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Oil and Government Expenditures: The Short Run Versus the Long Run Effect

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Summary

Dependency on oil rents (the difference between oil revenue and production cost) may not be sustainable over the short or the long run for oil dependent countries. Oil rents fluctuate with the oil price which is known for being volatile. Hence, more oil-dependent states may experience more volatile government expenditures. However, it is not sure if oil rents have a positive or a negative effect on government expenditures. In this paper, we try to identify short and a long run relationship between oil rents and government expenditures between 99 oil-producing countries from 1967 to 2015. We compare two models that assume different relationships between the countries we analyze. One being a similar long-run effect for all countries, and the other allowing for heterogeneity across countries. Our results indicate that there exists a robust short-run relationship for both models. The most robust results indicate a positive short-run relationship between the growth rate of oil rents and the growth rate of government expenditures. There is weak evidence for a long-run relationship between oil rents and government expenditures.

Part 1

Introduction

Countries with government expenditures that become dependent on their oil income over the short and long run face highly volatile oil prices. There are several examples of countries that are reliant on their oil rents (Hammond, 2011; Sala-i-Martin & Subramanian, 2008). Some literature argues that politicians excessively use oil income to buy political support to increase the probability of staying in office, or redistribute the wealth through inefficient investments that are politically appealing and beneficial for remaining in office (Matsen et al. 2016; Robinson and Torvik 2005). The combination of highly volatile oil prices and excessive use of oil income can cause a country to increase government spending during oil booms and decrease spending or increased government debt during oil busts. Hence, government expenditures may become more volatile when states become more oil dependent. Oil dependency can, in turn, cause severe consequences for a country's economy. Other pieces of literature argue that politicians hide the government's oil income in tax havens or shell companies for their own financial benefit (Andersen et al. 2017; Ross 2012). Instead of using these funds to finance economic growth or saving it, in for example, a sovereign wealth fund, these politicians hide the country's resources for their own benefit. Hence, government expenditure experiences a slower increase than Gross Domestic Product (GDP), which in turn will decrease government expenditures as a percent of GDP. Thus, these pieces of literature argue for a negative effect of oil rents on government expenditures as a percentage of GDP. The literature, therefore, suggests that the effect of oil rents on government expenditures may go in either direction.

In our study, we limit the analysis by identifying a short and a long-run relationship between government expenditures and oil rents in oil-producing countries. We do this by using an error correction model. The primary aim of this study is to document whether there exists some relationship between oil rents (the difference between oil revenue and production cost) and government expenditures for oil-producing countries. To capture the long-run effect of the variables of interest, we structure the analysis around countries with a long oil-producing history, which in our context is at least 15 years. The time frame of the analysis is between 1967 and 2015, where we use 99 oil producing countries. Because of many oil producing countries, we expect to find a relationship between oil rents and government expenditures that systematically varies across oil-producing countries.

Our analysis is general in the sense that it does not divide the countries into specific groups. We analyze in two different ways. In the first one, we constrain the long-run relationship between the oil-producing countries, and in the second one, we allow the long-run relationship to vary across oil-producing countries.

We start this study by reviewing some historical events that shaped the oil market and the government's relationship to it. We also look at the general effect oil rents had on some oil-producing countries and these countries response to changing oil prices and its effects on government’s fiscal process. We then review some literature that is related to our analysis. These pieces of literature present evidence of a relationship between oil rents, fiscal policy, GDP growth, and discuss why this relationship varies across countries. Next, we take a closer look at our dataset. We compare summary statistics between oil producing countries and non-oil producing countries and find that there is little difference in the means and standard deviations in government expenditures, political corruption and the level of democracy. Finally, we try to identify a short and a long run relationship between oil rents and government expenditures using an error correction model. We find a robust short-run relationship, but a weak long-run relationship between the variables of interest. This study does not try to develop a theory for why a relationship between oil rents and government expenditures exists. Instead, we aim to document a general association between the variables of interest. We will also use existing theory to argue for the relationship we find. Since the study is limited, these theories could produce an insufficient explanation for the relationships presented.

Background

In this section, we will describe the oil market, and its relationship with government expenditures. We do this by a literature review. A briefly review of the oil markets history and some important events that shaped the oil market, and its relationship to the different oil-producing governments. The "oil curse" describes how countries abundant in oil have experienced a rather dismal history with a higher number of civil wars, slower growth in wealth and no change in the level of democracy and peace. In contrast to oil-producing countries, non-oil producing countries have experienced fewer civil wars and higher growth in wealth and a higher level of democracy and peace. This difference between oil producing countries and non-oil producing countries is called the "oil curse" (Ross, 2012).

There is very little evidence suggesting an "oil curse" before the 1970s and 1980's. The oil producing countries were similar to the non-oil producing countries in growth, the likelihood of being ruled by dictators, and civil wars. Before the 1970s the world oil industry was dominated by some large oil companies. These companies were known as the "seven sisters." These companies colluded and kept control over the entire oil industry. The companies controlled the extraction, the export, marketing and the shipping of oil. However, in the 1960s and 70s, governments started to nationalize their oil industry, by taking control of the oil reserves. Hence, the companies were now reliant on the government's authorization for extracting oil. Other incidents that shaped the development of the oil market was the collusion of some oil exporters in the developing world into the Organization of Petroleum Exporting Countries (OPEC). The Bretton Woods system which maintained stable prices through fixed exchange rates fell apart which affected the oil market. Apart from this, oil demand increased while the supply stagnated (Ross, 2012).

The nationalization of the oil industry increased the governments` non-tax revenues. The governments were now able to capture a higher share of the oil rents than earlier. Before the nationalization, countries and oil firms had an agreement where they shared the profits equally. However, the vertically integrated companies were able to hide the actual number of the profits from the governments. Ross (2012, p. 39) states that the nationalization “raised the government's share of oil profits from 50 percent in the early 1960s to 98 percent by 1974". An example is Nigeria, where the Nigerian government’s oil revenue increased from $4.9 billion to $21.5 billion between 1969 and 1977. At the same time, government spending increased from about 10 percent to around 25 percent of the Nigerian economy. Another example is Azerbaijan, where the value of government expenditures increased by 600 percent between 2001 and 2009 despite the fact that some oil producing governments on purpose underestimated the real value of the revenues from the oil sector by hiding it (Andersen et al., 2017). Some countries like, Brazil, New Zealand, and Norway are examples of countries that make their public aware of their oil revenues. However, other countries, mostly non-democratic countries hide the scale of their oil revenues from their public, through unreported off-budget accounts. Ross (2012, p. 59-60) states that oil-producing governments, use unreported off-budget accounts to "keep a large fraction of their spending off the books, sometimes hidden in the crevices of national oil companies, whose finances are withheld from public scrutiny."

