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**Ownership Rights versus Access Rights Allocation to
Critical Resources: An Empirical Study of the
Economic Impact of Changes in Oil Governance**

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Working Paper 2016-02

<http://econbus.mines.edu/working-papers/wp201602.pdf>

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April 2016

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Title: Ownership Rights versus Access Rights Allocation to Critical Resources: An Empirical Study of the Economic Impact of Changes in Oil Governance*

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ABSTRACT

During the 1970s, many oil-producing countries gave National Oil Companies (NOC's) ownership rights to oil and gas resources. Following the success of Norway in managing its oil and gas resources, development institutions have tried to push oil-producing countries to change their oil governance. Over the past two decades, several countries have enacted laws that create a regulatory entity and establish the NOC only as a business entity. Thus, these NOCs now are only given access rights to explore and produce oil and gas like other international oil companies. Employing a difference-in-difference method, this paper aims to empirically investigate the impact of changes in oil governance, specifically of changes in allocation of ownership rights versus access rights, to aggregate domestic income. Using data from 35 countries in the period 1990-2012, our results suggest that a country which creates a separate regulatory entity and makes the NOC merely a business entity increases its aggregate domestic income by around 10%.

JEL classifications: **Q3, O13, L5**

Keywords: oil governance, access rights regulation, economic growth

*I am indebted to Professor Ian Lange for his guidance on shaping my research which include but not limited to refining research question, showing relevant literature, commenting and suggesting on methodology and writing. I am grateful to Professor Harrison Fell and Professor Peter Maniloff for their invaluable directions and comments. I am thankful to seminar participants, particularly Claire Brunel (discussant of this paper) at the Association of Environmental and Resource Economics session of the 2016 Midwest Economics Association Conference and also thankful to seminar participants at Society of Indonesian Energy Professional and at Colorado School of Mines.

1. Introduction

In oil-producing countries, oil and gas play an important role in shaping their economy. Grayson (1981) termed the oil and gas sector “the commanding height of economy”. According to World Bank data in the period of our observation (1990-2012), rents from oil and gas can contribute up to 70% of a country’s GDP. Therefore, how the countries regulate their oil and gas resources is important. They can regulate the sector indirectly through tariffs, taxes and licenses or directly through the creation of a National Oil Company (NOC). This paper is interested in the latter, particularly in the regulation of rights (ownership rights or access rights¹) given to NOCs. Historically, many oil-producing countries gave ownership rights to their NOC. Thus, the NOC not only had access rights to explore and produce in a working area but also to hold bidding rounds, to award, regulate and monitor contracts and to collect revenue from other oil companies. However, recently, some oil-producing countries have enacted laws that create a separate regulatory entity and establish the NOC purely as a business entity that only has access rights to explore and produce like other oil companies.

To our knowledge, there has been no empirical study of the impact of these changes in oil governance (i.e., changes from giving a NOC ownership rights to just access rights) on aggregate domestic income. Therefore, this paper aims to answer the research question: What is the economic impact of changes in oil governance? To put our research question in broader economic terms, this paper aims to answer empirically whether the state’s withholding ownership rights and granting access rights to all agents is superior to granting ownership rights to one agent (the NOC).

¹ This paper uses the definition of ownership rights and access rights in the incomplete contract literature which ownership right is defined as the residual right of control or the right to use the asset that is not contractible and access right is defined as the ability to work with critical resources without getting residual rights of control.

The question is answered by employing a difference-in-difference methodology with aggregate domestic income of the country as the dependent variable. The result shows that countries that change their oil governance increase their GDP per capita by around 10%. This result is statistically significant and robust to changes of control variables and number of countries. We further explore the impact on different political institution, and find that the impact of the changes to aggregate domestic income is higher in non-democratic (autocratic and anocratic) institutions than in democratic institutions. We also find the impact is higher on countries whose contributions from oil and gas sector to their GDP are high.

This analysis can guide governments of oil-producing countries that are seeking the best way to govern their oil and gas sectors. Thurber et al. (2011) built case studies on several important oil-producing countries and made qualitative inferences about the impact of just giving access rights to the NOC on sectoral oil performance, but they did not provide an empirical model to test it. Thus, this study will provide empirical evidence on the impact of changes in oil governance, which is important particularly for those countries who are considering whether to change their oil governance.

