to preserve their relations with the international companies. If the conditions are too harsh, the companies might leave. While established resource-extracting countries may go further, the new ventures are more at the mercy of the private companies and the capital and technological capabilities they have. Therefore, the returns will have to be of a sufficient level in order to warrant an increase in state control. In other words, once the price of oil is high enough to take the risk.

Resource nationalism is associated with xenophobic feelings, usually triggered by foreign-owned private actors entering the country and "stealing" the oil. State leaders and the public may feel that natural resources is the sovereign right of the nation, and such notions was one of the major justifications for the creation of OPEC (Yergin 2009: 566). This is also related to the revenue stream: If there is a noticeable gap between the revenue that goes to the state and the private operators, this could increase nationalistic sentiments and influence the leaders, possible increase the probability that the leadership will change their ownership structure in the direction of increased state control (Manzano & Manaldi 2009). This notion of resource nationalism has a similar outcome. Many petroleum contracts lack a price contingency, which means that high oil prices lead to disproportionately higher revenue streams for operator firms in comparison to the revenue that is allocated to the state (Mahdavy 2014).

However, it is important to note that resource nationalism may not necessarily lead to nationalization of the oil sector. Bremmer and Johnston (2009) make the distinction between *economic* and *soft* resource nationalism. The latter, while similar in form, is associated with the oil exporters who intend to maximize profits, but want to do so in a more orderly fashion than would be the case in economic resource nationalism. The most significant change, like the name suggests, would be the avoidance of expropriation and sudden contractual break-ups; rather, soft resource nationalism seeks to assert the state's share in the sector but along the lines of legislation that has already been established. According to Bremmer and Johnston, this will most likely appear as a tax increase or added royalty payments for the international companies, but in general the motivations for the soft type can be either revenue maximization, increasing state control or some other form of control over the international companies. Soft resource nationalism is associated with the more developed oil exporters, most OECD countries, and has been the case in countries like Canada, the United Kingdom and also occasionally in the United States and Australia. This final form of nationalism also seems a better fit for the type of nationalism that emerges in countries without a state-owned company like an NOC: This implies that the tools available for the states are limited to the fiscal type, rather than giving the state's own competitive branch of the industry any added benefits (Bremmer & Johnston 2009: 152).

2.1.1 Ownership and control

Both ownership and control is used to describe how the structure of the petroleum policy regime is constructed in different countries. Ownership relates to a simple dichotomy of whether it is the private or the public sphere that owns the rights to develop the majority of a country's resource deposits. These rights include not only the proceeds from the resource extraction, but the ability to tax, to revoke a granted concession and to police through regulation (Sarbu 2014: 29). Ownership of resources is conceptualized in two points: 1) It relates to who owns the rights to develop the resources in the petroleum sector; and 2) It describes how much of the sector shares that is legally owned by the state. What category each country belongs to is classified in accordance with official legislation in each country. Luong and Weinthal describe it as such: “[...] whether legislation (broadly construed) mandates that the state owns rights to develop the majority of shares in the petroleum sector” (2010: 9). The concept of ownership is quantifiable

through the distribution of shares in the sector, with above 50 percent ownership signaling a simple majority ownership in the hands of the state. Thus, when a country in the sample is flagged as "state owned", this actually indicates a 50 percent majority right on the behalf of the state, usually granted by petroleum law or through contractual agreements.

While ownership relates to rights over reserves, the concept of control describes the operational control of the production activities. While control is more vaguely described in *Oil is not a Curse* than ownership, it is best summarized as whether the state retains managerial and operational control when it allows private actors to participate. In principle, it is possible that a petroleum exporter can assert the ultimate ownership over the resources, but leave the running of the oil field in the hands of private companies through licensing. This is the main difference between control or not control: In an environment with less state control, the foreign investors would be allowed more managerial control, while in an environment with a great degree of state control, the foreign companies are mostly tagging along as subcontractors or given lesser roles. The distinction between control and not control can usually be found in the contractual framework of each individual country. Increases in control can be observed through forced nationalizations, through market-based mechanisms and through coercive measures, it can be considered an umbrella term for any type of increased state authority and widening of economic or political jurisdiction.

In this thesis, the dependent variable gives us three different indicators of ownership and control structure. These are 1) state ownership and state control; 2) state ownership without state control; and 3) private ownership and control. A theoretical fourth combination is possible, that of private ownership and state control, but this alternative is "practically non-existent" in the real world (Sarbu 2014: 30), and not observable in the empirical data used in the thesis. Hence, state control automatically involves state ownership in the entirety of the empirical data.

2.2 Incentives to nationalize

As previously mentioned, the literature on nationalization/expropriation has a much more richly developed theoretical framework available when analysing the petroleum sector. This section

will outline the relevant parts of nationalization and expropriation that will be helpful when determining changes in ownership and control. Mechanisms that determine why leaders nationalize may also explain their decisions to increase control through economic policy.

Nationalization is, in its simplest form, the transfer of the ownership of assets (and/or control) from the private sector over to the public sector (Butler 2013). Similarly, privatization is the transfer of the ownership of assets (and control) from the public to the private sector. This distinction is elaborated upon by Stevens (2008), who asserts that resource nationalization can be summarized in two components: 1) Limitation of the amount of private activity in the resource sectors (in favor of state-driven activity) and 2) Assertion of state control over the development and extraction of the resource base.

While there is a large body of literature on nationalization/expropriation available, there has been less focus on this in the energy industry (Warshaw 2012). Expropriation can be broadly defined as involuntary forced divestment of foreign direct investments, referring to a government takeover of assets owned by foreign shareholders. Usually, nationalization and expropriation is considering interchangeable terms, and refers to the same concept. It does not include for instance restrictions of ownership, mandatory local content requirements and price control mechanisms, which are not divestment of equity per se. Expropriation also usually refers to across national borders (Kobrin 1984: 330). In practice, expropriation involves government-sanctioned forced sales of equity, and in the hydrocarbon industries this usually happens through renegotiation of contractual agreements. It may involve full nationalization of previously private assets or partly so.

Arguably, the majority of expropriations take place on a selective basis, where the fulfillment of certain industry-specific (and occasionally country-specific) ambitions is attempted through nationalization policies. While expropriation can be systemic, involving a total overhaul of the international private ownership in a country, this is less frequent and can be explained as a function of broad ideological or social changes; Selective expropriation usually entails specific economic goals related to one or more sectors (Kobrin 1984: 337). Expropriation in the world of petroleum is arguably tied to the market itself, and more specifically the expected returns the oil

producing countries have from their activities. In a price climate with growing returns, the producers will increasingly seek to maximize these returns, which means that IOCs will have to face states with a less favorable attitude, perhaps leading to expropriation policies (Joffé, Stevens, George, Lux & Searle 2009).

2.2.1 Political, economic and institutional backgrounds for resource ownership

How can we assume that the international oil price climate has any effect on the ownership and control structures? First, when oil prices grow, the increased profits are first and foremost going to the operator oil companies, not the state. Wolf (2009) finds that given a doubling of international oil prices results in *more than* doubling of the net income of an oil company, even when controlling for potential differences, such as the varying efficiency between NOCs and IOCs. This may depend on the state's tax structure, as a very broad variety of taxation can be applied to private companies' revenue. This will not be discussed in detail here. However, broadly speaking, price growth seems to benefit private companies even more than state-owned enterprises. Higher revenue directly to the state apparatus will then be more profitable than simply regulating and taxing the income of the international companies, given an environment where the international oil price is very high. Relatively high oil prices will result in a fiscal windfall for states that would be more modest if any private ownership model were present, supporting the argument that state ownership can be justified through a simple revenue maximization mindset. As mentioned earlier, the gap between income that goes to the state and that which goes to the firms also facilitates the emergence of resource nationalism, which may also justify a change in ownership and control.

Furthermore, higher oil prices enable governments to control their oil sector and maintain its ownership over time. The process itself is easier to implement once oil prices are high, because the higher demand that goes with high prices means that governments have leverage over the IOCs. Higher prices also give states the investment strength that is needed to develop new oil fields, for instance by purchasing new advanced technology, which previously would require involvement from IOC with superior capital and technological capabilities.

When oil prices are high, it is actually assumed that the world oil supply has peaked. Peak oil refers to the assumption that there is a finite supply of petroleum resources available, and that a peak in the resources available will eventually be followed by a steep decline in production. Once this happens, the oil remaining is going to be both more expensive and more difficult to extract. This is also considered to be a signal that the less available fields (in terms of extraction) need to be developed, which also requires technology that only IOCs possess (Yergin 2006). This actually suggests that the opposite is true: As higher oil price requires more involvement from private actors, more advanced technology will be needed to develop the fields. However, as we have seen, the dynamics of oil price are caused by both the market and politics. The oil price is often affected by other dynamics than supply and demand, such as the interstate economic climate, domestic conflict in the main exporting countries or new discoveries. Furthermore, the fear of oil resources running out has been present since the 1960s, with Hubbert's original predictions claiming the reach of peak production between 1965 and 1971. This threat has since been shown to be too pessimistic in regard to future oil production, but peak oil may still happen in the future. I will, however, not be going too deep into this possibility in this analysis. For future research, the actual causal mechanisms for oil price change and its effect on ownership and the possibility of a spurious correlation may be an interesting subject of study.

2.2.2 The effect on decision-making, short-term economic gain and time frame of nationalization

Why would resources affect the decisions of government reform in the first place? One point of departure is the added expectations of the population once resource revenue starts to increase. To satisfy these demands, politicians may be prone to quick, short-term decisions in order to achieve political goals, such as staying in office at the mercy of the people. This is especially the case when governments decide on spending, which tend to increase once the contents of the bank account are sufficiently large. If maximizing of the revenue from resources thus becomes first priority, it will lead to attempts at increasing government control over the business, or if possible, even complete nationalization. Also, large amounts of money tends to weaken the politicians' ability to make effective, long-term economic planning (Auty 2001b, Sarraf & Jiwaji 2001).

Populist resource politics follows along with the governments of some resource rich states. If the short-term prognosis for the oil price is positive, high government spending of resource revenue can be upheld. Resource dependence will accompany a type of "government myopia" where short-term revenue becomes the priority over more prudent economic development.

Also, changing the ownership structure in a country will probably be time-consuming. Therefore, there is likely a time lag between adoption of a new strategy and the actual implementation of a new ownership structure, which may include nationalization, expropriation of foreign assets and renegotiations of IOC contracts. Furthermore, country-specific circumstances such as domestic conflict, economic crisis or in some cases recent independence (such as may be the case with post-colonial states) will also make the time frames for actually enforcing and implementing ownership reform differ between states. The ability to enforce changes will ultimately also be affected by the amount of executive restrictions in a single country, as mentioned above. This may be adjusted by the use of petroleum law and official documents to operationalize the dependent variable, as is done in this thesis.

Since the goal of this thesis is to explain what makes state leaders choose state ownership and state control, it seems more convenient to attempt to measure intent, rather than the leaders ability to implement. While the time frame between passing a legislation and actually implementing the changes required for the ownership structure to pass the threshold between for instance "private" and "state ownership" will differ between states and distort the analysis, this time frame can be controlled for by instead using legislation as an indicator of the change. Thus, if a change in the country's constitution, an executive order or a policy is passed at one time, that signals a change in the direction of ownership structure, this is the temporal point of departure for this change. This will ensure that the state leaders' intention to make the changes is the object of study, not the actual institutional change.

2.3 The factors that drive ownership and control

Let me briefly return to the research question: What makes state leaders choose state ownership and control over private ownership and control? The question by itself is interesting because the

general consensus among both scholars and the industry itself is that "too much state" is bad. It is considered unhealthy for international energy security, and less economically efficient than having private oil companies do the work and relying on taxation to ensure that the state gets its rent from the resources. For instance, the literature unanimously agrees that NOCs are less efficient than private companies when directly compared (Victor, Hults & Thurber 2012, Warshaw 2012, Wolf 2009). Why this is so has been researched, albeit with limited substantial conclusions (Victor 2007: 1). Likely the most frequent argument is that NOCs are often given commercial constraints and political goals to fulfill by the government, while simultaneously attempting to maximize company profits on behalf of the state and act alongside other, private companies in the global market (Hartley & Medlock 2008, Stevens 2008, Wolf 2009, Victor et. al 2012: 890). In the long term, the implication is that private oil companies are a superior choice to begin with. This begs the question of why states still choose the strong state variety when faced with the choice between models of ownership.

The historical reasons for developing an oil sector with state ownership and control can be summarized in two points: The state wants the full sovereign rights to control their resources, and to maximize its earnings from the resource base. These two points are not entirely separate, because it can be assumed that full control over the extraction of resources ensures that the state does all decision-making in relation in the industry, which enables them to manage it in a manner that also maximizes the revenue to the state. In a situation where all intervening variables are controlled for, any and all governments should want to control its oil sector if this means the most possible revenue back to the state, especially if the only alternative is to split with, or even lose, income to the private international companies.

A major assumption of this proposition, and of economic nationalism in general, is that a state leader will act according to the principle of utility maximization: The driver of reform in a ownership model will ultimately be in accordance with the path that yields the greatest possible value for the country, and its leaders. Applied to the language of the natural resource sector, this implies that state leaders always will prefer the path of development that maximizes the economic returns to the state, all other variables kept constant. Alternative goals such as re-election or foreign policy strategy may complicate the picture, but revenue maximization may

benefit such secondary goals as well. A second assumption is that state leaders will want to maximize their sovereignty, and that this is the major driving force for choosing a development trajectory that ensures ownership and control over a country's natural resources. Sovereignty will make sure that the state and its leaders have as high as possible a control over how, why and when the resources are developed, which will not only maximize the amount of revenue and/or rent, but will grant them the ability to make decisions regarding daily and future operations in the sector. This will ensure not only maximization of returns from the operations to the state, but that national interest is upheld through forward and backward linkages between the petroleum sector and other sectors of the economy.