As the oil revenues increase, the countries get less dependent on their tax revenues. Ross (2012) states that for the leading thirty-one hydrocarbon-rich countries, "On average, the oil sector makes up 19 percent of the economy in these states, but funds 54 percent of the state's budget" (Ross, 2012, p. 31). These results favor a positive relationship between government expenditures and oil rents. However, it is not sure that this relationship holds in periods where the oil price plummets. In these situations, oil rents drop, but the states are still able to use existing oil revenues or issue new debt.

Several authors connect the resource curse to institutional quality, and other political foundations (Mehlum, Moene, & Torvik, 2006; J. A. Robinson, Torvik, & Verdier, 2006; J. Robinson, Torvik, & Verdier, 2017; M. Ross, 2012b; M. L. Ross, 1999). As mentioned, Matsen et al. (2016) argue that politicians use oil revenues to stay in office by providing voters with goods and services. Hence, the politicians run short-run policies that cannot be sustainable over time. This theory favors a positive short-run relationship between oil rents and government expenditures. The authors also argue that if the voters become better informed, the politicians would turn to extract more oil than the efficient quantity which the social planner would extract. The authors refer to the usage of oil revenues to buy political support as Petro populism. The findings by Andersen and Aslaksen (2013), Cuaresma et al. (2010), support that powerful politicians stay longer in office in oil abundant countries. An example of Petro populism is Venezuela's, Hugo Chavez. Between 2000 and 2010, Venezuela's government expenditures as a percent of GDP increased by nearly ten percentage points. Even though Chavez's policies were recognized by both insiders and outsiders of Venezuela as unsustainable, highly dependent on Venezuela's oil resources and the high oil price, "he won numerous presidential elections and national ballots over his 15 years in power" (Matsen et al., 2016, p. 1).

Other examples of Petro populism is the Soviet Union and Russia. The Soviet Union nationalized its oil sector in 1917 after the Russian Revolution. The Soviet Union struggled with low oil supply, but after discovering new wells in Siberia, the Soviet Union became a major oil exporter. Oil prices increased after 1973, which boosted the economy. "Oil accounted for 80 percent of Soviet’s hard currency earnings between 1973 and 1985"(Ross, 2012b, p. 83). The government used its oil money to fund military operations abroad and increased growth in several industries at home, like the vehicle industry and the agricultural industry. The usage of the oil money was frequent until 1980 where the oil price peaked. The next six years the oil price fell by over 70 percent. The oil price plunge caused a significant drop in the government's oil revenues, which in turn caused an economic and political crisis, and then the fall of the Soviet Union. In 1980, when the oil price peaked, the per capita oil and gas income was about $3100, which decreased to $475 in 1998 when the oil price fell to $10 per barrel. The plunge in the oil price forced the Russian government to go bankrupt and default on billions of dollars’ worth of domestic loans. Government spending decreased considerably, causing the government to default on prior responsibilities such as loans, and most likely other types of investments (Matsen et al., 2016; M. Ross, 2012a). These cases favor the theory of Petro populism and a positive relationship between oil rents and government expenditures, but countries are different, causing the effect of oil rents on government expenditures to be different across countries. Not all cases are as extreme as the one just reviewed. Hence, these cases hint that only countries with weak institutions and regimes experience Petro populism. However, Matsen et al. (2016) argue that Norway, using the right-wing populist Progress Party rise as an example. They argue that even though Norway is known for their success in managing their oil money, the "party's solution to nearly all problems has been to spend oil revenues" (Matsen et al., 2016, p. 2)

Robinson and Torvik (2005) argue that some politicians use inefficient investments to prolong their time in office. Investments known as "white elephants", which generate negative social surplus are politically attractive because not all politicians can credibly commit to it (Robinson and Torvik (2005)). Those who can, use it as a political tool to stay in power, and not an investment to generate growth. Hence, these investments turn out to be economically nonoptimal. Robinson and Torvik (2005) present several examples of investments labeled as white elephants. White elephants could be linked to the usage of oil revenues to buy political support. Robinson et al. (2017) create a framework that explains the political consequences of public income volatility that is caused by for example volatile natural resource prices. The authors argue that politicians tend to run unsustainable policies to increase the probability of re-election. For example, when the politician instead of the social planner extracts natural resources such as oil, the politician tends to over-extract, because of the uncertainty of re-election in the next period. Further on, this over-extraction is done to provide goods and services for themselves that benefit their group value. The future uncertainty of the resource price tends to cause inefficient policies, which would not have been done by the social planner. The inefficient policies, in turn, cause volatility in public spending, which again promotes more resource extraction in the present. Robinson et al. (2006) also argue that future uncertainty creates incentives to over-extract and that resource booms increases these incentives and cause resource misallocation. The authors, however, link the overall impact of resource booms to institutions and argue that the institutions determine whether political incentives "map into policy outcomes" (J. A. Robinson et al., 2006, p. 1). These theories suggest a positive relationship between oil revenue and government expenditures, where increasing oil prices promotes increased government spending through over-extraction or other inefficient investments. In the next part, we review some other theories related to the relationship between government expenditures and oil rents.