In addition, Rajan and Zingales (1998) have shown theoretically that withholding ownership and granting access rights to all agents is a superior mechanism to granting ownership to one agent and access rights to all other agents, but they did not provide empirical evidence to support their theory. Thus, this paper will be the first study which provides evidence to support this theory in the oil and gas industry setting.

In order to answer the research question, the remainder of the paper will proceed as follows. First, we will provide a conceptual framework for how changes in oil governance could impact

the aggregate domestic income. Second, we will explain our econometric model and methods. We will also provide the results and concluding remarks.

2. Conceptual Framework

In this section, we will provide a brief explanation of the changes of oil governance and some transmission mechanisms based on related previous literature on how these changes impact aggregate domestic income.

In order to explore and produce oil and gas, the state as de jure owner of the oil and gas resource needs to work with technological provider's agents. These agents are oil and gas companies who have the capital and technology to explore and to produce oil and gas. Typically, in order to work with an agent, the state entity or its NOC who has the ownership right of oil and gas resources will split the area which contains oil and gas resources into several working areas or blocks. The holder of the ownership rights will then hold a bidding round to tender these working areas. After awarding the contract, the holder of the ownership rights will monitor and regulate the contract and collect revenue from it.

With regard to the rights given to a NOC, the resource nationalization literature (Guriev, Kolotilin, and Sonin, 2011; Mahdavi, 2014b; Stevens, 2008) shows that during the 1970s, many oil-producing countries nationalized their oil and gas resources by creating NOCs as the dominant agent in their oil and gas resources extraction. As the dominant agent, these NOCs would hold bidding rounds, award, regulate and monitor contracts as well as collect revenue from other oil companies. Thus, they function not merely as a business entity like other oil companies (international or domestic) who have just been given access rights to explore and

produce in a working area but also as a policy and regulatory entity. Hence, these NOCs are given ownership rights to oil and gas resources.

By contrast, Norway, which has been considered successful in developing its oil and gas resources, has had a clear separation between policy, regulatory, and business functions since oil and gas extraction began there in 1972. The policy-making function is carried out by the Ministry of Petroleum and Energy and the regulatory function is carried out by the National Petroleum Directorate (NPD). Statoil, which is the NOC, only functions as a business entity like other oil companies and thus only has access rights to explore and produce. In a recent work, Mideksa (2013) employed a synthetic control method to investigate the impact of oil and gas extraction in Norway and found that oil and gas extraction increased annual GDP by 20%. Therefore, as argued by Thurber et al. (2011), the Norwegian model of oil governance in which the NOC functions only as a business entity has been promoted by development institutions to be adopted by other oil-producing countries.

During the 1990s and 2000s, several countries have changed their oil governance by enacting laws that create regulatory entities and establish the NOC as a business entity that only has access rights. These countries are Peru, India, Brazil, Indonesia, Colombia, Algeria, Ecuador, and Turkmenistan. Based on the literature which will be described below, we hypothesize that the changes in oil governance will increase sectoral profitability due to an increase in investment incentive and sectoral efficiency and thus have a positive impact on aggregate domestic income.

The first stream of literature that supports the hypothesis is the incomplete contract literature. Rajan and Zingales (1998) argue that in an incomplete contract², regulation of rights to critical resources is an important factor. They argue that access rights are better than ownership rights because with access rights, the agent is more motivated to make the efficient level of investment. Rajan and Zingales also show that allocating ownership to a single agent and access rights to other agents results in lower total specific investment than withholding ownership and granting access to all agents and that by withholding ownership and granting access to all agents, the state will increase the incentive for all agents to invest. This is so because by conveying the ownership right which gives the right to award the contract, the NOC would be strategizing over which working areas should be awarded to other oil companies. Awarding a more lucrative oil and gas working area to another oil company would reduce the NOC's incentive to invest. Likewise, awarding a less lucrative oil and gas working area to other oil companies would reduce other oil companies' incentive to invest.