2.3.1 The cycles of state ownership - patterns of appearance

The early 1970s was characterized by a rapid and significant increase in revenue to the states with petroleum industries. This coincided with the rise of state ownership, through the numerous NOCs that were established concurrently with the growth of revenue that oil resource gave. This sharp increase in oil price, it should be noted, was the effect of OPEC controlling the prices and adjusting it high: itself a political reaction to the Yom Kippur war and thus a price shock that was not an outcome of the relation between supply and demand in the market. The rise of NOCs was a precedent for state oil becoming a dominant force in the 1970s and early 1980s, with the resource access of the IOCs dropping from approximately 85 percent to nearly 50 percent in between 1970 and 1980 (Bagheri & Minin 2015: 8). The trend of state ownership reversed in the mid-1980s, a trend that is usually explained as a result of the drop in oil prices during the period 1986-1987, with a total drop of nearly 80 percent. Immediately following the oil shock, privatization occurred in several countries including the UK, Argentina, France and Italy. This was followed by a general orientation towards a more market-controlled business model for many oil exporting countries (Bagheri & Minin 2015: 9). In the early 2000s the price level once again rose significantly, and this too was accompanied by a trend shift, this time towards states consolidating their control over the sector by renegotiating contracts with the private oil companies and occasionally revising the lucrative deals that were made during the two pre-millennial decades. This resulted in even less reserves in the hands of IOCs and the emergence of

global NOCs with both financial and technological strength to operate outside of their national borders.

The history of petroleum for the last five decades can be broadly rendered as periods of dynamic shifts in the business model that defines the interaction between states and private firms, shifts that originates in the nature of the state's ownership structure. A 1960s market dominated by international private firms that were gradually overpowered by the home states and reduced from enjoying easy access to most of the world's oil assets to losing most of this control, while still being technically, financially and administratively superior to their state-owned counterparts. The trend was reversed in the 1980s concurrently with a crisis in the international petroleum price levels, and was yet again reversed in a similar vein as before, with a denationalization trend emerging in the early 2000s. However, at this point the technical experience gap and the difference in access to capital between private and state firms had shrunk, making the states much less dependent on the IOCs than they were in the 1960s: Many NOCs could now become operators and work on their own terms.

If resource nationalism and ownership changes is cyclical in nature, it means that the popularity of state oil, state-owned companies and state participation comes and goes and is likely to persist in the future. What determines these cycles is the petroleum market. Like any other market, petroleum is subject to a market of supply and demand, where petroleum exporters are the suppliers and petroleum-consuming states are (usually) the demand. Periodically, the demand will be high and the supply low, which is realized through high oil prices. Price shocks, on the other hand, may or may not be related to supply and demand, as I show in the analysis chapter. In periods of high demand, the role of IOCs will shrink overall, in favor of the state companies. Following this logic, resource nationalism is a constant threat to the private and foreign companies, but to varying degrees according to the petroleum market (Joffé et. al 2009). However, whether this tendency will persist in the future is more uncertain. While IOCs were previously superior in terms of technology, and able to account for drops in price, this gap has since shrunk significantly.

2.4 Alternative explanations

2.4.1 Regime types

Going back to the idea of resource nationalism from Bremmer and Johnston (2009), there is a possibility that certain types of regimes are more prone to choose state ownership and control over a structure that favors private actors because of the political conditions of the country, such as regime type. This is because of the emergence of revolutionary resource nationalism, which usually accompanies a state-led economic reform on a large scale. Reforms of the revolutionary type also affect other parts of the domestic economy apart from merely the natural resource sector. Bremmer and Johnston describe it as “political and social upheaval” where the effects can be summarized as a forceful consolidation of state power at the expense of private actors. In the case of the resource sector, this might be expropriation of foreign-owned assets or renegotiations of contractual agreements with little regards to economic compensation for the investments and sunk costs of the companies, with uncompromisingly severe effects (Bremmer & Johnston 2009: 150). Contemporary examples of revolutionary resource nationalism have happened in Russia and Venezuela, under the strict state-assertive regime of Vladimir Putin and the revolution of Hugo Chavez, respectively.

2.4.2 Rent-seeking behavior

Another reason for introducing state ownership in oil is the amount of free rein that this will grant the state in relation to rent-seeking behavior. While IOCs usually are subject to external scrutiny through international accounting standards or transparency policies, this will not be the case with government-controlled domestic companies. If the state controls the sector on its own, this will allow them to bypass these rules and more effectively pursue control over the revenue stream as well. Furthermore, rent-seeking activity in petroleum is most frequently widespread in authoritarian regimes. Therefore, it can be expected that authoritarian regimes will be more likely to seek more ownership and control over their resources, especially following price shocks.

2.4.3 Institutional limits

Institutional limits can be summarized in two forms, domestic political factors and international factors. The main argument here is that the institutions in a country can be a major barrier to the introduction of policy that increases state control. As mentioned, previous findings from the nationalization/expropriation scholarship have argued that non-democratic systems are also more prone to nationalizing their petroleum governance models. This is because of several reasons. First, whether a state is democratic or autocratic can serve as a proxy for institutional checks and balances in that country. More institutional constraints through checks and balances usually implies that reform in a vital economic sector such as oil will be forced to go through a long and tedious democratic process in order to go through. Thus, a country where less political power lies with the executive will be less likely to go through reform, while countries with little executive constraints will be more likely to nationalize when faced with the right incentives (Warshaw 2012, Mahdavy 2014). The opposite effect is also present when looking at privatizations: Countries with checks and balances (usually democratic countries) are more likely to privatize their national oil companies than autocratic countries (Warshaw 2012). The correlation between regime and privatization can be generally be observed in other industries as well, where democratic countries usually are the first to privatize (Bortolotti et. al 2003). There is, however, observed less correlation between executive constraints and nationalization of petroleum in more contemporary times, more specifically from 1980 onward: The strongest correlation is found before this point (Warshaw 2012).

2.4.4 Diffusion effect

Nationalization in one country has also had an observable effect on the tendency of other oil-producing states to go through similar processes. It is suggested that the likelihood of nationalization happening in other countries increase once it has happened in *some* countries, an argument originally presented by Kobrin (1985), who suggests that nationalization can have a "domino effect" on other oil-exporting countries. For instance, Kobrin argues that the nationalization of the Libyan petroleum sector in 1970 set the bar for other oil exporters to do the same thing. Kobrin refers to this effect as the "diffusion effect", and significant results of this

have been discovered in several other studies as well (Warshaw 2012, Mahdavi 2014, Murillo 2002). The diffusion effect suggests that nationalization (or privatization, as the case may be) spreads between countries. This may show itself through for instance regional similarities. Added implications in this case may be that one immediate restriction that countries willing to nationalize must face, is the backlash from the international petroleum scene. Other reasons may be ideological waves or pressure from international actors, such as the terms of entry in organizations like OPEC. The outcome would theoretically be the same, however: The possible reactions make it difficult to break line with the current trend, even if changing ownership would be economically beneficial for the individual country. Similarly, the opposite tendency (that of changing policy towards private ownership) may be caused by similar determinants, such as pressure from international organizations to liberalize the economy. Nonetheless, there is strong support for the presence of a copycat effect when states change their ownership structures or nationalize the petroleum industry.

Chapter 3: Data and method

The following chapter will give a more detailed outline of the data that is used to perform the analysis, as well as the structure of the data and possible challenges associated with it. Following this is a presentation of the variables used as well as the indicators and the way these are coded in the data set. Finally, I go through the approach used to make inferences in regards to the hypotheses is presented.

If we take all assumptions laid out in the previous chapter for granted, we can expect the following from the data:

1) Price shocks of petroleum leads to an increase in the possibility of short-term economic gain from petroleum operations. This will in turn increase the probability of a change in ownership structure, most likely to state ownership. A second assumption following from this would be that once a state has ownership with control, this structure will most likely be maintained as long as the oil price is approximately steady. Thus, higher oil prices will likely result in more state ownership over time as well.

2) The likelihood of a change in ownership will be more noticeable in less democratic countries. The more political control vested in the hands of autocrats or the executive, the easier it is to deploy reform strategy based on short-term decision making. More executive control will likewise reduce the probability of this. This, the lower a country scores on regime, the higher the probability of change.

3) A similar ownership change in a different oil exporting country will also increase the likelihood that such a reform will take place in other countries. This will support the proposition that international trends and the overall climate plays a role in decision making. More specifically: If another state changed model of ownership the previous year, other states are more likely to do so in the following year.

4) OPEC membership will also increase the probability that a state chooses state ownership with control. The organization charter highlights the importance of sovereignty over natural resources as well as enforcing a strict production quota on each member state. Overall, most OPEC members nationalized their oil industries and are thus likely to have state ownership with control as well.

3.1 Data and operationalization

The statistic analysis used in this thesis relies on primary and secondary data that is compiled in a data set from several different sources. This data accounts for ownership and control change in 49 oil-producing developing countries in the period 1960-2010, originally compiled by Luong and Weinthal (2010). Ideally, non-developing countries should have been included in order to generalize the eventual results to all oil exporters. Using the current data is simply a question of availability, as Luong and Weinthal's data set is accessible, well documented and, to my knowledge, not used extensively apart from the original work. While the original data on ownership and control structure is available for the entire period, it is not available for each individual country at all times because of petroleum discovery and operations starting at different points in time⁶.

The original data on the dependent variable goes back to 1900, but data this far back is not included in the analysis. The main reason for this is that the pre-1960s was chiefly dominated by large, vertically integrated private oil companies (often referred to as the Seven Sisters) and most oil revenue went to these firms, rather than the home states. Also, very small quantities of oil were actually produced by most countries during this period. Until 1940, only three countries worldwide produced any quantities of economic significance (Andersen & Ross 2014): The US, Mexico and Venezuela, whereas only the latter two countries are included in the data. Furthermore, longitudinal analysis data tend to bias estimates if the relationship between dependent and independent variables has changed over time. Also, 1960 marks the creation of

⁶ Only 31 countries in the original data were oil producers at the point of departure in 1960. The most extreme example on the other side of the scale is Timor Leste, which has only had a petroleum sector and official law since 2006.

OPEC, which was of major significance concerning states' consolidation over their natural resources. This may, however, also be problematic in terms of sampling bias: Dropping available data in favor of time periods where changes in ownership became more frequent could make the results of the analysis biased. However, taking all other factors into account, including the availability of data before 1960, I consider it prudent to cut observations from before 1960, when oil production accelerated more quickly around the world.

3.2 Dependent variable

The data on ownership structure is collected from the index originally used in Luong and Weinthal's *Oil is not a Curse* (2010). The criterion that was used to collect this data originally was based on whether a country is considered petroleum-rich. Usually, the benchmark for determining this is the petroleum export revenue as a percentage of the total exports and government revenue. Once petroleum revenue makes up 40 percent of total exports, a country is considered resource rich. Luong and Weinthal do not do this however, in order to avoid mixing resource wealth and resource dependence: Hypothetically, there are oil exporters who are less dependent on their resources but still have a substantial resource base available. The measure of wealth actually used is compiled from the *Oil and Gas Journal Database* and includes the top 50 resource-rich developing countries on three separate lists: "1) Country's position from averaging world rankings; 2) country's position from averaging quantities; and 3) country's position from weighting quantities" (Luong and Weinthal 2010: 310). The 50 countries included in the analysis are those that are among the top 50 on two of these three lists.

An important distinction in the ownership and control structure literature is that of "de jure" and "de facto" control. The former is what Luong and Weinthal use for their operationalization of ownership and control: Whether the legislation in each country points towards one structure or the other, based on constitution, law, official regulation and sometimes contracts between state and private petroleum entities (Luong & Weinthal 2010, 311). Sarbu (2014) instead opts for a "de facto" definition of control: The ratio of oil production by the state (NOC) to the total oil production, from 0 to 100 percent. This ratio would measure the total share of oil production that the private companies would have managed to secure. The reason for choosing the former

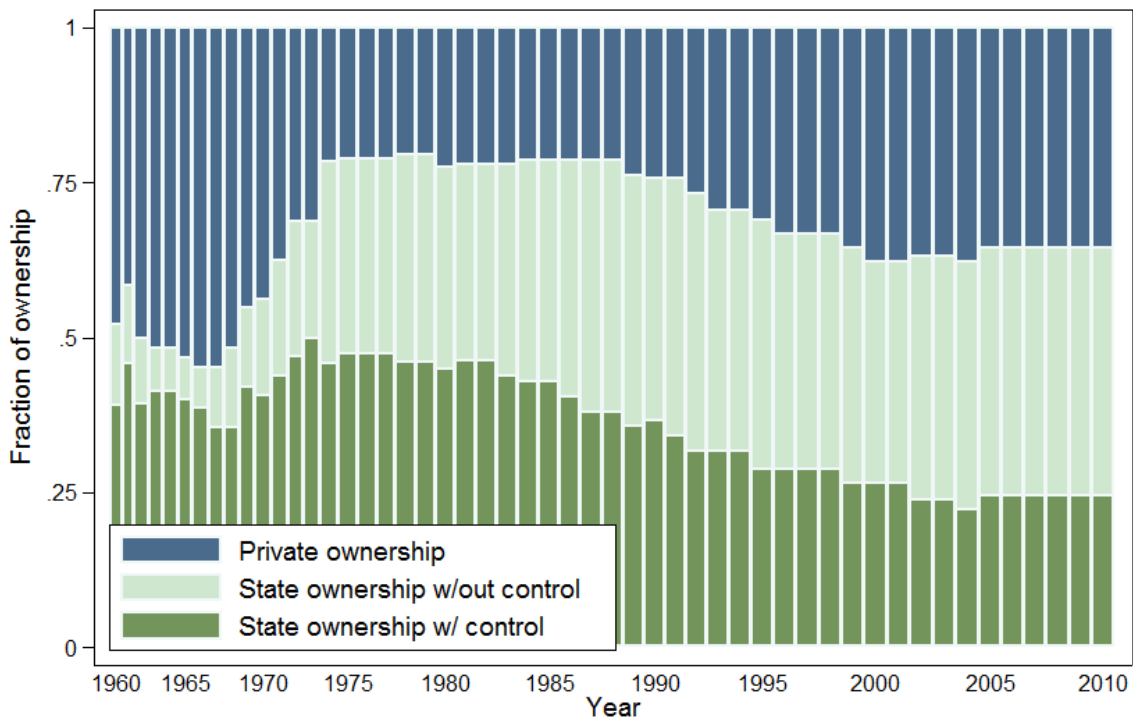
measurement in this thesis is, apart from the availability of the data, the more precise inferences that can be made from using a dichotomous dependent variable. If oil prices affect ownership and control structures, I have argued that they do so through the decision-makers and state leadership. Very small changes in control (which Sarbu argues can be captured through a ratio variable such as the one mentioned above) will likely be determined by other variables than explicit sovereign decisions to reform the ownership and control structure, which is what this thesis aims to determine.