Literature review

There is little cross-country research on the long-run relationship between oil income and government expenditures. We, therefore, review literature that put most weight on the short and middle run. Villafuerte et al. (2008) examine the fiscal responses of oil-producing countries to the oil boom through 2005, where they also look at the role of special fiscal institutions (SFIs). SFIs have been central in some countries, where they have been created to protect the economy from the volatile nature of the oil price, and other oil market conditions. The non-renewable nature of the oil and the volatile oil price causes implications for oil-producing countries. Additionally, the SFIs helps to manage fiscal revenues arising from the oil price booms, and in some countries, from the increased output of oil. SFIs exist as oil funds, fiscal rules, and fiscal responsibility legislation. The authors argue that many oil-producing countries have established SFIs to enhance fiscal management. Countries with vast oil resources benefit from its oil revenues during booms. However, the volatile and uncertain nature of the oil price and the exhaustive nature oil in itself constitutes a problem for the oil producers. Hence many oil-producing countries have found it difficult to smooth out government expenditures and make it independent from the volatility of the oil revenue. To secure the country's economy from the volatile nature of its oil revenue, oil producing countries establish SFIs. In an empirical analysis, they find that: "SFIs have not had a discernible impact on the fiscal position, as measured by the ratio of the non-oil primary balance to non-oil GDP, which tends to be more dependent on the short-run volatility of oil revenue" (Ossowski, Villafuerte, Medas, & Thomas, 2008, p. 16)

Further on, controlling for institutional quality, their results suggest that higher institutional quality is connected to lower non-oil deficits. Hence, they argue that higher institutional quality suggests higher non-oil primary balances, where the main contributors for the higher non-oil primary balance are government stability, law and order, and bureaucratic quality. Further on they find that: "SFIs did not have a significant impact on expenditure growth nor helped constrain the expenditure response to changes in oil revenue" (Ossowski, Villafuerte, Medas, & Thomas, 2008, p. 18). They find that during the boom, SFIs strengthened the response of spending to a rising oil income, however, in a sample with a more substantial number of countries, they find that this relationship is insignificant. Further, their data show that expenditures reacted more strongly to changing oil revenues. After introducing a corruption index, the coefficient of the SFI variable becomes close to zero and insignificant. However, the coefficient for corruption is significant and suggests that countries with higher levels of corruption have higher correlations between expenditures and oil revenue.

In some cases, countries with a weak institutional infrastructure experience corruption, where some powerful groups use the countries resources in their favor. These groups can use the government's financial process to access the countries capital stock. When faced with a windfall, from for example a boom in oil prices, government expenditure perversely increases and reduces growth. Tornell and Lane (1999) analyze an economy that has multiple powerful groups and has a weak legal-political institutional infrastructure. The authors present some empirical evidence that suggests oil producers with divided societies and weak institutional structures dissipate the resources gained from booms in the oil market, with no gain in welfare or growth and they often suffer from chronically low growth. They use evidence from the 1974 oil price shock that permanently raised the oil price, until 1986. They use Nigeria, Venezuela, and Mexico as examples and show that government spending increased more than the increase in GDP during the windfall. Further on they show that the countries had deficient growth performance despite the increased oil revenues. As argued by the authors, the windfall causes a financial process where the resources from the windfall get redistributed, through for example government spending, but this redistribution generates approximately no growth. The authors label this the "voracity effect" (Tornell & Lane, 1999). They argue that the government's financial process could work as a way to redistribute the capital stock, especially after windfalls such as oil income shocks, when the economy suffers from a weak legal-political institutional quality and populated by multiple powerful groups.

If there exists a relationship between the resource curse, institutional quality, high-level corruption, and other political foundations, such as the level of democracy (Andersen & Ross., 2013), would this explain a long-run relationship between the income from the natural resource sector and government spending? Andersen et al. (2017) study the outcome of petroleum rents under direct government control and find that for countries with weak institutional checks and balances, following an exogenous oil income shock, hidden wealth increases. "The results suggest that around 15% of the windfall gains accruing to petroleum-producing countries with autocratic rulers is diverted to secret accounts" (Andersen et al., 2017, p. 818). The outflow of petroleum rents suggests that government expenditures as a share of GDP decrease when oil revenues increase. When oil revenues increase, GDP increase, but because of the transformation of oil rents into hidden wealth these resources disappears leaving GDP with an increase, and government expenditure with nothing at all. This result, therefore, suggests a negative relationship between oil rents and government expenditures.

Andersen et al. (2017) found no relationship between the International Country Risk Guide (ICRG) corruption measure, which is the longest-running corruption perception index, and the transformation of petroleum rents into tax haven deposits. They argue that the corruption perception indices may be less suited for capturing high-level corruption. Further on, they find some evidence that links the relationship between the hidden wealth and political elites to countries with autocracy. However, they point out that because of the limited number of incidents analyzed, they cannot distinguish autocracies from non-autocracies. However, as their main result indicate, level of democracy rather than corruption may capture high-level weaknesses that cause transformation of petroleum rents into hidden wealth. Therefore, controlling corruption alone will not be sufficient, but including the level of democracy as control may increase the reliability of the results. Next, we present the method and theoretical framework which is used to identify the long- and short-run relationships in this paper.

Part 2

Research design

The first step in identifying a long run relationship is to check if government expenditures and oil rents are non-stationary in levels and integrated of the same order. We then test for cointegration. One standard feature about cointegrated data is that the cointegrated variables are not expected to drift away from each other. If the variables drift away from each other responding to a shock, it is expected to return to its long-run equilibrium. These features combined with other assumptions such as the regressors being identically and independently distributed (IID) forms an error correction model (ECM). "Error correction" implies a model that estimates the rate at which the dependent variable returns to its equilibrium after a change in the independent variable. Hence, the short run dynamics of the variables in the model respond to deviations from its long-run equilibrium. In equation (1) the outline of the ECM which we use is displayed.

(1) $\Delta y_{it} = \phi_i(y_{i,t-1} - \theta_i X_{it}) + \Sigma_{j=1}^{p-1} \lambda_{ij}^* \Delta y_{i,t-1} + \Sigma_{j=0}^{q-1} \delta_{ij}^* \Delta X_{i,t-j} + \mu_i + \epsilon_{it}$

Where $\phi_i = -(1 - \Sigma_{j=1}^{p} \lambda_{ij})$, $\theta = \Sigma_{j=0}^{q} \delta_{ij} / (1 - \Sigma_k \lambda_{ik})$, $\lambda_{ij}^* = -\Sigma_{m=j+1}^{p} \lambda_{im}$

$j = 1,2,\ldots.,p-1$, and $\delta_{ij}^* = -\Sigma_{m=j+1}^{q} \delta_{im}$, $j = 1,2,\ldots,q-1$.