Another stream of literature that supports the hypothesis is the study of the impact of ownership rights in terms of risk of expropriation using a dynamic model of oil extraction. Bohn and Deacon (2000) develop a theory and also find empirically that risk of expropriation can discourage private investment. They show that optimal ratio of capital to reserve is an increasing function of price and decreasing function of expropriation risk. Guriev et al. (2011) argue that expropriation risk increases in periods of high oil prices, when there are few checks and balances on the government, and when there is an increase in the managerial and technical capabilities of oil-producing countries since these will increase the government's outside options. Hence, oil

² Contracts between states and oil companies are typically long-term (20-30 years). Moreover, these contracts start with the exploration phase; negotiation on more detailed agreement will start after discovery of recoverable reserve. Thus, it is an incomplete contract.

governance in which oil companies are making contracts with the NOC has a higher expropriation risk because the NOC has technological and capital capability to expropriate whenever the outside option value is high. This condition is different when the contracting party is a state entity who does not have the technological and capital capability to take over the operation after the expropriation. The state entity can appoint the NOC (or other oil company) to take over the operation but there will be a time gap to transfer knowledge and assets, which incurs an opportunity cost to the state. For that reason, changes in oil governance would reduce expropriation risk and hence, increase investment.

The literature on the efficiency of NOCs and International Oil Companies (IOCs) also supports the hypothesis. Hartley and Medlock (2008) and Eller, Hartley and Medlock (2009) have shown theoretically (using a dynamic model of oil extraction) and empirically that due to their noncommercial objective, NOCs are less efficient. Therefore, oil governance which establishes the NOC merely as a business entity to explore and produce oil and gas will increase the efficiency of NOCs.

Lastly, in relation with learning by doing in the oil and gas industry literature which looks at the increase of efficiency (proxy by drilling rate) as experience of an agent increases (Kellogg, 2011; Osmundsen, et al 2012), Thurber et al. (2011) argued that the regulatory entity has the power to benchmark between NOCs and other IOCs. Thus, a regulatory entity can create a positive knowledge spillover effect between oil companies operating in a country. This argument would require further research to empirically investigate the impact of changes in oil governance on learning by doing.

3. Econometric Model

Pérez-González (2004) pointed out that the difficulty in empirical study of contract theory is to find a setting in which the contract is incomplete, specific investments are important (investments that have no value outside of the relationship) and ownership is changing. We can overcome this difficulty by studying the impact of the changes in oil governance because the contracts between states and oil companies are incomplete³ and the investments (e.g., exploration and development drilling, production facilities) have no value outside of the relationship and there are changes in ownership right given to NOC.

To empirically study the impact of changes in oil governance, this paper employs a difference-in-difference method. This is a popular method in estimating causal relationships and is widely used when one wants to analyze the impact of a policy change by analyzing data before and after the change is implemented. In this method, the impact of policy change is the difference in the difference of the outcome before and after the policy change for the treatment group relative to the control group. In this paper, the treatment group consists of countries which enacted a law that creates a separate regulatory entity and the control group consists of countries which have not enacted a law that creates a separate regulatory entity.

Our analysis starts with 35 of the 49 countries listed as oil producers in the 2014 BP Statistical Review⁴ who have a NOC as the dominant agent in their oil and gas extraction. These countries are significant oil and gas producer but the impact of the oil and gas sector on their economy might not be significant and thus we will not be able to see the impact of changes in oil governance to aggregate domestic income. Therefore, first we will drop countries whose

³ See footnote 2.

⁴ To create a representative sample of oil producing countries, we choose countries listed in 2014 BP Statistical review which are accounted for 98.5% of world oil production.

percentage of contribution from oil and gas rent (source data World Bank) to GDP is less than 5%, which leaves 29 countries. A 5% threshold is arbitrary, but we will show later that the result is robust to changes in this threshold.

To identify our treatment group, first, we use secondary sources which discuss oil sector organization and NOCs (e.g., Victor, Hults and Thurber, 2012), the Energy Information Administration (2014) country analysis, and the World Bank's *A Citizen's Guide to National Oil Companies* (2008). We further confirm the policy through individual company or regulatory body websites and the law itself and find 8 countries which have enacted a law that creates a separate regulatory body. Table 1 below shows the full list of the treatment group countries.