Table 3.1 shows the evolution of state ownership with and without control in the last five decades. The total amount of observed ownership structures across time is approximately balanced, but the frequency of each model has changed over time. Table 3.2 on the other hand, shows the timing of the transitions between ownership structures and how they compare to a straight NOC indicator. This table is listed in the subchapter on statistical methods, (3.5).

Table 3.1: Overall distribution of ownership & control

	Freq.	Prc.
State ownership w/ control	709	35.74
State ownership w/out control	637	32.11
Private ownership and control	638	32.16
Total observations	1984	100

Graph 3.1: Ownership model distribution (1960-2010)



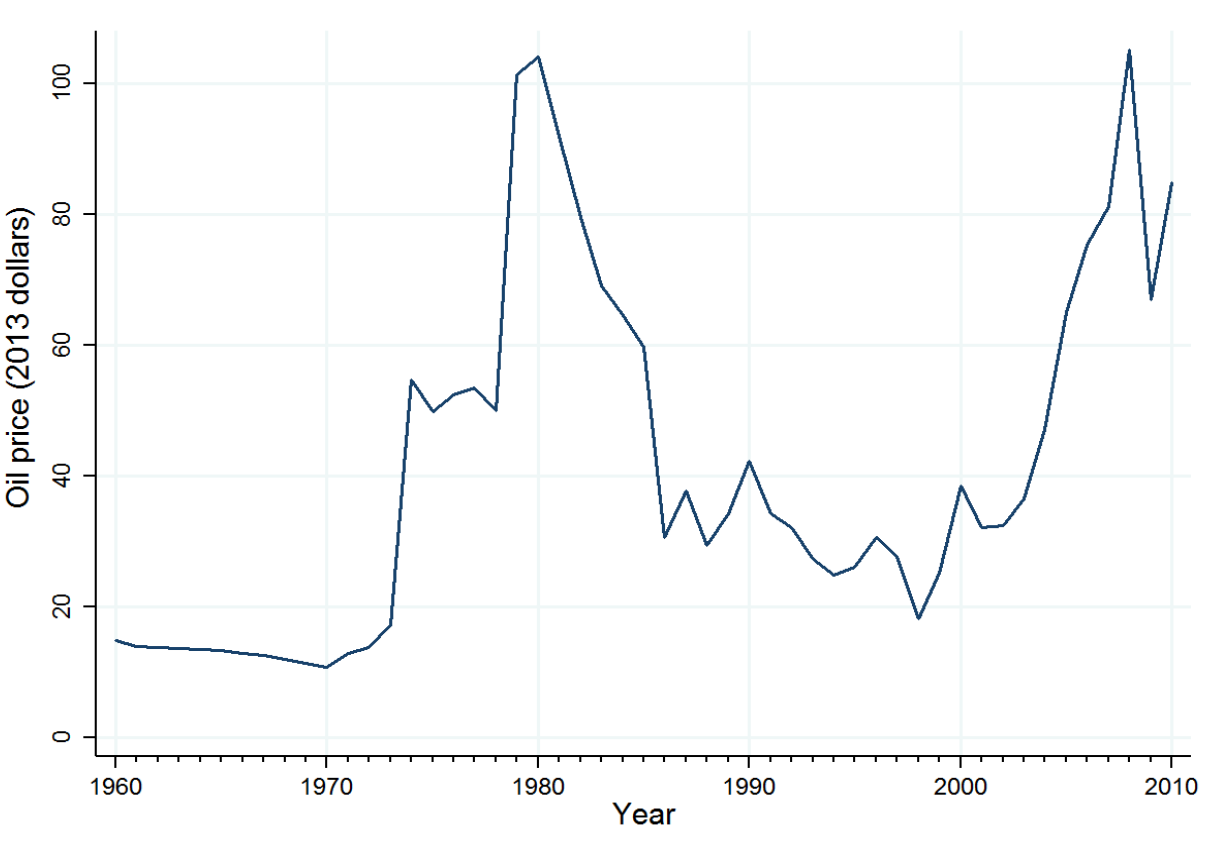
3.3 Independent variable

Independent variable is oil price shocks. To measure oil price levels, I use crude oil price data retrieved from the BP database (British Petroleum 2015b). The data used are real rather than nominal oil price levels, in 2013 international dollars, from 1960 to 2010. BP presents prices as an amalgamation of different measured crude oils: the price from 1960 to 1983 is Arabian Light posted at Ras Tanura, while 1984 to 2010 is Brent dated (BP 2015a). In order to simulate the effect of a shock in oil price, the model from Guriev *et al.* (2009) is adapted and simplified somewhat. Their original estimation of oil shocks are based on a long-term oil price behavior model, originally proposed by Pindyck (1999). Essentially, the following equation predicts the evolution of oil price using the previous years' price as an independent variable:

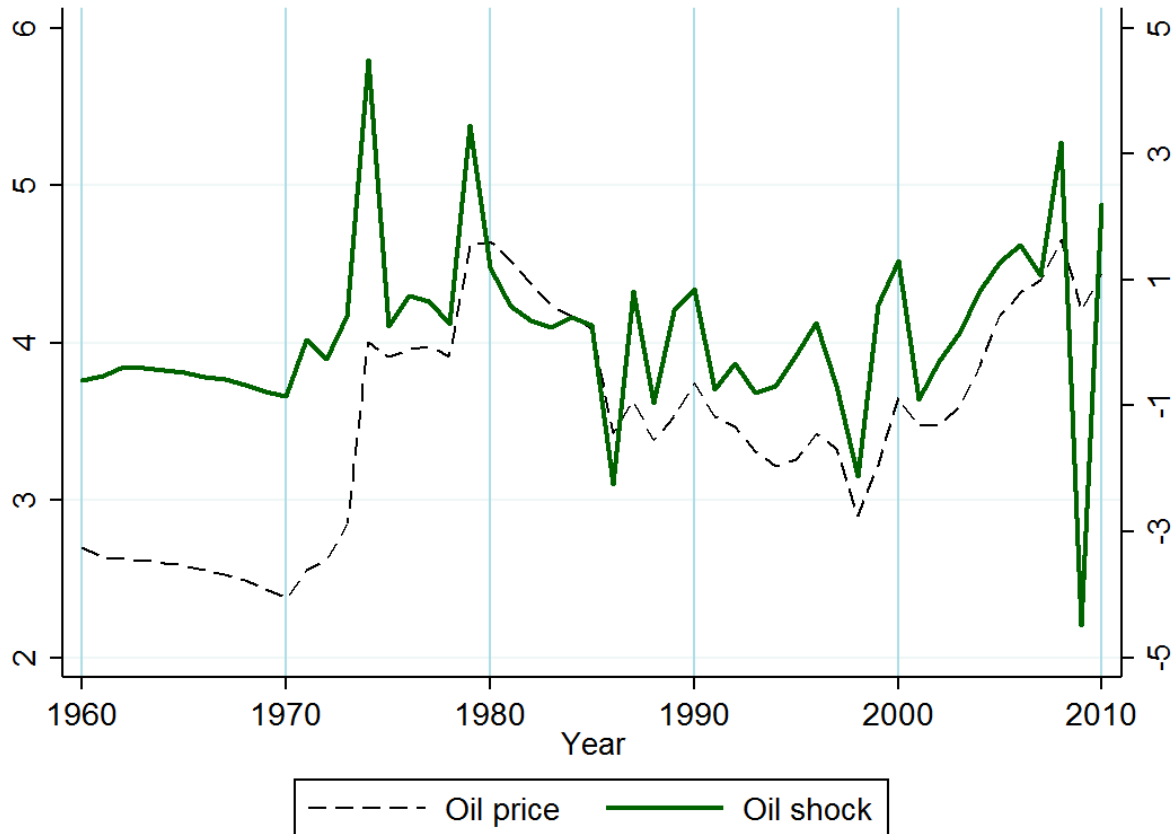
$$\ln(p_t) = a + b * \ln(p_{t-1}) + c*t + d*t^2 + \varepsilon$$

This equation is then estimated for each year t between 1960 and 2010, using the data oil price for the previous years $[t-50, t-1]$. The deviation from this trend is what composes the independent variable *oil shock*: Essentially, this is the residual from the predicted price trend. Past data on oil prices is used to predict ownership structure in the following year. The oil prices included in the calculation starts in 1910, since data on oil prices beyond this point is less reliable (Guriev *et al.* 2009). I simplify this by performing similar calculation for each year, but doing a linear regression with t as dependent variable and $t-1$ as independent. Therefore, the price shock for 1960 is estimated using the prices for 1910-1959, and so on. The residuals from these estimations are then used as the independent variable *oil shock* in my analysis. As an alternate independent variable, the actual nominal oil price (in dollars) are included as a possible explanatory factor: $\ln(p_t)$. Graphs 3.2 and 3.3 show the oil price by year in the data: The former show the nominal price level by 2013 dollars, while the latter shows how the resulting *oil shock* variable is distributed in relation to the (logged) original price variable.

Graph 3.2: International oil prices, in international 2013 dollars



Graph 3.3: Oil shock as residual of estimated price trend



Since both variables are logarithmically transformed, the values by themselves make little practical sense. The values on the oil shock variable (the right side of the graph) indicate negative as well as positive values, meaning that both directions of price shocks are captured. Any values above 0 thus indicate a rise in oil price that is higher than what would be expected, previous price trends taken into account. The higher the value, the more prominent break from expected value. Similarly, values below 0 mean that the price level is lower than what would be expected. Therefore, a flat oil shock line does not mean that the oil price *level* stays constant, unless the value of the shock is at exactly 0. Applying a variable like this makes oil shocks a continuous measurement, rather than a dichotomous.

3.4 Control variables

As mentioned, it is assumed that the type of regime a country has, as well as the strength of its political institutions, will have an effect on the leaders' ability to reform the ownership and control structure. More constraints on the state leaders are believed to decrease the likelihood that the leadership is allowed to increase control over the sector. The effect of domestic political restraints on petroleum policy has been shown extensively through the works of Guriev *et al.* (2009), Warshaw (2012) and Christensen (2011), which uses a variety of measurements to test this. However, this is not the case in Luong and Weinthal (2009), where regime does not have an observable effect, and Sarbu (2014), where the effect is the opposite of the above findings. To measure the amounts of executive constraints and checks and balances that the executive is faced with in a country, I will use the Polity IV project data set. This data set aggregates socioeconomic and political factors in all the world's countries and presents combined measurements on the regimes in each country. While there are numerous other indices available that measure the quality of institutions, none of them provides data annually for each year in the sample. Polity IV is included with its own executive constraints variable *xconst*, coded as a range of 1 through 7 where the numbers refers to the amount of checks and balances that each state imposes on its executive. However, this variable is problematic because of the amount of periodical missing values in the data (Examples include governmental transition periods such as the Iranian revolution from 1979-1981). Therefore the *polity2* variable is favored instead of *xconst*, as this variable is coded with approximations of the regime scores in transition periods⁷. This variable also correlates strongly with the executive constraints variable, so it makes less difference result-wise. The *polity2* variable is coded on a 21-point scale from -10 to 10: This is recoded to a scale of 0 to 10, to avoid the difficulty of interpreting negative numbers in indendent variables.

Also included is a variable for controlling diffusion, i.e the possibility that the growth of state ownership and control can "spread" between countries (Luong & Weinthal 2009, Mahdavi 2014, Guriev *et al.* 2009). This may be spatially related, in that countries in close proximity will be affected by each other's decision because of the reduced risk associated with increasing control

⁷ All models in the final analyses have been tested alternatively with *xconst* as a regime variable. The results are consistent with both variables, and the models are therefore not included here.

or nationalizing the industry (Kobrin 1985). The basic variable to control for this is based on whether a country has changed their ownership, either towards increased state ownership or private ownership, in the previous year (t-1). This gives me two separate variables for observing whether a copy effect takes place for both transitions towards more state ownership and control, and towards more private control. Both of these variables are coded 1 if a transition took place in the previous year, 0 if not. Also included is a similar variable that controls for regional diffusion: This is measured in the same way as the former, but only accounting for ownership and control changes in the same region of the world (the coding of these regions are accounted for below). This latter measurement is inspired by Mahdavi's model for diffusion control, which uses a similar variable for regional diffusion (2014). Also, a self-coded OPEC dummy will be included to account for the argument that OPEC members were encouraged to nationalize their petroleum industry in the early 1970s, in order to meet the production quotas set for initial membership. This may affect the results from these countries.