The parameter ϕ_i is the error correcting term. This term gives us the rate at which our variable of interest returns to its long-run equilibrium after a disequilibrium. If $\phi_i = 0$, then a long run relationship does not exist. For there to exist a long run relationship ϕ_i should be negative and less than one in absolute value. The parameter θ_i contains the long-run relationship between the variables and gives us the long-run effect. The variable μ_i is a country varying but not a time-varying variable that controls for country varying factors. The notation Δ represents the first difference, while i and t respectively represent country and year. Our parameter of interest is y_{it} which represents government expenditures for country i in year t, while X_{it} is a vector of our independent variables. The parameter ϵ_{it} is the error term which is assumed to be IID.

As mentioned earlier, one important assumption when identifying a long run relationship is that the variables of interest are cointegrated. Hence, the variables must be integrated of the same order d and, there must exist a variable $\beta_1$such that the error term ϵ_{it} is integrated of a lower order (less than *d*), for example (*d-a*) where *a>0*. Fulfilling these two criterions implies that the variables are cointegrated. To test for cointegration, we use the cointegration test developed by Westerlund (2007). The test developed by Westerlund (2007) is an ECM based cointegration test. The author develops a cointegration test where one could test for whether the coefficient above is $\phi_i = 0$; hence the null hypothesis becomes $H_0: \phi = 0$.

The alternative hypothesis depends on our assumptions about the characteristics of ϕ_i. Westerlund (2007) develops four different types of tests. The first pair of tests called group-mean (GM) test's does not require homogeneity in ϕ_i. Hence ϕ_i can vary across groups (countries). The alternative hypothesis, therefore, becomes $H_1^{GM}: \phi_i < 0$. The second pair of tests called panel tests (PT), assumes homogeneity in ϕ_i for all $i's$ and therefore tests for H_0 versus the alternative hypothesis that ϕ_i is the same for all $i's$ and less than zero: $H_1^{PT}: \phi_i = \phi < 0$.

Pesaran & Smith (1995) and Pesaran et al. (1999) has developed similar models, a Pooled Mean Group-model (PMG) and a Mean Group-model (MG). The MG-model developed by Pesaran & Smith (1995) is very similar to the GM-model developed by Westerlund (2007). We will use Westerlund (2007) cointegration test to test for cointegration and the models developed by Pesaran & Smith (1995) to find the estimates. In contrast to the Fixed Effects (FE) models, which suppresses the time-series data for each country and lets the intercepts vary across countries, the MG-model fits the model for each group. By doing so, the model lets the intercept, the slope coefficient and the short and long run relationships vary across countries. By choosing the MG-model, we assume that these relationships vary across countries. One could also take the path in between an FE-, and an MG-model. This PMG-model constrains the long-run relationship, like an FE-model, but lets the intercept, slope coefficients and error variances vary across countries, like an MG-model. This model produces efficient and consistent estimates when the assumption of homogeneity in long-run relationships are correct. This assumption is a weakness when dealing with a large number of countries. As illustrated by Pesaran & Smith (1995), when dealing with a large number of countries (M) and a lengthy time frame (T) dynamic panels, the assumption of homogeneity of slope parameters is often inappropriate, which is common when dealing with fixed effects (FE) models. It could be that our dependent and independent variables are correlated with country-specific factors that are not accounted for in the model. The country-specific factors cause omitted variable bias if not accounted for as discussed by Haber and Menaldo (2011). One way to account for such bias is to use a variable that varies from country to country but not with time, as done in our model (1) presented above. This variable will pick up factors that vary between countries.

We can test which model (PMG vs. MG) to choose by using the general Hausman specification test developed by (Hausman, 1978). This test uses the result that under the null hypothesis of zero misspecification in the model, the covariance of the difference between an efficient estimate, and a consistent but inefficient estimate must be zero (Hausman, 1978). In our case, the estimates of the PMG are inconsistent if the correct model is heterogeneous (inconsistent under the alternative hypothesis) but efficient under the null hypothesis, while the estimates from the MG is consistent in both cases (Blackburn & Frank, 2007).

Data

Data Description

In our study we want to study the short and the long run relationship between oil rents and government expenditures. Therefore, we choose government expenditures as our dependent variable and oil rents as our independent variable. The statistical method used in this paper limits the number of covariates used, which we will get back to later in this paper. The independent variables used are oil rents, political corruption, polity and GDP per capita. The variables are defined as follows:

- Government expenditures - The general final government expenditures, excluding military expenditures that are part of government capital formation. The value is measured as a percentage of GDP. This variable is country and time-varying.
- Oil rents - the difference between country *i*'s crude oil production at world prices and total costs related to crude oil production. The value is measured as a percentage of GDP. The variable is country and time-varying.
- Political corruption - is a measurement of the corruption level in a given country's public sector. This variable is both country and time-varying.
- Polity - is a measurement of the level of democracy in country *i*. The score varies from "-10" to "10", "-10" being entirely autocratic, and "10" being fully democratic. This variable is country and time-varying variable.
- GDP per capita - is the gross domestic product per capita for country i at time t. This variable is country and time-varying.

The model uses the first difference of the independent variables on estimating the short-run effect and the model uses the variables in levels to estimate the long-run effect. Equation (1) displays which variables in the model that differ or not. Our dataset consists of yearly data from 1967 to 2015 for 99 oil producing countries. Table 1 displays summary statistics measured over time and across countries. We see from column 7 that oil rents have a mean of 6,590, which means that the average income from the oil sector for the 99 oil producing countries in our set is 6,590 % of GDP. We also see that the standard deviation (SD) is high (almost two times the mean). Hence, oil rents vary a lot over time, in contrast to government expenditures, where the standard deviation is less than half the mean. There is one crucial fact about the government expenditures which could explain the difference in the standard deviation between oil rents and government expenditures. From Figures 1 and 2 (in the appendix) we see that government expenditures correlate higher with its lags than oil rents.