Table 1: Treatment group countries

No	Country	Law/Regulation	Year	Regulatory entity	Business Entity (NOC)
1	Peru	Hydrocarbons Law, Law N° 26221, 1993	1993	Perupetro	Petroperu
2	India	Resolution No. O-20013/2/92-ONG, D-III	1993	Directorate General of Hydrocarbon	ONGC
3	Brazil	Oil Law No. 9	1995	ANP	Petrobras
4	Indonesia	Oil and Gas Law No. 22/2001	2002	BPMIGAS	Pertamina
5	Colombia	Decree 1760	2003	ANH	Ecopetrol
6	Algeria	Hydrocarbons Law No. 05-07	2005	ARH and ALNAFT	Sonatrach
7	Turkmenistan	Law on Hydrocarbon Resources, 2008 (the agency was formed in 2007 by a presidential decree)	2007	State Agency on Management and Use of Hydrocarbon Resources	Turkmenneft
8	Ecuador	Correa Oil Law Reform	2010	Agencia de Regulación y Control Hidrocarburífero	Petrucuador EP

We analyze the impact of changes in oil governance on aggregate domestic income over the time span of 1990 to 2012. Our difference-in-difference model is:

$$Y_{it} = \alpha_i + \gamma_t + X'_{it}\beta + \tau D_{it} + \varepsilon_{it} \quad (1)$$

The dependent variables Y_{it} are log of GDP per capita, constant 2005 US\$ (source: World Bank). Our variable of interest is treatment dummy D_{it} which is equal to 1 each year after a country enacted a law which creates a separate regulatory body and 0 otherwise (see Table 1 for the year a country in the treatment group enacted a law that creates a separate regulatory body). We also include other time-varying variables X'_{it} which have a significant relation to growth (Doppelhofer et al., 2004) as our control variables. These control variables are oil production (source: BP statistical review), labor productivity (source: the Conference Board Total Economy Database), investment as a percentage of GDP and openness (source: PWT 7.1; Heston, Summers and Aten, 2012).

Moreover, as pointed out by Guriev et al. (2011) and Brunnschweiler and Valente (2013), expropriation risk which shapes investment incentives is correlated with checks and balances or the political regime of the government. This argument aligns with Thurber et al. (2011), who pointed out the importance of political competition and institutional quality to the success of changes in oil governance. Therefore, in an effort to control for political competition and institutional quality, we also include the Polity2 variable from the Polity IV data set (Marshall, Jaggers, and Gurr, 2010) which has been widely used in empirical studies as an explanatory variable for political competition and institutional quality (see Brunnschweiler and Valente, 2013; Cust and Harding, 2014; Guriev et al., 2011; Mahdavi, 2014a, 2014b). Polity2 is a composite variable derived from the democracy institution score (Democ variable) minus the

autocracy institution score (Autoc variable). Democ and Autoc variables are scored from 0 to 10, with a higher number representing stronger democratic/autocratic institutions. Hence, the Polity2 variable ranges from -10 (strong autocratic institution) to +10 (strong democratic institution). All variables described above are in log scale except for the treatment dummy and polity variables⁵.

4. Results

There are two key assumptions in the difference-in-difference method. First, as mentioned above, in the absence of treatment, the underlying difference between the treatment and control groups does not change and second, the treatment is exogenous. First assumption is tested by determining if the treatment and control group have the same trend in the pre-treatment period. In order to check this assumption, we employ a model:

$$Y_{it} = \alpha_i + \gamma_t + X'_{it}\beta + \sum_{\delta=0}^q \tau_{-\delta} D_{it-\delta} + \sum_{\delta=1}^r \tau_{\delta} D_{it+\delta} + \varepsilon_{it} \quad (2)$$