Table 3.2: Descriptive statistics

Continous/categorical variables	Range	Mean	Standard deviation
Ownership structure	1 - 3	1.966	0.823
Oil price, log	2.378 - 4.656	3.494	0.688
Oil shock	-4.488 - 4.493	0.141	1.379
Regime type	0 - 10	3.631	3.327
Dichotomous variables	Range	0	1
Opec membership	0 - 1	1447	545
Transitions, state	0 - 1	1973	19
Transitions, private	0 - 1	1968	24
Diffusion effect, state	0 - 1	1578	414
Diffusion effect, private	0 - 1	1227	765
Regional diffusion, state	0 - 1	1840	152
Regional diffusion, private	0 - 1	1796	196
NOC establishment	0 - 1	2468	31
Expropriation	0 - 1	2428	71
Privatization	0 - 1	2487	12

3.5 Statistical Method

To test both my hypotheses, I use a combination of descriptive data analysis as well as longitudinal maximum likelihood-based regression. First, I will compare the variation in ownership model to the history of oil price shocks in the sample period, as well as how the changes in these models relate to the nationalization trends that the petroleum industry has seen since the start of the period. In the regression analyses, I show several different models using logit models with random effects for each separate country. The software I use is Stata 13.1. Apart from the default computation available in the program I use some user-written commands: These are elaborated upon and given proper citation where relevant.

In the analysis as well as the subsequent chapters I refer to the country data as the sample. Strictly speaking, it is not a sample as it is not a random selection of cases from a larger population of states, or oil-producing countries. This also means that while I put a certain focus on the statistical significance of the results, it is important to note that the results are not easily generalizable to a larger pool of states or country-years that are not observed here. Rather, the regression analysis should first and foremost be seen as a tool to make descriptive inferences from the empirical data at hand, not to make grand assumptions about the future of petroleum ownership structure.

The data itself is structured as a cross-sectional time-series data, with the dependent variables treated as a function of both time-specific and country-specific covariates. There will be two separate analyses applied: One analysis to see what determines the variation in ownership models and a second for what determines changes in these models. The first model is based on a multinomial logistic regression, using random effects to control for between-unit variation with a mixed model; The second will be a random effects logistic regression to check for determinants of transitions from one form of ownership and control to another using a dichotomous variable to measure these transitions. I will elaborate upon each of the analysis methods below.

3.5.1 Multinomial logistic regression

A dependent variable that is dichotomous with several categories (more than two) that can't be ordered in a meaningful way suggests a multinomial logistic regression. It could be argued that the dependent variable can be ordered according to the degree of state control, which means that an ordinal model could be applied. However, if there exists separate causal mechanisms that incentivize state leaders to choose one model of ownership over another, these would be difficult to capture with an ordered logistic regression. Therefore, it seems more prudent to capture these determinants with maximum likelihood methods.

As previously mentioned, panel data where there is assumed to be unobserved heteroskedasticity between the higher-level units can be amended with fixed-effects regression. Software-wise, there is however fewer possibilities when doing multilevel or mixed models combined with multinomial logistic regression. One possibility is to perform a regular multinomial logistic regression with standard errors clustered at the level of the states: Usually this underestimates the size of the standard errors, giving biased estimates that may not be statistically significant even if the results point toward this. The second possibility is a mixed model using a generalized linear latent and mixed model (Rabe-Hesketh, Skrondal and Pickles 2005). While this is not available by default in most statistical packages, it can be installed as a user-written program for Stata. The results are comparable with, and virtually interchangeable with, most multi-level model commands in the same software, result-wise.

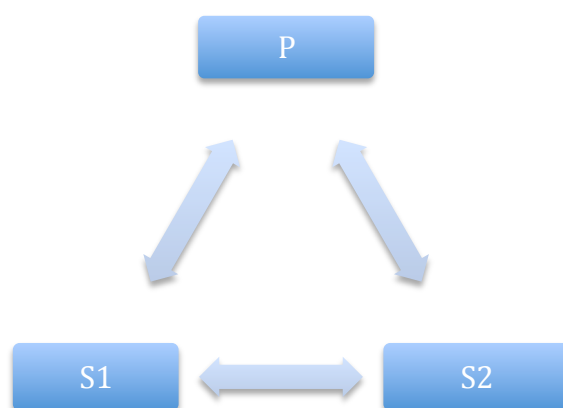
The models used in this thesis will therefore be based on the latter option, which allows the application of a mixed model with random effects based on a multinomial logistic regression. This model is similar to and partly replicates Luong & Weinthal's original analysis of the data. However, their model is based on a regular ordinary least squares regression that orders the properties of the dependent variable as a linear function of the regressors. Also, they do not control for random effects in their model, but rather fixed effect for individual countries.

In the alternative model that I present below, oil price shocks will not be used as independent variable, as this makes little theoretical sense: Price shocks is not suggested to be able to predict the type of ownership model in a state, but the timing of the change. Instead, I will present the effect that oil prices *per se* (measured in 2013 international dollars, as presented above) have on

the likelihood that either state ownership with control (*S1*) or without control (*S2*) are more likely to manifest as a function of the oil price. Also, the variable for regime will be applied to the model to control for potential differences between authoritative versus democratic states. This model also control for OPEC membership, which is likely to affect the presence of state ownership, as well as the previous year's ownership model ($t - 1$).

3.5.2 Logistic regression with random effects

The second regression model will control for determinants of changes in ownership and control, hereunder referred to as transitions. The three possible categories in the dependent variable (*S1*, *S2*, *P*) make out a total of six different transitions that can be undertaken by a government. A stylized diagram of this is shown in the figure below:



Of all the possible outcomes, the most theoretically relevant to the hypotheses are the countries that transition from *private ownership* (*P*) to *state ownership with control* (*S1*). This is the transition that signifies a change from a governance model with private firms as owners as well as operators, to a model with state majority ownership and state operatorship. However, all possible movements will be given some attention in the analysis. Table 3.3 shows all observed movements from one model to another in the period 1960-2010. From a purely descriptive aspect, a separate dichotomous variable will be coded to account for each possible transition, with the value 1 indicating the relevant transition took place in that year, 0 otherwise.

One immediate problem is the frequency of the changes. Ideally, each transition should be modelled out similarly for the maximum amount of information regarding the determinants of the transitions. However, the occurrence of the events that I seek to observe is quite rare: Considering that these changes entails a structural change in petroleum operations activity, as well as a *de jure* official change in stance which is realized through changes in petroleum law, it makes sense that this is not a thing that happens frequently, but it creates statistical difficulties. When facing such rare event dichotomous variables, it narrows down the possibility of statistical models to calculate consistent and unbiased results. For instance, regular logistic regression based on maximum likelihood estimation is consistent only when asymptotically unbiased. This means that events that occur rarely will give biased estimates with logistic regression. Another problem with this is that finding significant unbiased correlation for within-unit analyses are less likely, considering that states rarely change its *de jure* ownership model once it is established.

Table 3.3: Changes in ownership structure, 1960-2010

	P → S1	P → S2	S2 → S1	Total
Amount of transitions, to state	12	4	4	20
Amount of transitions, to private	S1 → S2	S1 → P	S2 → P	Total
	12	4	6	22

One possibility to amend this somewhat is to maximize the amount of positive outcomes by coding all transitions in the same direction as a single variable. If I assume that there are similar incentive mechanisms behind the choice to reform from P to S1 as there are to reform from P to S2 or S2 to S1, it would make theoretical sense to group the transitions together. Table 3.3 above shows all transitions in accordance with the direction. This would bring the total amount of transitions to 20 and 22 for each direction, respectively. While this will not solve the problem of rare events entirely, it amends it. However, it must be noted that this eliminates the possible differences between what incentivizes state leadership to choose S1 as opposed to S2, which might lessen the inference possibilities from the results.

One way to counteract this, regularly used in small-n dataset is to perform an exact logistic regression. However, exact logistic regression is very computationally heavy and is therefore usually unfeasible even with strong memory software capabilities. With $n > 200$ or with any regression models that include several covariates or continuous independent variables, exact logistic regression is not a good option with the software limitations of Stata and regular computers. A different alternative is a censored regression model, which is proposed by

3.5.3 Fixed vs. random effects: Hausman test

In a design like this, it is difficult to make strong causal designs between the explanatory variables and the dependent variable. It is also very unlikely that all possible independent variables can be accounted for when explaining changes in ownership and control. Controlling for unobserved heterogeneity between countries is an important factor. There are quite likely several differences between countries that cannot be accounted for. The regular statistical go-to solution to this is to include dummy variables for all level two units in the analysis. This is usually known as fixed effects. A drawback to using fixed effects regression is that time invariant variables can not be controlled for in the analysis, because all variation between countries only is controlled for by the dummy variables. The upside to this however, is that *all* country-specific and time-invariant effects are effectively controlled for in the model. The ability to control for such unobserved heterogeneity is why many scholars choose to pool their data just for the purpose of controlling for these unmeasured explanatory variables, with no other particular reason for doing so (Plümper & Troeger 2007).

Using fixed effects also makes it unable to make inferences about units not included in the analysis. With a fixed effects estimator, the unit effects of the unobserved units are unknown, thus making it impossible to do out-of-sample predictions (Clark & Linzer 2012). Another problem is that all clustered units with only non-positive outcomes (only zeroes) cannot be included in the model. In this case, all states where ownership change did not take place is excluded from the model, which is impractical and leaves out a significant amount of data. Although it differs depending on the type of design, it is generally considered more consistent to

use fixed effects models when analyzing panel data, although this may not always be the most efficient. Random effects models are however considered by many scholars to be the most efficient model in panel data, as long as it is statistically justifiable to use it. The Hausman test gives an indication of whether the null hypothesis that coefficients estimated from fixed effects are the same as the ones from random effects is true. If the Hausman test fails to reject the null hypothesis, it can be assumed that there is somewhere between close to approximately zero correlation between the covariates in the model and the unit effects, which is one of the assumptions of random effects modelling. An insignificant P-value here thus indicates that it is safe and statistically viable to use the random effects model as opposed to fixed effects. The test does indeed indicate that if the choice is between random and fixed effects, the former is preferable in this case.

An important distinction to make when attempting to explain the effect of price environment on the development of ownership models is whether the effect can be observed within or between the countries that are under observation. Between-country effects measures whether changes in oil price affects the average probability that changes in ownership may occur in an oil-producing country, or as the case may be, whether a certain ownership model will materialize in countries that are starting out with oil production. Also, between-country effects will give an impression of the general variation in ownership structures, which will help illustrate whether there are trends in state ownership versus private ownership and whether one manifests more often when oil prices are high, compared to the other. Within-country effects on the other hand measures whether oil price climate affects the probability that a single country will change its ownership model following oil price changes. This makes it possible to better observe whether states' individual development trajectories are affected by the independent variables. It also enables the observation of variations between states on the presence (or strength) of the effect of oil price on the dependent variable. The within-effects may be of more academic value than the former, but both illustrate the relationship between the variables that are included in the study. A design as this is mostly useful to capture within-country variation while using techniques for statistical control. However, as mentioned above, it is an approach that does not yield strong causal inferences.

Chapter 4: Analysis

This chapter will present the results from the analysis itself. The first part discusses the evolution of oil prices and how the rise in popularity of state ownership potentially reflects this. This will be based mostly on the descriptive statistics laid out in the previous chapter. The subsequent parts present the results from the multinomial regression as well as the logistic regression with random effects. Any theoretical inferences that can be made from these results are then presented in chapter 5.

4.1 A closer look at the evolution of ownership

The evolution of international oil prices (as shown in graph 3.2) gives an impression of the sudden and abrupt growth in income for oil exporters. The initial spurt of growth happened between 1970 and 1974, with the most significant burst happening in 1974. During this period, the oil price grew from barely above \$3 to reaching \$10.84 per barrel in the second half of 1973, further growing in 1974. In 2013 dollars this amounts to a growth from \$10.79 to \$54.73 per barrel. This tendency continued through the 1970s, with a second spurt of growth in 1979, with a rise from \$50.09 in 1978 to \$101.42 (2013 international dollars) in 1979. This signified a peak in international oil price levels. In the 1980s and 1990s, the growth turned around, and oil exporters instead experienced negative growth, with prices steadily descending and hitting the bottom in 1998 with contemporary prices reaching as low as \$10.72 at one time. At the turn of the millennium, prices started climbing more steadily and gradually however.

Graph 3.3 as shown in the previous chapter shows how the oil shock variable relates to the real price levels, and paints a clearer picture of the volatility of oil price. Following the evolution in the 1970s through the 1980s, there are three significant oil shocks observable: The two positive shocks in 1974 and 1979, as well as the negative one in 1986, is observable in the right hand-side of the scale. A similar shock is observed in the 1998 oil crisis. Otherwise, there are only smaller impacts during the 2000s, with one notable exception being the 2008 financial crisis, which resulted in a drop that almost halved the oil price in 2009. While the 2009 levels were

historically not particularly low, the shock impact is stronger because of the continuous climb of the prices ever since 2001.

In a side-by-side comparison with the evolution of different petroleum ownership models (table 3.1), there are no immediate visible correlations between governance model and price levels to be observed in the sample, with one exception. There is a significant increase in state ownership structures especially during the 1970s. In 1974, almost half the states in the sample had state ownership with control, and in 1975, more than 3/4 of all the observed states had either state ownership with or without control. However, this is a period that also saw the emergence of several new petroleum exporters, which also implies that many of the new exporters chose state

Table 4.1: Ownership model transitions vs. NOC counter, 1960-2010

	P -> S1**	P -> S2**	S2 -> S1**	NOC
Algeria	1971			1963
Angola				1976
Argentina			1963	2005
Azerbaijan				1992
Bahrain				1975
Bolivia	1969			1936
Cameroon				1980
Congo Brazzaville				1974
Ecuador	1972		1990	1972
Egypt	1961			1976
Equatorial Guinea				2005
Iran			1973	N/A
Iraq	1961, 1972			1964
Kazakhstan		2005		1996
Kuwait	1974			1975
Libya		1971		1968
Malaysia		1974		1974
Nigeria	1969			1971
Oman				1974
Peru		1968		1969
Qatar				1974
Russia	2005			N/A*
Saudi Arabia	1974			1974
Sudan				1996

Syria	1964		1962
Trinidad and Tobago			1974
Tunisia			1972
Turkmenistan			1991
UAE			1971
Uzbekistan			1992
Venezuela	1975	2001	1976
Vietnam			1976
Yemen			1996

*Although Russia has several NOC-status firms, none were established after the fall of the Soviet Union, and are not included here.