From figure 1 we see that the correlation coefficient between period *t*'s government expenditure and its first five lags is above 0,5, while the correlation coefficient between oil rents in period *t* and its lags drops beneath 0,2 after its first lag and is almost zero on its fourth lag. Hence, Government expenditure changes little over time. Imagine the labor party in country x proposes increased spending on education. Before this proposal becomes a reality, it must go through several political stages, like voting and so on., before its set into action. Hence, a decision on increased spending takes time to implement. Further on, resources also need to be available to be spent. Unless a country discovers a natural resource that's of value like for example oil, the country is dependent on tax income and debt. High debt levels and volatile tax rates are not sustainable in the long run. Hence, countries try to keep these variables stable. Although, using tax rates as an automatic stabilizer in fiscal policy, massive changes in tax rates are usually unpopular. Hence, the unpopularity means that most governments do not afford massive changes in government expenditures, and therefore, only makes small changes every period. Further on, government expenditures usually follow a constant growth of GDP, unless the economy falls into a recession or other significant events, like war, which could trigger a sudden change in government expenditures (Peacock, 2004).

Oil rents are highly dependent on the oil price, which is known to be volatile. Hence, the variation in oil rents is most likely explained by the oil price. Further on, under columns 7 and 8 in Table 1, the growth rates of oil rents and government expenditures are both positive, which mean that between 1970 and 2015 the average growth in oil rents and government expenditures was positive. The oil price could explain the growth in oil rents, and factors like growth in GDP, oil rents could explain the growth in government expenditures. The standard deviation of the growth rate in oil rents is larger than its mean, and the standard deviation for the growth rate in government expenditures is (more than two times it means) higher than its mean, in contrast to the data in levels. The large standard deviation tells us that the growth rate in oil rents and government expenditures for oil producing countries has experienced relatively large changes between 1970 and 2015. As mentioned earlier, the volatile nature of the oil price and the nationalization of oil reserves could explain the significant variation in the growth rate of oil rents.

From table 1, we see that the level of democracy (variable named polity), varies over time, for both oil-producing countries and non-oil producing countries. The standard deviation is roughly seven times its mean, which is a relatively large variation. The increased democratization in the world between 1970 and 2015 could explain this variation (Huntington, 2012; Kotera & Okada, 2017).
Next, we see that the mean and standard deviation for political corruption is similar for both oil-producing countries and non-oil producing countries, which goes against our hypothesis that oil producing countries are affected by higher political corruption. However, comparing means are simple comparisons. It cannot explain causal relationships without being affected by biases. Hence, we wait with concluding on causal relationships until using a more appropriate method. We move on to analyzing our data, which is our first step to finding a causal relationship.

Table 1
Summary statistics comparing non-oil producers with oil producers

	(1)	(2)	(3)	(4)	(5)
			Non-Oil Producers		
VARIABLES	N	Mean	SD	Min	Max
Government Expenditures	2,805	14.43	7.559	0	69.54
Oil rents	1,173	0	0	0	0
Gdp Per Capita	2,778	4,349	10,329	37.52	88,416
Political Corruption	3,506	0.491	0.274	0.0240	0.936
Polity	2,842	0.961	7.143	-10	10
Government Expenditures Growth rate	2,745	0.0353	2.445	-38.58	22.41
Oil rents Growth rate	1,143	0	0	0	0
Gdp Per Capita Growth rate	2,719	199.5	1,149	-15,113	13,810
Political Corruption Growth rate	3,439	0.00225	0.0334	-0.398	0.555
Polity Growth rate	2,784	0.0815	1.707	-18	16

	(6)	(7)	(8)	(9)	(10)
			Oil Producers		
VARIABLES	N	Mean	SD	Min	Max
Government Expenditures	4,520	15.63	6.663	0	84.51
Oil rents	3,817	6.590	12.31	0	83.51
Gdp Per Capita	4,586	7,542	12,311	34.74	103,059
Political Corruption	5,025	0.472	0.282	0.00949	0.958
Polity	4,794	1.026	7.584	-10	10
Government Expenditures Growth rate	4,421	0.0465	2.409	-32.33	37.47
Oil rents Growth rate	3,720	0.0474	4.589	-33.62	49.16
Gdp Per Capita Growth rate	4,488	281.7	1,710	-22,702	15,962
Political Corruption Growth rate	4,929	0.000827	0.0302	-0.623	0.424
Polity Growth rate	4,699	0.0885	1.598	-15	16

Note: Displays summary statistics for the variables used in the analysis.

Data Analysis

As mentioned earlier, when testing for a long run relationship it is essential to test for cointegration. Hence, we test for stationarity by using a unit root test. The unit root test tests whether the absolute value of the coefficient of interest is one or less than one. If the coefficient is equal to one, then the variable of interest is said to follow a random walk which means that it is not stationary. The opposite is exact for a coefficient with absolute value less than one. The variable is then said to be stationary. We use a unit root test developed by Im, Pesaran & Shin (2003) based on the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979), and find that the null hypothesis that all panels contains unit root can be rejected at the 1% (significance) level for both government expenditures and oil rents with zero lags.

Hence, both government expenditures and oil rents are stationary at zero lags. As we increase the number of lags, the results differ. When increased to three lags, the null hypothesis can be rejected at the 1% (significance) level for government expenditures but cannot be rejected for oil rents.

Next, we run the cointegration test to check for a long run relationship. As discussed earlier we use the test developed by Westerlund (2007). When including a constant and five lags, there exists a long run relationship between oil rents and government expenditure. Hence, we reject the null hypothesis of no cointegration at a 5% significance level. The results indicate that the dependent and independent variables are cointegrated when assuming both a heterogeneous or a homogeneous relationship. We get the same results when doing the test separately from the first lag of oil rents up to the fifth lag.

Next, we use the Hausman test to specify which model we should use, the MG- or the PMG-model. This test uses the result that "under the null hypothesis of no misspecification an asymptotically efficient estimator must have zero asymptotic covariance with its difference from a consistent but asymptotically inefficient estimator" (Hausman, 1978, p. 1). Hence, the PMG model that is assumed to be asymptotically efficient under the null hypothesis must have zero asymptotic covariance with its difference from the MG model, which is consistent under the null and alternative hypothesis but has asymptotically inefficient estimators under the null hypothesis. Hence, the test tests if the difference in the coefficients is systematic. By doing so, we choose to assume a heterogeneous or a homogenous long-run relationship. In comparing the estimate from the MG- and the PMG-model, we cannot reject the null hypothesis at a 0.1 (significance) level. The Hausman statistic is 0,65, which means that the Hausman test prefers the PMG estimates. Hence, we use the PMG-model to identify a long run relationship. Is it reasonable to assume a homogenous long-run relationship between government expenditures and oil income for all oil producing countries? Often a similar long-run relationship between countries is rejected empirically. Remember that the PMG-model yields efficient and consistent estimates when the restriction is valid. Therefore, the PMG-model yields inconsistent estimates if the correct model is heterogeneous. The MG model produces consistent estimates under both cases.