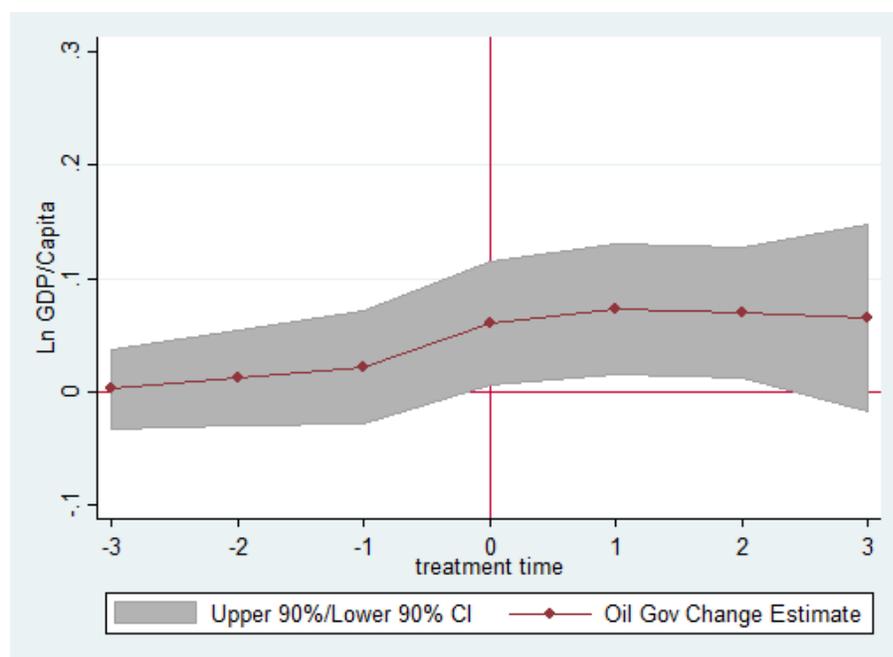
With this model we are able to capture the treatment effect in the pre-treatment period (parameter $\tau_{-\delta}$) and post-treatment period (parameter $\tau_{+\delta}$) so that we can see the trend of the treatment effect in the pre-treatment and post-treatment period. The result is showing (see figure 1) that there are no significant differences prior to treatment and there is a significant break when treatment occurs. Thus, the first assumption is valid.

With regards to second assumption, one would be concerned that the oil price, which is one of the determinants of resource nationalization (Guriev, Kolotilin, and Sonin, 2011; Mahdavi, 2014b) is also correlated with changes in oil governance. Since the countries that change their oil

⁵ We tried several specifications for the model, and Log-log specification gives the best fit and result of the model. Therefore, all variables are in log scale except for the treatment dummy and polity variables.

governance are price takers (i.e. the changes in oil governance will not impact oil price), this concern can be tackled by controlling for oil prices through the time fixed effect. One would also concern if the decline in oil and gas productions might drive the changes. However, as shown in figure 2 in the Appendix, there are no significant differences in oil and gas production between treatment and control group before the treatment. Thus, oil and gas production should also not be a concern that can cause endogenous treatment effect. More importantly, the literature in changes in oil governance (see Thurber et al. (2011) and Stevens (2008)) stated that the changes in the role of the NOC are pushed by development institution and therefore exogenous to oil and gas industry problem. Moreover, since there are no significant differences in pre-treatment period, there should be no unobserved variables that are correlated with treatment decision and are causing endogenous treatment.

Figure 1: The impact of changes in oil governance on aggregate domestic income in the pre-treatment and post-treatment periods



Our main estimation results using the difference-in-difference method are shown in Table 2 below. Specification 1 is our simplest model and only includes a treatment dummy as an explanatory variable. The estimate of treatment effect from simplest model is not showing the expected sign. This result is biased because treatment dummy variable is correlated with labor productivity and polity variables which are also correlated with aggregate domestic income. After controlling for labor productivity and political institution, the estimate of treatment effect shows the expected sign and is statistically significant and robust.

The result suggests that changes in oil governance increase aggregate domestic income around 10%⁶. The results are statistically significant at the 90% level for specifications 3 and 4 and at the 95% level for specifications 5 and 6. The result is robust even after controlling for labor productivity, polity, oil production, investment and openness. Another important result from the regression is that the coefficient for the polity variable is significant and has a negative sign. Thus, this might be an indication that the economic impact due to changes in oil governance might be contingent on political conditions, which is in line with the argument from Thurber et al. (2011).

Therefore, we further explore the impact of the changes in oil governance in different political institutions, specifically democratic, autocratic and anocratic institutions. In order to do that, we employ another model (equation 3) which includes an interaction term between the treatment dummy and the political institution dummy. In defining democratic, autocratic, and anocratic institutions, we follow the definitions used by Brunnschweiler and Valente (2013), who divide the polity variable ranging from -10 (strong autocratic institution) to +10 (strong democratic institution) as follows: a democratic institution has a polity variable ranging from 6 to 10, an

⁶ This increase is not yearly but an average over treatment period.

autocratic institution has a polity variable ranging from -6 to -10, and an anocratic institution ranges from -5 to 5.