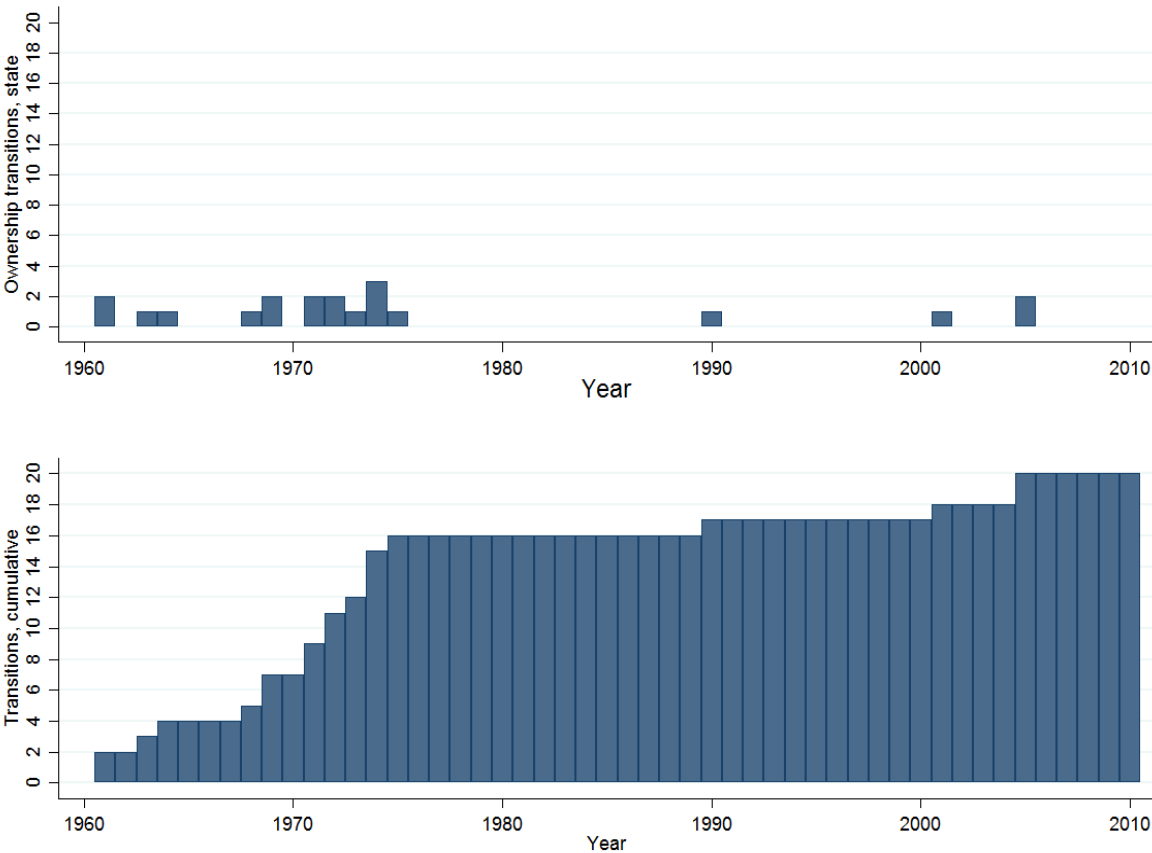
**S1 = State ownership with control, S2 = State ownership without control, P = Private ownership

ownership, both with and without control, in the 1970s. This tendency does not immediately follow the drop in oil prices in the 1980s and 1990s, although there are slightly more private ownership models to be observed in this period.

There are 20 transitions between ownership models in the direction of *either* state ownership without control or state ownership with control. These are shown in table 3.3, as well as in graph 4.1 (starting on the next page), which shows when these took place as well. Most of the transitions happened in the first half of the 1970s, although many took place before the oil shock in 1974. In comparison with Guriev *et al.*'s statistic of expropriations in the same sample states (2009), there is a similar tendency however, where most expropriations happened in the 1970s as well (shown in graph 4.4 at the end of the chapter). However, there are significantly less changes in ownership model than there were expropriations in this period, and the sample period overall. The graphs in 4.1 show all the transitions observable at each year, as well as a cumulative graph of all transitions. For instance, when one transition takes place in 1990, this is reflected with the cumulative graph adding one transition in the total stack. This graph can then be compared to the establishment of NOCs within the same period and sample. Graph 4.6 shows when and if the sample states created NOCs (Mahdavi 2014) between 1960 and 2010: Most of the NOCs were created in the late 1960s to mid-1970s. This fits well with the statistic of when most expropriations took place. The graphs that show the timing of expropriation, NOC establishment and eventual privatization of NOCs are all shown in graph 4.4 to 4.6 at the end of this chapter.

Meanwhile, transitions towards more private are less centred on a specific time period. This gives the rough impression that transitions towards private ownership are less connected to oil price shocks or changes in oil prices. Most of these transitions took place in the late 1980s and the 1990s (shown in graph 4.2): When compared to privatizations of oil assets, originally collected by Warshaw (2012), most of privatizations happened in the 1990s and early 2000s. While ownership and control changes have no immediate theoretical relation to privatization of oil assets, it can be reasonable to assume that the underlying political incentives are similar in both cases, with determinants such as oil price shocks. However, Warshaw does not test the effects of oil shocks on privatizations in the analysis.

Graph 4.1: Changes in ownership and control, private to state.



Directly comparing ownership model transitions with NOC establishment shows some overlaps, although the creation of an NOC in a country does not automatically entail a simultaneous

ownership transition, as seen. As previously mentioned, NOC establishment has been used as a proxy for nationalization in the literature. Comparing the two is thus the closest I can get to a direct comparison between nationalization and reforming ownership models to state ownership.

Graph 4.2: Changes in ownership and control, state to private

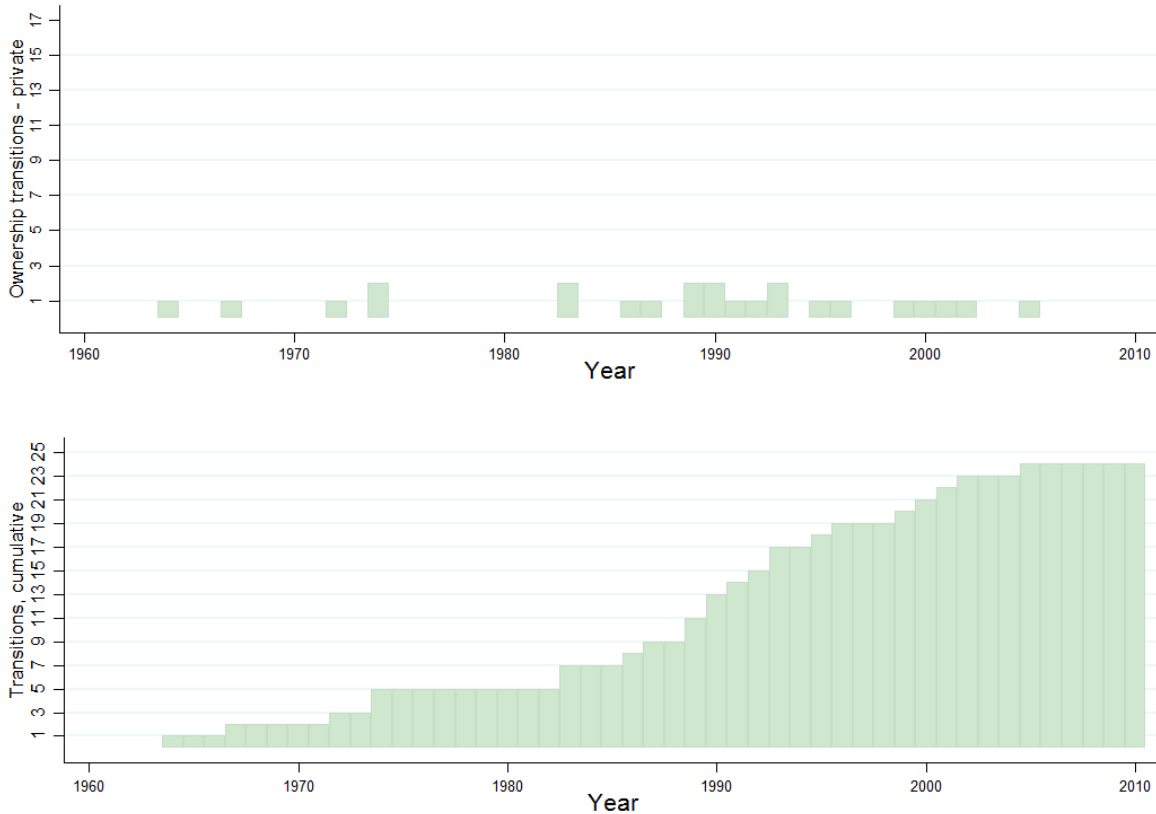


Table 4.1 shows a complete list of the countries that either established an NOC or increased their ownership and/or control (as illustrated by the three different columns showing possible transitions). Of the 32 countries that established an NOC in the period between 1960 and 2010, 16 of them never changed their ownership model during the same time period. This is a rough indication that when oil exporters nationalize their petroleum industries, there is not automatically a change in petroleum law that reflects this policy change. However, there are observable similarities as well: For instance, countries such as Saudi Arabia, Ecuador, and

Malaysia established NOCs while simultaneously changing ownership models from P to either SI or $S2$. Furthermore, there are several occasions where NOC establishment took place in approximately the same period as an ownership transition, give or take 1-2 years. Venezuela changed their ownership structure in 1975 and established PDVSA as a national oil company the following year. A similar tendency can be observed in Peru as well as to an extent Nigeria (where an NOC was established two years after ownership transition, between 1969 and 1971). Although obvious relationships can be observed, some cases are much less clear-cut: Egypt changed their ownership model from P to SI as early as 1961, but did not establish an NOC until 1976. The same can be observed with Algeria, which established an NOC in 1963 but did not change ownership model until 1971 (two years after joining OPEC). Finally, the most obvious discrepancy between nationalization (NOC establishment) and ownership transitions is the units that changed their ownership multiple times, which is Ecuador (1972, 1990), Venezuela (1971, 2005) and Iraq (1961, 1972): None of the countries nationalized *twice* in the sample period, however.

Finally, the same statistic can be compared to the expropriation statistic in the same period (graph 4.4). However, the frequency of expropriation taking place, especially in certain countries, makes this less useful from an analytic point of view. Also, almost all expropriations in this sample took place in the early 1970s.

4.2 Multinomial mixed-model logistic regression

Interpretation of a multinomial logistic regression model works somewhat differently than those of a binary type: The coefficients are equivalent to an increase in the log odds of being in the reference category given an increase in X . In a binary model, the coefficients would simply be the odds of being in category k , without explicitly referring to the reference category. Thus, two different models are needed, which estimate the change in the odds of being in category 1 *or* 2 rather than category 3. Two tables are presented in this section: Table 4.2 shows the coefficients for each outcome ($SI | P$ & $S2 | P$) through three different models, model 1 simply showing a pooled multinomial logistic regression and model 2 and 3 showing a variance component model and adding a random effect for oil price, respectively.

The results from table 4.2 show a significant positive effect of oil price on the likelihood that a state has ownership with control in a given year, across the three different models. Model 1 is a simple multinomial logistic regression where the base category of the response variable is private ownership. The coefficients are therefore interpreted as the increase in log odds of category 1 (S1) or category 2 (S2) being the case as opposed to category 3, for each unit increase in the independent variable.

Table 4.2: Multinomial mixed logistic regression (with GLLAMM)

	Multinomial logistic			Random intercept			Random variable		
	S.O control	with S.O control	w/out control	S.O control	with S.O control	w/out control	S.O control	with S.O control	w/out control
oil price, logged	0.425*** (0.086)	-0.262** (0.084)		1.973*** (0.203)	2.389*** (0.207)		1.567*** (0.267)	1.986*** (0.271)	
regime	-0.116*** (0.018)	0.045** (0.016)		-0.687*** (0.052)	-0.799*** (0.053)		-0.624*** (0.063)	-0.736*** (0.064)	
opec membership	0.295* (0.120)	-0.754*** (0.141)		3.902*** (0.405)	4.193*** (0.410)		-0.656* (0.330)	-0.397 (0.335)	
intercept	-1.369*** (0.322)	0.789** (0.304)		-4.514*** (0.621)	-5.874*** (0.639)		-9.519*** (1.011)	-10.866*** (1.024)	
Std. of intercept				8.433	8.433		7.211	7.211	
Std. of slope							2.683	2.683	
Rho				0.99	0.99		0.99	0.99	
Log likelihood	-2067.61	-2067.61		-1297.05	-1297.05		-1258.18	-1258.18	
N (level 2)	49	49		49	49		49	49	
N (level 1)	1987	1987		1987	1987		1987	1987	

Note: Base category for each model is (3) Private ownership.
Significant at 0.001=***, 0.01=**, 0.05=*

The base model shows a significant increase in the log oil price increases the likelihood for state ownership and control, as well as a negative relationship between regime and the same category.

This is also present when controlling for OPEC membership in the model. This suggests that the probability of a state having ownership with control increases when oil price is high, and that the probability decreases in more democratic regimes with more executive checks and balances. For state ownership without control however, there is a negative relationship between oil price and the likelihood for S2 over P. Similarly, there is a positive relationship between regime and the probability of state ownership *without* control. While the log odds cannot be interpreted directly, the odds can be logarithmically transformed to acquire the odds ratios: positive log odds indicate an increase in the odds of S1 or S2 instead of P.