Hence, when the Hausman test returns a Hausman statistic of 0,65 which follows a chi-squared distribution (Mulholland & Jones, 1968), the estimates from the PMG-model is preferred, and consistent which means that the restriction is correct (Blackburn & Frank, 2007). However, since a heterogenous long-run relationship is a strong assumption when the number of countries is as large as 99, we use the MG-model as well and compare the results. We, therefore, expect there to be variation in the long run relationship between countries. This variation is explained by country varying factors, as mentioned above. We will discuss this variation and its complications in the next part.

Endogeneity and other problems faced

Oil rent, which is the difference between oil income at world price and production costs is not a randomly distributed variable. According to Ross (2012, pp. 17–18): “The oil income variable is a function of three underlying factors: a country’s geologic endowment, which determines the physical quantity and quality of petroleum that can be exploited; the investments made in extracting it, which affect how much will be discovered and commercially exploited at any given time; and the price of oil, which determines both the rate of extraction, and the amount of money that petroleum sales will generate”.

A country's geologic endowment and the price of oil can be taken as exogenous factors, unaffected by a country's economic and political factors. Being affected by exogenous factors, however, is not correct for investments made by the government for extracting petroleum. For example, countries that are secure to invest in by foreign or domestic investors could attract more investors than countries that do not provide legal protections for investors. Several authors as mentioned earlier in this paper argue that institutional quality and high-level corruption could determine the effect of oil rents on a country’s growth level. Ross (2012) argue that the rate of extraction should be higher in countries that are already rich, hence, not poor before the discovery of oil, and more democratic and peaceful. He also argues that the democratic level varies with the oil income. The effect of oil rents on the level of democracy has been argued by other scholars as well (Andersen & Ross, 2013; Haber & Menaldo, 2011). Hence, oil income affects countries differently depending on country-specific factors, such as those mentioned above. Assuming a similar long-run relationship between countries would, therefore, be a naive assumption.

We use oil rents as our primary independent variable in checking for a long run relationship between government expenditures and oil rents. If oil rents are endogenous in its relationship between government expenditures, then our estimates would not tell us the isolated and correct effect of oil rents on government expenditures. For example, if the government increase the investments in the petroleum sector, then the rate of extraction could increase, which could increase oil rents. When the relationship between two variables goes both ways, we label it as reverse causality. A counter-argument is that it takes time to extract oil, hence a decision made by the government in period *t* would have a small effect on oil rents in period *t*. However, even though the physical extraction takes time, the expectation of future income could in some way affect today's oil rents, through speculations. Either way, we control for this by not using oil rents in period *t*, but by looking at the effect of oil rents in period *t-1*. The intuition behind this is that government expenditures today (period *t*) would not affect yesterday’s oil rents (period *t-1*), but yesterday's oil rents could affect today’s government expenditures. If this assumption does not hold empirically, then reverse causality would still exist.

Omitted variable bias (OVB) also causes challenges. As argued, oil income alone does not explain its relationship with government expenditures. The level of corruption and level of democracy do as well. Like these two factors, there could be several other factors that explain why the relationship is high in one country and low in another, or why such a relationship exists at all. If we do not control for these factors, our estimates could mislead us. The effect could, for example, be under- or over-estimated. In our analysis, we face problems that increase the probability of OVB. We need a higher number of observations per country if we increase the number of lags or covariates. Unfortunately, most countries in our sample do not have enough observations to use a PMG- or an MG-model with a high number of lags and covariates. That is one of the main reasons we only use up to four lags in oil rents when testing for a long run relationship. Further on, this restriction on covariates opens for omitted variable bias. This is mainly the reason why, we only use three covariates. Sovereign wealth funds and institutional quality are for example important covariates which we did not use in this analysis because of the limitations mentioned above. Hence, we are open for the possibility of OVB, but try to restrict it as much as possible by including as many omitted variables as possible, without affecting N (the number of countries) in our sample. Table 8 in the appendix includes the countries we use after removing countries with too few observations.

Part 3

Results

In this part we present the results from analyzing the short and the long-run relationship between Oil rents and Government Expenditures. We start by comparing the MG and the PMG model without covariates. The reason we compare the PMG with MG, even though the Hausman test recommended the PMG model is because assuming a homogeneous long-run relationship between 99 oil producing countries which differ on several aspects is a naive assumption. In table 2 we see the estimates. Under short-run coefficients, we have the error correcting speed of adjustment which tells how fast government expenditure return to its equilibrium level after a shock in oil rents. Below the speed of adjustment rate, we have estimates ranging from the first lag first difference of oil rents labeled as *LD.oilrent* up to the fourth lag first difference of oil rents labeled as *L4D.oilrent.* Under long-run coefficients, we present coefficients for the first lag labeled *L.oilrent* up to the fourth lag labeled *L4.oilrent*.

The error correcting speed of adjustment term is as seen in equation (1). If this parameter is equal to zero, then there doesn't exist a long run relationship. If this parameter is significantly negative, then it is expected that the variables return to its long-run equilibrium. From the table 2, we see that the terms are significantly negative for both the PMG and the MG model. From column 1 and 2, we see that the error correcting speed of adjustment term is *-0,221* for the PMG model, and *-0,260* for the MG model. The difference is small between the models; hence, each model implies similar short-run dynamics. Intuitively, the proportion of the disequilibrium in government expenditures that is corrected in each period is -*0,260* percent of GDP (estimate from the MG model). Hence, the growth rate of government expenditures has a relatively slow speed of adjustment towards the long run equilibrium after a shock in oil rents. The PMG-model has the same interpretation of the error correcting speed of adjustment rate. The coefficients below the error correcting speed of adjustment displays the relationships (positive or negative) between the variables.