Table 2: Main regression result

	(1) <i>Ln (GDP /Capita)</i>	(2) <i>Ln (GDP /Capita)</i>	(3) <i>Ln (GDP /Capita)</i>	(4) <i>Ln (GDP /Capita)</i>	(5) <i>Ln (GDP /Capita)</i>	(6) <i>Ln (GDP /Capita)</i>	(7) <i>Ln (GDP /Capita)</i>
Treatment Effect	-0.027 (0.083)	0.084 (0.055)	0.101* (0.050)	0.101* (0.049)	0.100** (0.047)	0.102** (0.048)	0.036 (0.033)
Labor Productivity		0.943*** (0.067)	0.944*** (0.069)	0.945*** (0.081)	0.915*** (0.082)	0.906*** (0.095)	0.909*** (0.095)
Polity			-0.005** (0.002)	-0.005* (0.002)	-0.006*** (0.002)	-0.007*** (0.002)	
Oil Production Investment				0.006 (0.034)	0.009 (0.038)	0.005 (0.034)	0.005 (0.034)
Openness					0.005 (0.015)	0.000 (0.018)	-0.004 (0.017)
Anocracy						0.034 (0.071)	0.038 (0.063)
Autocracy							0.074** (0.030)
Treatment X Autocracy							0.033* (0.019)
Treatment X Anocracy							0.048 (0.036)
R-squared	0.473	0.877	0.879	0.879	0.873	0.874	0.877
Observations	690	653	638	635	577	577	584

Clustered Standard errors at country level in parentheses

* $p < 0.10$, ** $p < 0.05$ ***, $p < 0.01$

$$Y_{it} = \alpha_i + \gamma_t + X'_{it}\beta + \tau_1 D_{it} + \tau_2 D_{it} * Autoc_{it} + \tau_3 D_{it} * Anoc_{it} + \tau_4 Autoc_{it} + \tau_5 Anoc_{it} + \varepsilon_{it} \quad (3)$$

With this model, we can estimate the impact of changes in democratic, autocratic, and anocratic institutions in which the democratic institution point estimate is τ_1 , the autocratic institution is $\tau_1 + \tau_2$, and the anocratic institution is $\tau_1 + \tau_3$. We can also generate the joint hypothesis standard error ($\tau_1 + \tau_2$ and $\tau_1 + \tau_3$) to test the significance of the result.

The regression result for this model is shown in Table 2 specification 7 and can be interpreted as shown in Table 3. The result shows that the changes in oil governance have a positive impact on domestic aggregate income for all political institutions. However, the magnitude of the impact is different for different political institutions. The changes of oil governance in autocratic and anocratic institutions have a positive and significant impact on aggregate domestic income, but the impact is not significant in democratic institutions.

Table 3. Treatment effect in democratic, autocratic and anocratic institutions

	Point Estimate
Treatment effect in democratic institution	0.036 (0.033)
Treatment effect in autocratic institution	0.084*** (0.025)
Treatment effect in anocratic institution	0.219*** (0.041)

Clustered Standard errors at country level in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

One plausible explanation of this finding can be drawn from studies of the risk of expropriation in the oil industry (Bohn and Deacon, 2000; Guriev et al., 2011). These works have shown

theoretically and empirically that risk of expropriation shapes investment incentive. Moreover, Guriev et al. argued that the risk of expropriation is higher in governments with less checks and balances. Therefore, in a democratic institution, the risk of expropriation is already low enough that changes in oil governance, which arguably lower the risk of expropriation, have a marginal impact on investment incentive.

As a further robustness check, we increase the average contribution of oil and gas rent to GDP threshold to 10% (i.e. we drop countries whose percentage of contribution from oil and gas rent to GDP is less than 10%). As shown in table 4 in the appendix, magnitude of the impact of changes in oil governance is even larger. This results might suggest that the impact of changes in oil governance is also contingent on the importance of oil and gas sector to country's economy.