Models 2 and 3 are interpreted in the same way, except that these are estimated using the generalized linear latent and mixed models technique. This makes it possible to add a random intercept and a random slope to the model to control for potential variance between the clusters, i.e. the sample countries. The effects of some of the variables are moderated slightly in model 2 and 3. Adding a random intercept and controlling for between-cluster variation makes the positive effect of regime disappear. The size of the coefficients for oil price also increases for both outcomes once a random intercept is added. Model 2 also adds a statistic for *standard deviation of intercept*. This is calculated at 8.433, which should be interpreted as the standard deviation of the base likelihood of either outcome taking place, all other variables set at 0.

Both the models with random intercept and random slope show similar results in the coefficients for oil price and regime: A positive correlation between oil price and the probability of both state ownership with and without control in comparison to private ownership, and a similar yet negative correlation for regime type. OPEC membership also, as would be expected, increases the probability that a country has either forms of state ownership as opposed to private ownership. The within-country variance (or level 1 variance) is shown through the *standard deviation of intercept* statistic. This is estimated at 8.433 in model. Once the effect of price is allowed to vary between countries, this number decreases slightly, to a standard deviation of 7.211. In more substantial terms, the indication is that the effect of oil price on the probability of either S1 or S2 over P varies between the countries in the analysis. However, the effect observed from the coefficients is still visible and significant. Meanwhile, model 3 adds a random slope effect as well, allowing the effect of one variable to vary between countries. In this case, this

variable is the *oil price* variable. The standard deviation here is 2.683. The observed effect of oil price on for both S1 and S2 thus varies between countries with a standard deviation of 2.683.

The last statistic that should be addressed is the *rho*, also referred to as the intraclass correlation coefficient. This gives the proportion of the total variance in the dependent variable that is accounted for by clustering, which in this case are differences between countries. This statistic gives little useful information, as it approaches 1 across all models with random effects added. A *rho* of 1 suggests that all observations within a cluster are identical: This is almost the case, as there are numerous countries that never change ownership models and thus only differs from other countries, not within clusters. However, this is to be expected in a sample like this.

Although it is possible to compute the standard errors for the within-country variance and use the Wald statistic to test the significance of the random effects model, the situation is unusual as the sampling distribution in this particular type of model is unlikely to be normal. The situation would instead suggest a likelihood ratio test examining the model with and without a random coefficient for oil price (Rabe-Hesketh, Skrondal & Pickles 2005). The likelihood ratio test suggests that the model with the random coefficient is significantly different from the model that treats all observations as independent from each other (model 1). From this, I can gather that a regular multinomial regression without taking into account the nested data, as the one shown in table 4.2, is biased compared to the regression models that accounts for random intercept or random slope.

4.2.1 Hypothesis testing

It should also be tested whether the variance between clusters, (ψ) which in this case would be the country level, is zero. If this is the case, there is no reason to perform a multilevel or mixed model of analysis because the variation between the countries is non-existent, meaning that the effect of the covariates is similar across all units, regardless of any unobserved differences between countries. Usually, this is performed with a likelihood ratio test where the null hypothesis equals zero variance. If H_0 cannot be refuted, this suggests that simpler models where only the covariates are included in the analysis would be sufficient in order to capture the nature

of the longitudinal data. All models tested in this chapter fulfill the general requirement that p-values should be > 0.001 , which suggests that the null hypothesis should indeed be rejected, and that a regular maximum likelihood model should be rejected in favor of a mixed or clustered model. This means that the use of statistical controlling mechanisms for handling longitudinal data can be supported both theoretically and statistically.

4.3 Transitions between structures

The weakness in this type of design is the difficulty in pinpointing determinants as to why variation and changes in control occur, not just ownership. While the temporal dimension of the data is attended to with the random effect, the timing of the actual transition is neglected. Neither is the difference between states that previously had a different ownership structure, or if there are new players that have started out in the period following a spike in oil prices. To check this, the dependent variable must account for the time of change, not just the presence of a certain structure over another.

Of the 49 petroleum exporters included in the sample, 24 of them never change their initial structure of ownership and control during the observation period. This leaves us with 25 that do. Furthermore, only 17 of the countries change their model towards state ownership: Either through transitioning from private ownership to state ownership, or from state ownership without control to state ownership with control. Of these, three countries change models twice (Iraq, Venezuela and Ecuador) leaving a total of 20 transitions towards *more* state ownership and control in the sample. There is a similar tendency in the other direction: Of the 49 countries included, 20 have experienced a transition towards less state control, either transitioning from state ownership to private ownership, or a model of state ownership with control to one without control. Similarly, there are three countries that change models twice (Algeria, Argentina and Bolivia) which leaves a total of 24 transitions towards *less* state ownership and control.

4.3.1 Random effects analysis

The random-effects analysis find some statistical support for the main hypothesis: That oil shocks have an effect on the probability that states change ownership models in favor of more state presence. This is shown in the coefficients under *oil shocks* in table 4.3, which shows consistently positive log odds increase of one unit change in oil shock on the dependent variable, across all models (all other variables kept constant). On the other hand however, there is little support to be found regarding the effect that regime types have on states' propensity to change ownership models. Most of the coefficients are positive, excepting model 3 in table 4.3, which shows a negative. All the coefficients are quite small and non-significant: The log odds from regime in all models goes from -0.028 to 0.044, and converted into odds ratios 0.972 to 1.045. Thus the change in odds of an event changes little with one unit change in *regime*.

Model 1 through model 7 shows an increasingly complex logistic regression with random effects where more covariates are introduced with each model. Initially, there is no statistically significant relationship between oil price shocks and the propensity for states to change their ownership model. However, this changes when the oil price levels *per se* for each year is introduced to the model. Model 3 shows a significant positive effect of oil shock variable, which suggests that the probability of changing ownership increases when adjusting for oil shocks. This implies that the probability of such a transitions occurring is approximately 2.2% higher when the oil shock is measured at an arbitrary value of 2, all other variables set at their mean value. While this is a small change, it does give a statistically significant estimation of the effect of oil price shocks on the likelihood of petroleum ownership change. This relationship is shown more easily interpretable in graph 4.3 below, which shows the predicted probability of transition given increasing oil shock values (with 95% confidence intervals):

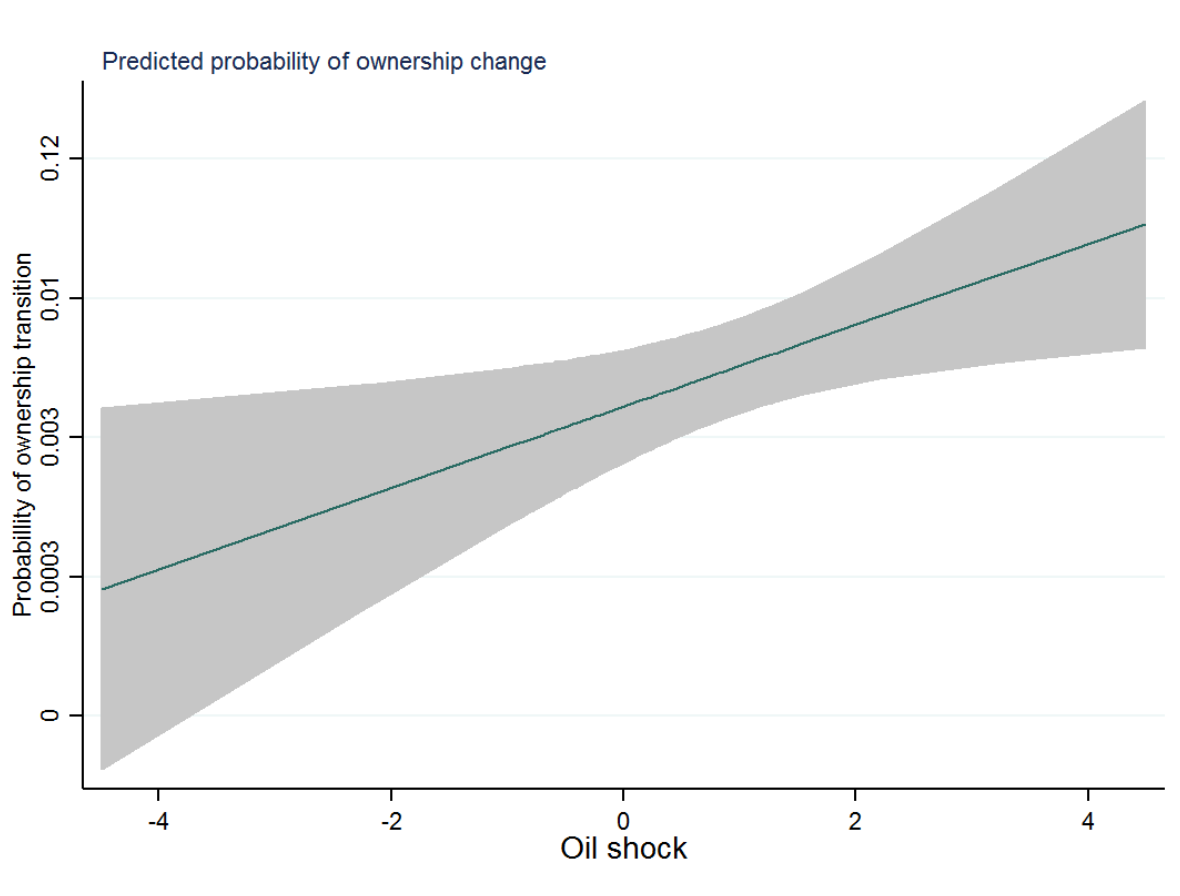
Table 4.3: Logistic regression with random effects (DV: transitions to state ownership)

	1	2	3	4	5	6	7
intercept	-4.591*** (0.225)	-4.672*** (0.242)	-4.568*** (0.337)	2.634 (1.613)	0.234 (1.957)	1.035 (1.775)	2.276 (1.628)
oil shocks		0.210 (0.150)	0.208 (0.160)	0.887*** (0.208)	0.631** (0.229)	0.710*** (0.222)	0.890*** (0.209)
regime			-0.028 (0.069)	0.007 (0.070)	0.014 (0.070)	0.019 (0.071)	0.044 (0.071)
oil price				-2.284*** (0.545)	-1.671** (0.594)	-1.867*** (0.574)	-2.344*** (0.547)
transitions in previous year					1.106* (0.555)		
transitions same region						1.263* (0.514)	
opec membership							1.123* (0.469)
log likelihood	-111.92	-110.98	-110.85	-99.22	-97.20	-96.44	-96.47
sigma u	0.002 (0.027)	0.003 (0.057)	0.003 (0.034)	0.002 (0.023)	0.002 (0.023)	0.002 (0.025)	0.002 (0.024)
rho	1.24E-06	2.10E-06	2.09E-06	9.11E-07	9.14E-07	1.08E-06	9.48E-07
N (level 2)	49	49	49	49	49	49	49
N (level 1)	1992	1992	1987	1987	1987	1987	1987

Standard errors in parentheses.

*** Significant at 0.001 level, ** significant at 0.01 level, * significant at 0.05 level.

Graph 4.3: Probability of transition as a function of price shock



The coefficients for the regime variable is slightly negative in model 3 and positive when controlling for regular oil price: However, there is no observed significant relationship between the dependent variable and regime type, even when controlling for other variables. This is consistent across all models. The same is true for the variables controlling for the diffusion effect worldwide as well as regional diffusion. It should also be mentioned that several other models using only bivariate regression approaches are tested, with consistent results as the one above. The same is true when testing for interaction effects between the oil shock variable or the regime variable and the rest of the predictors: No substantial or significant effects are observed. These models are not included here.

The control variables are added to the regression in models 5 to 7. These are all significant at the < 0.05 level, although barely so. More importantly, including the variables does not have any substantial effect on the initial results that were tested previously. The log odds of an event

happening are positive, thus indicating higher odds in OPEC countries compared to non-members. Similarly, the log odds is positive for both previous-year event variables, which means that a transition in one country increases the odds of another in a different country the next year.

Finally, the coefficients in *sigma u* and *rho* are the panel level estimators: They account for the standard deviation of the between country-variance and the fraction of variance in the dependent variable that is accounted for by the panel estimator, respectively. The large standard errors for the \hat{u} standard deviation as well as the size of the estimated coefficients suggest that the panel-level variance component is unimportant. This is also suggested by the *rho* coefficient that is very close to zero. The confidence intervals calculated from the rho coefficients yields results from approximately 0 to 1, which suggests that conventional software have trouble giving reliable estimations. Also, a likelihood ratio test for the null hypothesis that the panel estimator is different from the simple pooled estimator shows that this is not significant at the conventional < 0.05 level. Therefore, the estimated results from the panel-variance components are difficult to analyze further, but may suggest that there is no between-country level difference in dependent variable variance. However, this is more likely caused by the low number of positive outcomes in the dependent variable, i.e low amount of transitions taking place, which may cause biased results in such regression models, as mentioned above.

To account for administrative delay, I also include a model that uses a lagged dependent variable: In practice, this model controls whether the values of the covariates have an effect on the probability of a transition in the following year. This is shown in table 4.4. Also included are separate models to account for each possible ownership model transition: While useful in a comparative view, the lack of positive outcomes on each DV separately compared to negative outcomes makes it unlikely that the results are unbiased. Still, there are similar effects observed as the model that previously were tested. Price shocks significantly increase the probability of transitions both for P to S1 and P to S2: Not, however, for S2 to S1.

Table 4.4: Logistic regression with lagged DV / all possible transitions

	lagged DV	P to S1	P to S2	S2 to S1
intercept	-2.209 (1.768)	1.082 (2.508)	1.067 (3.689)	-2.594 (3.256)
oil shocks	0.242 (0.233)	0.716* (0.305)	1.064* (0.418)	0.268 (0.553)
regime	0.037 (0.070)	-0.033 (0.100)	-0.017 (0.165)	0.167 (0.142)
oil price	-0.992 (0.508)	-2.042* (0.782)	-2.329 (1.245)	-1.305 (1.013)
sigma u	0.002 (0.023)	0.002 (0.034)	0.005 (1.213)	0.002 (0.517)
rho	9.14E-07	2.12E-06	8.00E-06	7.73E-07
N (level 2)	49	49	49	9
N (level 1)	1964	1977	1977	1977

Standard errors in parentheses.