In the upper panel beneath the error correcting speed of adjustment rate, we find the short-run estimates. Both models take the average of all countries without constraining the short-run relationship. We still find some differences between the models. For the PMG model, we can reject the null hypothesis of no short-run relationship at a 10% (significance) level for all the variables except the second lag first difference in oil rent. For the third lag first difference and the fourth lag first difference of oil rent, we can reject the null hypothesis at a 5% (significance) level. While for the MG model, we can only reject the null hypothesis at a 10% (significance) level for the second lag first difference and the fourth lag first difference for the oil rent. Further on, these coefficients have opposite signs as we see in the table. Intuitively, the short-run estimates state which direction oil rent pushes government expenditures after a change in oil rents. Hence, the opposite signs gives an interesting result. From the PMG model, all the short run estimates indicate that the lags of oil rent push government expenditures in the same direction (positive estimates). Hence, an increase in oil rents as a percentage of GDP, increases government expenditures as a percentage of GDP, in the short run.

Under long-run coefficients in table 2, we find considerable differences in the estimates between the models. These differences occur because the PMG model constrains the long run relationships between the countries, while the MG does not. The long-run coefficients represent our model which is a vector that contains the long run relationships between the variables. From the PMG model, we see that the coefficients are weak and close to zero. Further on, we can only reject the null hypothesis of a long run relationship at the 10% (significance) level for the fourth lag of oil rent in the MG model. This coefficient indicates a negative long-run relationship between government expenditures and oil rent. Hence, when oil rent increases with one percent of GDP, government expenditures decrease with *113,2* percentage of GDP, which is very unlikely to happen in practice. Hence, we cannot say that this result is economically significant. The lack of covariates could explain this biasedness in the results.

Table 2:
Oil rents effects: Without covariates

VARIABLES	(1) PMG	(2) MG
Short run coefficients:		
Error Correcting Speed of Adjustment	-0.221***	-0.260***
	(0.0171)	(0.0190)
LD.oilrent	18.94*	1.700
	(10.59)	(5.960)
L2D.oilrent	3.840	-16.58*
	(4.732)	(9.999)
L3D.oilrent	16.90**	15.64
	(7.854)	(12.43)
L4D.oilrent	8.523**	13.63*
	(4.233)	(7.515)
Long run coefficients:		
L.oilrent	0.0236	61.53
	(0.895)	(42.26)
L2.oilrent	-0.0593	2.201
	(1.162)	(4.470)
L3.oilrent	-0.0730	-63.03
	(0.824)	(51.87)
L4.oilrent	0.0247	-113.2*
	(0.0384)	(68.73)
Constant	3.642***	4.402***
	(0.291)	(0.444)
Observations	4,387	4,387
Pooled Long Run Relationship	YES	NO

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Compares the results from the MG and the PMG model.

In Tables 3 and 4 we present the MG and PMG models with the covariates described in the data description. As we add covariates, the error correcting speed of adjustment rate gets stronger, as seen in Figure 3. The increasing rate indicates that a higher proportion of the disequilibrium in government expenditures returns to its long-run equilibrium. The first column in table 3 is the same as column 2 in table 2. From column 3 and 4 in table 3 in the upper panel we see that *L4D.oilrent* rejects the null hypothesis at a 10% significance level. Hence, an increase in oil rents in period *t-4* (*L4D.oilrent*) by one percent of GDP, respectively increases the growth rate in government expenditures by *16,92* and *15,86* percent of GDP. Hence, controlling for political corruption weakens the estimate of *L4D.oilrent's*. However, these results are still a bit extreme to be practical. We can conclude that these results are statistically significant, but not economically significant.

Further on, the only statistically significant long-run relationship in the lower panel is *L.oilrent in column 3 (table 3)* where we control for GDP per capita and level of democracy. Hence, an increase in oil rents in period *t-1* by one percent of GDP increases the growth rate of government expenditures by 27*,36* percent of GDP. However, this relationship loses its statistically significance after controlling for political corruption, as we see in column 4 in the lower panel of table 3.

Table 3:
Oil Rents Effect (MG): With Covariates

VARIABLES	(1) MG	(2) MG	(3) MG	(4) MG
Short run coefficients:				
Error correcting speed of adjustment:	-0.260***	-0.326***	-0.390***	-0.434***
	(0.0190)	(0.0210)	(0.0246)	(0.0266)
LD.oilrent	1.700	31.63	21.84	23.83
	(5.960)	(26.30)	(20.97)	(21.61)
L2D.oilrent	-16.58*	24.10	-3.849	-1.916
	(9.999)	(23.99)	(2.944)	(2.461)
L3D.oilrent	15.64	-0.900	28.20	33.07
	(12.43)	(13.29)	(20.08)	(20.78)
L4D.oilrent	13.63*	-0.847	16.92*	15.86*
	(7.515)	(9.611)	(8.896)	(9.039)
LD.GdpPerCapita		0.000567**	0.000469*	0.000726***
		(0.000262)	(0.000254)	(0.000279)
LD.PoliticalCorruption			30.17	31.96
			(19.46)	(20.09)
LD.Polity				1.039
				(0.906)
Long run Coefficients:				
L.oilrent	61.53	5.858	27.36*	9.665
	(42.26)	(16.11)	(14.07)	(18.40)
L2.oilrent	2.201	1.419	0.466	-2.405
	(4.470)	(3.250)	(3.441)	(2.260)
L3.oilrent	-63.03	100.7	-68.09	-74.76
	(51.87)	(118.6)	(45.02)	(46.35)
L4.oilrent	-113.2*	-12.13	-29.10	-0.493
	(68.73)	(12.52)	(28.30)	(5.254)
L.GdpPerCapita		-3.01e-05	0.000418	-0.000943
		(0.00105)	(0.000476)	(0.00113)
L.PoliticalCorruption			3.049	-12.06
			(71.50)	(74.48)
L.Polity				-3.045
				(1.940)
Constant	4.402***	5.107***	8.834*	6.885
	(0.444)	(0.635)	(5.180)	(7.663)
Observations	4,387	4,371	4,281	4,212
Constrained long run relationship	NO	NO	NO	NO
Covariates	NO	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Displays the results from the regression using the PMG model. We add covariates along with the columns.