To further explore this hypothesis, we divide observations in our sample such that the treatment group countries are divided at the median of average contribution from oil and gas rent to GDP. We create oil contribution dummy variable $DumP^0_i$ which is equal to 1 for countries whose average contribution from oil and gas rent to GDP is below the median and $DumP^{50}_i$ for those countries above the median. Then, we employ another econometric model which includes interaction terms between treatment dummy D_{it} and oil contribution dummy $DumP^0_i$ and $DumP^{50}_i$ (equation 4).

$$Y_{it} = \alpha_i + \gamma_t + X'_{it}\beta + \tau_1 D_{it} * DumP^0_i + \tau_2 D_{it} * DumP^{50}_i + \varepsilon_{it} \quad (4)$$

The result (see table 5 in the appendix) shows that magnitude of the impact of changes in oil governance is larger and significant for countries whose contribution from oil and gas rent to their economy are above the median. Thus, it confirms the hypothesis that the impact of changes

in oil governance is also contingent on the importance of oil and gas sector to country's economy.

5. Conclusion

This paper aims to empirically investigate the impact of changes in oil governance on aggregate domestic income by employing the difference-in-difference method. Our findings from the difference-in-difference method suggest that oil-producing countries which change the rights given to their NOC (i.e., from ownership rights to only access rights) by enacting laws that create a separate regulatory entity and establishing the NOC merely as a business entity (i.e., only be given access rights to explore and produce like other oil companies) increase their aggregate domestic income around 10%. These results are statistically significant at the 90% and 95% level and robust to various specifications and changes in average oil and gas rent contribution to GDP threshold. From further exploration we also find that the impact is contingent on political institution, with the increase in aggregate domestic income due to changes in oil governance being higher in autocratic and anocratic institutions. The magnitude of the impact of changes in oil governance is also contingent on the importance of oil and gas contribution to country's economy. The magnitude is larger and significant for countries whose average oil and gas contribution to their GDP are above the median. These empirical evidences also support Rajan and Zingales' (1998) theory that withholding ownership rights and allocating access rights to all agents is a superior mechanism to granting ownership rights to one agent.

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Appendix

Table 4. Difference-in-difference result with 10% average oil and gas rent contribution to GDP threshold

	(1) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(2) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(3) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(4) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(5) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(6) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)
Treatment Effect	0.030 (0.129)	0.154** (0.065)	0.162** (0.069)	0.162** (0.070)	0.189*** (0.066)	0.195*** (0.063)
Labor Productivity		0.942*** (0.074)	0.941*** (0.075)	0.946*** (0.086)	0.916*** (0.088)	0.906*** (0.106)
Polity			-0.003 (0.003)	-0.003 (0.003)	-0.006** (0.003)	-0.007** (0.003)
Oil Production Investment				0.002 (0.035)	0.007 (0.039)	0.003 (0.034)
Opennes					0.003 (0.015)	-0.001 (0.018)
R-squared	0.441	0.867	0.868	0.869	0.861	0.862
Observations	575	538	525	522	472	472

Clustered Standard errors at the country level in parentheses

* $p < 0.10$, ** $p < 0.05$ ***, $p < 0.01$

Table 5. Difference-in-difference result with interaction term between oil governance change dummy and 2-quantile of oil and gas contribution to GDP dummy

	(1) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(2) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(3) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(4) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(5) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)	(6) <i>Ln</i> (<i>GDP</i> <i>/Capita</i>)
Treat Dum X	-0.074	0.029	0.048	0.048	0.043	0.041
Small Oil Rent	(0.066)	(0.052)	(0.041)	(0.039)	(0.029)	(0.029)
Treat Dum X	0.022	0.142**	0.153**	0.152**	0.181***	0.191***
Big Oil Rent	(0.124)	(0.063)	(0.068)	(0.069)	(0.062)	(0.060)
Labor		0.944***	0.944***	0.947***	0.920***	0.908***
Productivity		(0.067)	(0.068)	(0.080)	(0.081)	(0.094)
Polity			-0.004*	-0.004*	-0.006***	-0.006***
			(0.002)	(0.002)	(0.002)	(0.002)
Oil				0.003	0.005	0.000
Production				(0.034)	(0.038)	(0.033)
Investment					0.008	0.002
					(0.015)	(0.018)
Opennes						0.042
						(0.071)
R-squared	0.475	0.879	0.880	0.881	0.876	0.877
Observations	690	653	638	635	577	577

Clustered Standard errors at the country level in parentheses

* $p < 0.10$, ** $p < 0.05$ ***, $p < 0.01$

Figure 2: Log of oil and gas production before treatment