*** Significant at 0.001 level, ** significant at 0.01 level, * significant at 0.05 level.

4.3.2 Comparison with alternative dependent variables

The same model, run with different dependent variables, is shown in table 4.5: The data on expropriations by Guriev *et al.* (2009), NOC establishment by Mahdavi (2014) and privatizations by Warshaw (2012) and are useful for comparing whether the same determinants can explain related phenomena. These are adapted for the same sample as the regressions run above. The coefficients show similar results as table 4.3 when comparing expropriations and NOC establishment, with some exceptions. In these models, the *oil shock* variable give a significant positive coefficient, controlled for *oil price*, which yields a negative coefficient. The former finding also replicates the findings from the original authors. While the coefficients for *oil price* are identical in the two models in table 4.5, they are smaller than when compared to the model for ownership transitions. Furthermore, neither of the coefficients for *regime* is significant in any of the three models. While OPEC membership shows a positive effect on the likelihood of changing ownership model as well as expropriating, this is not the case for the NOC model.

There is also an observed significant effect for expropriations in the previous year, showing some support for the diffusion theory in the case of expropriation: Not when testing the same theory for NOC creation, however.

Table 4.5: Alternative DV

	Expropriation	NOC creation	Privatization
intercept	-3.323*** (0.867)	-1.106 (1.188)	-6.915* (2.733)
oil shocks	0.506*** (0.109)	0.672*** (0.150)	0.348 (0.324)
regime	-0.073 (0.052)	-0.109 (0.069)	0.468** (0.164)
oil price	-0.936*** (0.237)	-0.928** (0.351)	-0.741 (0.738)
opec	2.086*** (0.357)	-0.164 (0.425)	- ⁸
event (1) in $t-1$	2.628*** (0.379)	0.471 (0.421)	1.027 (0.653)
sigma u	0.649* (0.247)	0.001 (0.016)	1.677** (0.739)
rho	0.113	4.56E-07	0.461
N (level 2)	49	49	49
N (level 1)	2093	2093	2093

4.3.3 Transitions towards private ownership

An identical analysis performed on transitions in the direction towards less state control role is shown in table 4.6. None of the Wald chi-square tests from the five models indicate that the results are statistically significant from zero overall. The results from this model, similarly to the previous models, suggest that there is no significant country-level variance to be observed in the probability of reform towards *less* state control. Overall, none of the models are statistically

⁸ Unsurprisingly, none of the privatizations listed in Warsaw (2012) happened in OPEC member states, which means that variable is dropped in model 3.

significant at the < 0.05 level. Similarly, none of the independent variables have significant effects.

Table 4.6 Logistic regression with random effects (DV: Transitions to private ownership)

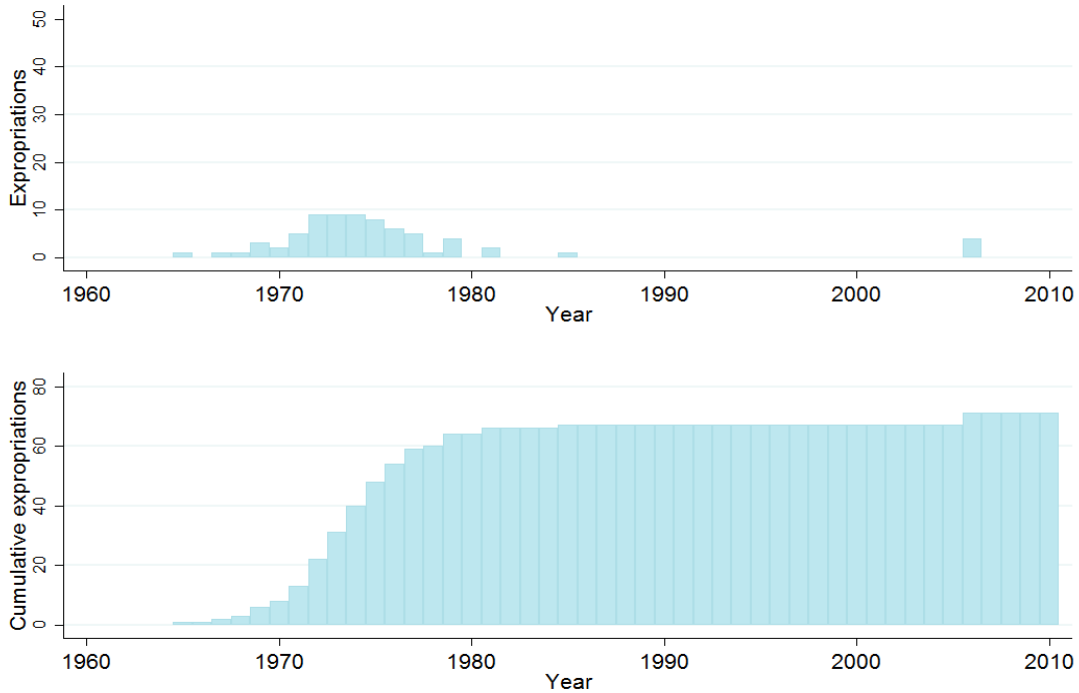
	1	2	3	4	5	6	7
intercept	4.449*** (0.209)	-4.451*** (0.212)	-4.674*** (0.324)	-3.596** (1.323)	-3.577** (1.347)	-3.871 (1.368)	-3.732 (1.333)
oil shocks		0.010 (0.147)	0.012 (0.149)	0.091 (0.186)	0.091 (0.186)	0.069 (0.182)	0.091 (0.186)
regime			0.056 (0.059)	0.059 (0.059)	0.059 (0.059)	0.054 (0.059)	0.074 (0.061)
oil price				-0.313 (0.378)	-0.315 (0.379)	-0.265 (0.383)	-0.334 (0.379)
transitions in previous year					-0.031 (0.432)		
transitions same region						0.892 (0.514)	
opec membership							0.495 (0.454)
log likelihood	-125.48	-125.48	-124.98	-124.64	-124.63	-123.37	-124.07
sigma u	0.002 (0.022)	0.002 (0.022)	0.001 (0.013)	0.001 (0.013)	0.001 (0.233)	0.001 (0.232)	0.001 (0.228)
rho	8.48E-07	8.49E-07	2.77E-07	2.76E-07	3.51E-07	3.46E-07	3.29E-07
N (level 2)	49	49	49	49	49	49	49
N (level 1)	1992	1992	1987	1987	1987	1987	1987

Standard errors in parentheses.

*** Significant at 0.001 level, ** significant at 0.01 level, * significant at 0.05 level.

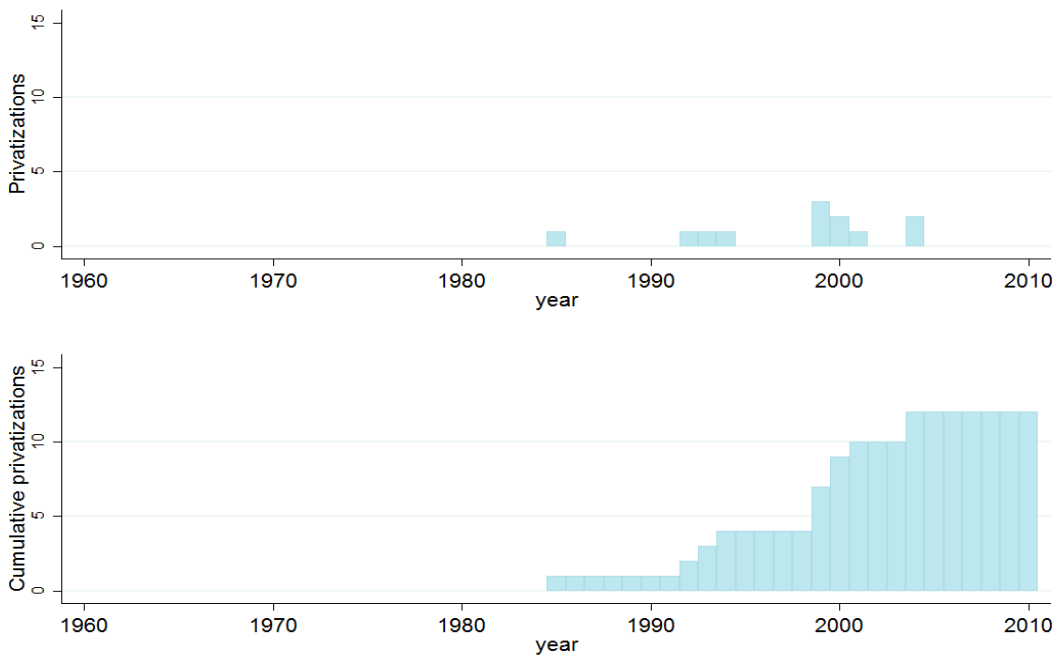
Graph 4.4: Expropriations of oil assets, by year

Expropriations (Guriev 2009)



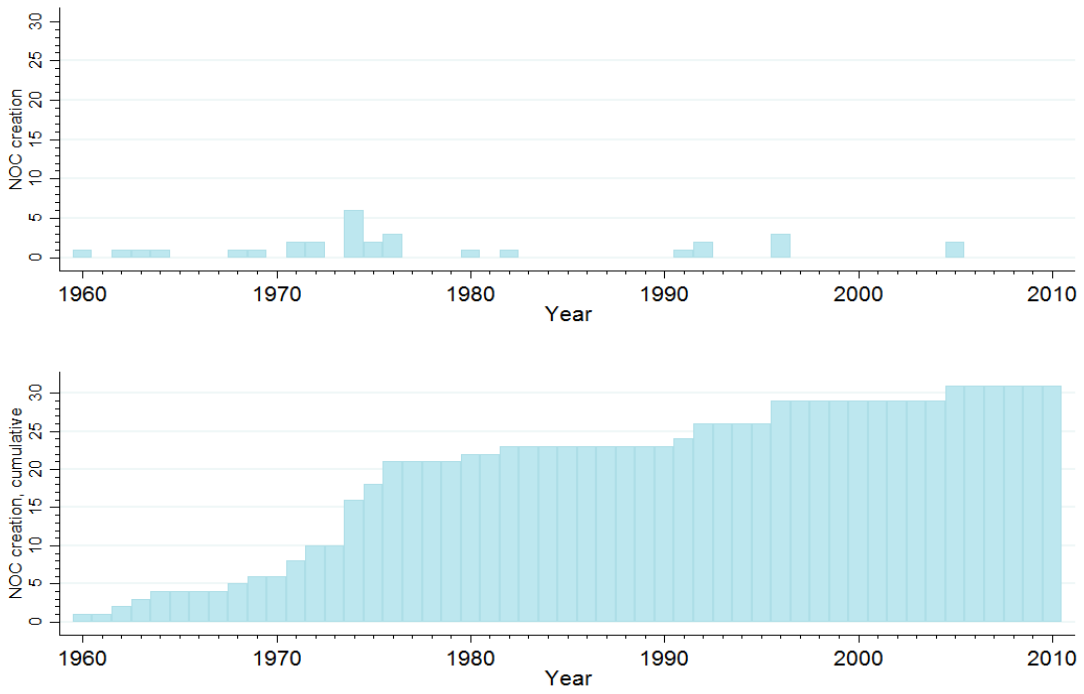
Graph 4.5: Privatizations of NOCs, by year

Privatizations (Warsaw 2012)



Graph 4.6: NOC creation, by year

NOC creation (Mahdavi 2014)



Chapter 5: Discussion

The quantitative analysis shows that the economic context shaped by changes in the oil prices has a certain impact on the structures of ownership and control in petroleum, although only partly so: While there are some correlations to be observed, these are limited. The most obvious correlations are found in the multinomial logistic regression analysis, in terms of statistical correlation and generalizable results, and these results are partly complimented by some of the results through the random effects regression. All together however, the results are ambiguous. This may be the result of weaknesses in the design, as there could be more precise models to apply based on hierarchically structured data with few events. I am, however, unaware of any alternative approaches available. Another problem is likely related to ill-suited data. This chapter will discuss the implications of the results in both models more in-depth. I will also extrapolate possible generalizations that may show itself, as well as possible shortcomings with the analysis and the models applied in the thesis.

5.1 What can be learned from ownership model variation?

The models that are based on a multinomial logistic regression all show a similar tendency, which confirms the prior suspicions that ownership models have followed the historical evolution of the oil price levels in the period between 1960 and 2010. On the one hand, this could suggest that state ownership and control have grown in popularity with the rise of the oil price, and as a consequence of this. On the other hand, it could also be a result of resource sovereignty and resource-rich states' growing awareness of the values they have available. The correlation observed could therefore, of course be coincidental.

Regardless, there is an observed correlation that is shown through several different models, all with consistent results: The states in the sample are more likely to have state ownership with control (S1) and without control (S2) as opposed to private ownership when the oil price is high. Furthermore, there is also a clear tendency for authoritarian states to choose both S1 and S2. As

previously mentioned, higher levels on the regime variable indicates more democratic states, on a scale from 1 to 10. The results from the final model show a log odds of -0.624 for each unit increase in the regime variable for S1, meaning that the probability of S1 occurring decreases as a country's regime gets more democratic.

However, the models does not show any clear distinction between either of the two possible non-base outcomes, which means that it is difficult to make more detailed inferences about what type of ownership model that are more likely than the other.

One of the shortcomings with the multinomial model is that it simply indicates the correlation between oil price and ownership models, but does not give a clear picture of the causality involved. The period when state ownership increased in popularity is the early- to mid-1970s, a period when the profits from oil exports also increased by an unprecedented amount. However, if this trend shows that state ownership peaked in popularity during the time of the first oil crisis (as the distribution of ownership models seem to suggest) or that new up and coming petroleum exporters chose this model as a direct reaction to the potential rewards that came from petroleum at the time. This model simply suggests that there is a correlation between price level and the presence of state ownership. What can be posited from this however, is that the results are similar to and compliment the random effects logistic model, and also supports the general consensus in the rest of the literature that state presence and national control have a strong correlation with the rise of oil revenue.

5.2 Why do they change?

The second analysis tests for changes in ownership model by increasing the likelihood of a transition taking place. All models taken together, the analyses support the notion that change in the direction of increased state ownership and control are more likely to take place when 1) oil price shocks are high, and 2) when a state is member of OPEC. There is also some support for the same to happen when other states have done a similar reform the previous year, both internationally and in the same geographical area. However, there is no support for increased likelihood in less democratic states. The overall line that the analysis suggests is that

international factors play a bigger role in determining ownership models change, while domestic factors does not.

As shown, a limited amount of the variables in the analysis show statistical significance, meaning that numerous assumptions about the determinants of changes in ownership structure are not supported by the data. However, hypothesis 1 is supported on the basis of the analysis in table 4.3 alone, where the positive coefficients support the assumption that oil shocks increase the probability of ownership structure transitions in the direction of more state control. This is a statistically significant finding, and tentatively confirms H1. This assumption strengthens the previous suggestions that the evolution of ownership and control structures parallells changes in international oil prices, as shown in the multinomial regression in table 4.2.

The strongest argument of falsification is the non-significant results of the simple bivariate logit regression in model 1: By itself, there is no observable connection between price shocks and ownership change that cannot be hand-waved as a coincidence, according to the model. The direction of the coefficients show an increase in the log odds of a transition taking place when oil shocks occur, but the coefficient is relatively small, to the limited extent that the log odds can be directly interpreted. When translated to odds ratios, the ratio grows from 1.131 to 2.162 between models 3 and 4. Also, it should be mentioned that the econometrics literature tradition often use more liberal cutoff values for significance tests, i.e. 10% level. Most of the results that were insignificant at the 5% level were, however, also insignificant at the 10% level. One important exception to this is the random effects model that tested increase in probability of a transition from private ownership (P) to either S1 or S2, which indicated a positive effect that was (barely) significant at the 10% level. This means that excluding the transition of S1 to S2 from the positive outcomes in the dependent variable also increased the observed correlation between price shocks and ownership transitions.

5.2.1 Confounding factor

Some attention should be brought to the fact that the registered effect of oil shocks is only statistically significant when oil price are included. This is consistent across all models tested in

the chapter, with the exception of the models testing for transitions to private ownership. The results by themselves imply that when controlling for oil price *level*, oil *shocks* have a much stronger positive effect on the probability that ownership transitions take place, with standard errors that are sufficiently small so that the effect can be considered significant at conventional levels. The most obvious solution when analyzing instable regression coefficients would be to write it down to multicollinearity. This is very tempting in this situation, considering that price shocks and the log of the oil price is calculated using the same base. This can be controlled for using basic tests such as checks for correlation or variance inflation factor test (VIF).

Considering that the coefficient for oil price *per se* is negative (and significant at < 0.05), and this in itself may suggest that high oil prices do not, in fact, increase the likelihood for transitions towards state ownership and control. Rather, it could mean that the effect is limited to when the growth of oil prices goes from high to low, as measured by the shock variable. This would not be a contradiction: Oil shocks will not be as profound when the prices are high, but all the more powerful if prices are low, especially if there is a long-time trend of low prices. This negative effect of regular oil prices can also be registered when modelling the regression with NOC establishment or expropriation, i.e. similar effect of both shocks and price levels. A situation like this may also be caused by a confounding effect. This would mean that the omitted variable (*log oil price*) is significantly associated with the originally non-significant variable of *oil shock*, which is likely in this scenario. When the former variable is omitted, the remaining variable will show the effect of the one that is left out (which is negative) in addition to its own effect (which still remains positive, albeit with a lesser effect). When oil price is then included in the model, the oil shock variable no longer captures the partial effect of the omitted variable.

The most obvious discrepancy between the previous research performed on nationalizations and changes in ownership models seem to be the frequency of occurrences. While nationalizations or expropriations happens relatively frequent and occasionally more than once in a country, as shown above, this does not always occur concurrently with a change in ownership structure. While this should not be an automatic assumption in any case, it does bring up an interesting point, mainly that changes in petroleum upstream sector policy is not always reflected in laws, contracts or official documents. The lack of variation both within and across countries in these

structures is also observed by Sarbu (2014), which as far as I am aware is the only other research performed on determinants of ownership and control structures. A different point that this illustrates is that the initial choice of ownership structure in a country seems to play a significant role in their further policy: Under half of the countries in the sample changed this policy over the course of the sample period. This could suggest another determinant that is not elaborated upon in this thesis, that of path dependence. Ultimately however, this finding supports the idea that domestic, rather than international circumstances, also plays a role as to what ownership structure a state ultimately chooses.

Another possible explanation to the lack of changes observable in the sample is elaborated upon in the mentioned volume written by Sarbu, the discrepancy between "de facto" ownership and control compared to that of "de jure", as termed by the author herself. Sarbu argues that when comparing "de jure" with "de facto" control, there are several countries where the petroleum law does not fit with the "empirical reality", namely her own data material. This implies that ownership and control structures as observed through petroleum law, contractual frameworks or regulations (as coded by Luong and Weinthal) may not accurately reflect the true policy that many of these countries were permitted in the sample period. Sarbu further argues: "there is a mismatch between what is potentially permitted ("in theory") and what the reality looks like ("in practice")" (Sarbu 2014: 88). If this is the case, then transitions in ownership and control structure will be less frequent in a data sample than in reality. However, this is only illustrated through a discrepancy in her respective data material, not through any further analysis⁹. Any conclusions on the perceived gap between official documented policy and "de facto" control structures remains highly speculative. However, the possibility of this should be acknowledged when the empirical relevance of this thesis' findings are concluded.

I also presented a model that showed the probability of changing ownership model from state ownership (S1/S2) to private ownership (P). While not explicitly mentioned in the hypotheses, I made some assumptions regarding this in chapter 2. This model, as well as any alternatives that were tested along the way, does not confirm any of the previously held assumptions about

⁹ According to Sarbu (2014), 10 of the 49 countries in the sample have this: Algeria, Argentina, Colombia, Ecuador, Iran, Libya, Nigeria, Qatar, Syria and Venezuela.

determinants: None of the models show significant results, even at a liberal 10% significance level. Overall, this suggests that decrease of state control is a mechanism that is determined by other variables than the ones in the model. There is also, unfortunately, the possibility that this model, similar to the other ones presented, are biased because of a lack of positive outcomes in the dependent variable.

Problems with random effects: Tests using fixed effects for each country in the sample yields, as expected from the results in the Hausman test, different estimates for the covariates compared to the original model. However, the general direction of the results is similar. Overall, the random effects model does not result in too much useful information. However, it is helpful purely as a form of statistical control that enables some generalizations that would not be possible with a regular logistic regression model.

5.3 Control variables

The results of the testing of control variables are mostly of a negative kind, with very little significant results in the regression analysis. In the initial analysis,

Surprisingly, there is no statistically significant relevance of the regime variable, which initially suggests that executive restraints and lack of democratic processes have no significant effect on states' propensity to change ownership and control structure and the timing of this. This is surprising mostly because of the findings in similar research, such as the effect of executive constraints on expropriations found in Warshaw (2012) and Guriev *et al.* (2009) that confirms an increase in the likelihood of expropriations when executive constraints are low. The other direction, that which suggests that state control will increase along with executive limitations, cannot be confirmed either. However, this is not necessarily a contradictory result: As argued above, while changes in ownership and control may be a process related to the nationalization/expropriation literature, they are not the same phenomena. Democratic versus autocratic regimes may be related to the form of ownership, i.e. private ownership is more likely in democracies, but does not determine the stability of the current petroleum regime. Not the very least because of the suggested separation between "de facto" and "de jure" petroleum

control, where the latter likely is more connected to potentially "unlawful" expropriations. Even when disregarding the large size of the estimated standard errors for the model coefficients, the effect itself is very small, suggesting very limited correlation between the regime variable and the outcome variable. Another possible explanation could be that the results are skewed because of the sample countries, as all countries included are considered developing countries. However, the distribution in the *polity* variable is quite high, and authoritarian states are not overrepresented in the analysis: If all observations with values below 5 on the *regime* scale are considered authoritarian, roughly 2/3 fall into this category.

The most basic form of argument that can be presented from the diffusion effect, meanwhile, is that when a certain petroleum policy increases in popularity, similar policy seems to follow from it. Whether states copy each other's strategy, or that the growth of states as petroleum entrepreneurs rather than landlords spreads as a product of trends is not clear from the results itself. Ownership and control may also, as shown, be closely related to NOC creation, which could mean that the diffusion effect observed is related to NOC establishment as a policy instrument rather than changes in petroleum law. Finally, the diffusion effect may show up because of the change in leverage in favor of petroleum exporting states across from foreign private companies.

Chapter 6: Conclusions

A significant drop in price and a subsequent fall in profits in the last 18 months have hit petroleum exporters and firms hard. Meanwhile, new discoveries are continually made, and new producers are entering the scene in a much more uncertain future than we have seen in the last two decades. This is likely to directly affect expectations from the states, the international oil firms and ultimately policy in oil producing countries worldwide. Less certainty in regards to profit will if nothing else make state leaders, who have to juggle political support and differing interests, with the potential profits associated with petroleum involvement.

In this study, I can provide a few answers to two interlocking questions. First, I investigate whether there is increased probability of a state's ownership and control structure changing following an oil price shock. Here I find that there is an increased probability of states going from private ownership to state ownership (both with or without control) in *the same year* as an oil shock occurs. However, I could not find any statistical support of this when adding a one-year delay of the transition. In theory this supports the assumption that ownership transitions takes place based on the short-term gain associated with price shock. However, the lack of substantial correlation in the delayed model may be a sign that the original findings are coincidental, although it does confirm the assumption that previous reserach have proclaimed.

Second, I investigate whether democratic states have increased probability of changing ownership model. Here, I find no support for either direction: Democratic regimes are not found to have any statistical differences in probability for ownership change compared to authoritarian regimes. Therefore, we can assess the hypotheses as follows:

A): *Oil-producing states will be more likely to change their petroleum ownership structure to state ownership following oil price shocks:* Confirmed

B): *Democratic or non-authoritarian oil-producers will be less likely to develop state ownership with control:* Not confirmed

Although the results, based on limited data support and availability, are uniform in supporting the proposed Hypothesis A, the overall findings compliment each other to the extent that I can posit the confirmation of it: Transitions are more likely following oil shocks. There are a few caveats here, however. The most significant one is that the results may be biased based on the problem of rare events, which may suggest that the likelihood estimation of the regression is imprecise. The obvious solution to this would be to increase the sample of states that have changed their ownership structure, but this is not an easy task if the sample reflects the reality of oil exporting states: That ownership structure is a fairly static type of institution. Therefore, the major problem of the analysis is the small number of data points I have to work with.

These findings are also complimented by the results in the multinomial regression, showing that state ownership is less likely to show up state non-democratic states, where there are less executive checks and balances. However, this correlation may show nothing more than a connection between similar political institutions. Since states with less executive checks and balances are highly correlated with democratic states, which suggests that state ownership both with and without control is more frequent in authoritarian states. This could just mean that authoritarian states are more likely to exert sovereignty over their natural resources and remain sceptical of foreign private actors. The *timing* of transition does not seem to be related to the regime at all, though.

The findings here also compliment the literature on nationalization and expropriation in the petroleum sector, with similar results in regards to oil prices. The multinomial logistic regression basically replicates many of the findings in Luong & Weinthal (2009), which showed similar conclusions regarding the connection between ownership models and oil price. The findings also support the notion that changing ownership model in order to increase state control is related to nationalization processes: Similar results were found in both Guriev *et al.* (2009) and Mahdavi (2014), albeit with different measurements of nationalization. The findings differ somewhat from the established literature, especially in terms of regime. Both Warshaw (2012) and Mahdavi find that nationalization and expropriations are more likely in less democratic regimes, unlike the

results I found. Similarly, the results in Sarbu (2014), that shows a negative correlation between oil price and increased state control, are refuted in this study.

Likewise, the proposition of a "wave" or "domino effect" of petroleum policy, based on the claim that state ownership is less costly if many other states has a similar policy, shows promise. There is a tendency that transitions to state ownership and control, similar to nationalization, is more likely to take place following similar transitions in other countries. This is also argued in the nationalization literature by both Kobrin (1985) and Mahdavi (2014). The regression result supports the claim that previous transitions have an effect, both regionally and overall. This confirms the notion that a transition in one oil-producing country is often followed by similar transitions in other countries.

Finally, there are unanswered questions in the form of such variables as regime type or a diffusion effect. The lack of correlation between the dependent variable and the suggested determinants cannot be strictly rejected due to the lack of variance in the data, obviously. Preferably, the determinants proposed here should be researched further, perhaps with different statistical approaches and a more in-depth qualitative strategy to test the connections proposed here. A different index on ownership and control structure could also be of use, as there is likely to be differences between states that is not picked up by the one used here.

The results also show that there is no obvious correlation between the nationalization of a country's oil industry and the implementation of a policy that reflects this, at least not in accordance with the usual operationalization of nationalization as a concept. Many countries have established NOCs while simultaneously allowing for foreign involvement in operatorship and asset ownership. The puzzle of state ownership and control is not solved yet, and it may be that a more detailed typology of ownership models will be more helpful in providing answers. On the other hand, the small number of changes that occurs in ownership models makes it even more important to understand what makes these changes happen.

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