Table 4 shows the results from the PMG-model with the same covariates used in the MG-model. We notice that adding covariates increases the error correcting speed of adjustment rate at a slower pace compared to the MG-model. Hence, in the MG model, with all the covariates added the proportion of the disequilibrium in government expenditures that is corrected back to its long-run equilibrium in each period after a change in Xit is *-0,494* units, In the PMG the proportion corrected only amounts up to *-0,266*. Hence, the MG model has a higher correction rate than the PMG. Further on, we see that there are a higher number of significant short-run relationships between the growth rate of government expenditures and the growth rate of oil rents in the PMG.

The null hypothesis of no short-run relationship between the variables can be rejected at higher levels of significance and amongst more variables in the PMG model. We see that *L3D.oilrent* gets positively stronger estimates as we add covariates. After controlling for all the covariates, we see that the growth rate of government expenditures today increases with 17,90 percent of GDP after the growth rate in oil rents three periods earlier (*L3D.oilrent)* increases by one percent of GDP. When controlling for GDP per capita, the growth rate of government expenditures increases with *7,651* percent of GDP after the growth rate of oil rent four periods earlier (*L4D.oilrent*) increases by one percent of GDP. The first difference of GDP per capita (the growth rate of GDP per capita) picks up the indirect effect of oil rents on government expenditures through other industries that are dependent on the oil market. It also controls for business cycles. There could be several reasons why the relationship becomes insignificant when controlling for GDP growth.

In the lower panel of table 4, we see no statistically significant long-run relationships between oil rents and the growth rate of government expenditures. However, we see that the covariates have a significant long-run effect on the growth rate in government expenditures.

Table 4:
Oil Rents Effect (PMG): With Covariates

VARIABLES	(1) PMG	(2) PMG	(3) PMG	(4) PMG
Short run coefficients:				
Error correcting speed of adjustment:	-0.221***	-0.231***	-0.236***	-0.230***
	(0.0171)	(0.0177)	(0.0186)	(0.0181)
LD.oilrent	18.94*	18.55	19.95	20.80
	(10.59)	(11.64)	(13.15)	(13.65)
L2D.oilrent	3.840	3.175	6.115	4.886
	(4.732)	(3.676)	(5.529)	(5.582)
L3D.oilrent	16.90**	15.31**	17.10*	17.90*
	(7.854)	(7.337)	(9.092)	(9.229)
L4D.oilrent	8.523**	7.651*	12.09	11.21
	(4.233)	(4.459)	(8.284)	(7.690)
LD.GdpPerCapita		0.000280	0.000446	0.000462
		(0.000454)	(0.000339)	(0.000367)
LD.PoliticalCorruption			21.96	22.92
			(21.71)	(22.08)
LD.Polity				0.134
				(0.0943)
Long run Coefficients:				
L.oilrent	0.0236	0.0462	-0.0216	0.0212
	(0.895)	(0.914)	(0.889)	(0.0266)
L2.oilrent	-0.0593	-0.0657	0.0587	-0.0337
	(1.162)	(1.176)	(1.133)	(0.0395)
L3.oilrent	-0.0730	-0.0555	-0.0709	-0.0210
	(0.824)	(12.05)	(13.37)	(0.0458)
L4.oilrent	0.0247	-0.0256	-0.0504	-0.0352
	(0.0384)	(12.02)	(13.34)	(0.0355)
L.GdpPerCapita		5.23e-05***	5.72e-05***	5.14e-05***
		(5.24e-06)	(5.92e-06)	(5.95e-06)
L.PoliticalCorruption			-3.864***	-4.257***
			(0.912)	(0.944)
L.Polity				0.0413**
				(0.0179)
Constant	3.642***	3.649***	4.205***	4.085***
	(0.291)	(0.302)	(0.355)	(0.341)
Observations	4,387	4,371	4,281	4,212
Constrained long run relationship	YES	YES	YES	YES
Covariates	NO	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Displays the results from the regression using the MG model. We add covariates along with the columns.

Sensitivity analysis

In this part, we check for what happens to the results when we remove GDP per capita as control and change the order of polity and political corruption. (Tables 5 and 6). After removing GDP per capita, we see a significant change in both models. However, the PMG-model experiences the most significant changes. From the upper panel in table 5 we see that the results are somewhat similar. We see that *L3D.oilrent* is significant at 5 % level in column 2 and a 1% level in column 3 and that the estimates are stronger for the PMG-model. *L4D.oilrent* is significant when controlling for polity and political corruption, which it was not when controlling for GDP per capita as well. This is also true for *LD.oilrent*.

In the lower panel of table 5, we see that when controlling for level of democracy and political corruption, the relationships between oil rents and government expenditure gets significant. The coefficients under column 2 for the first, second and third lag of oil rents are significant but very close to zero. Hence, an increase in *L3.oilrent* by one percent of GDP decreases government expenditures with *0,0842* percent of GDP. However, when controlling for political corruption as well, this effect changes from a *0,0842* percent of GDP decrease to a *6,308* percent of GDP decrease. We also see that the coefficients for the first and second lag increase as well. The fourth lag becomes positive and significant. In contrast to the short-run effects of oil rents on government expenditures, which was positive, the long-run effects of the first to the third lag of oil rents when controlling for level of democracy and political corruption is negative except the fourth lag of oil rents. For example, an increase in *L3.oilrent* by one percent of GDP decreases the growth rate of government expenditures by *-6,308* percent of GDP, while an increase in *L4.oilrent* by one percent of GDP increases the growth rate of government expenditures by *34.32* percent of GDP.

These different results indicate an interesting relationship between oil rents and government expenditures. However, as we see in the lower panel of table 4, column 4, the relationship between oil rents and the growth rate of government expenditures become insignificant and close to zero when we control for GDP per capita. As explained earlier, GDP growth controls for business cycles as well as the indirect channel between oil rents and government expenditures. Hence, there could be several explanations for why the change in the results occur. Furthermore, not controlling for GDP per capita decreases the robustness of the results.

From table 6, we see some minor changes in both the upper panel and lower panel. In the upper panel in column 2, the relationship between *L3D.oilrent* and *L4D.oilrent*, and the growth rate of government expenditures is significant at a 10% level. This relationship is only significant when controlling for Polity. When adding political corruption, this relationship becomes insignificant. In the lower panel, we see no significant results.

Table 5:
Oil Rents Effect (PMG): With Covariates

VARIABLES	(1) PMG	(2) PMG	(3) PMG
Short run coefficients:			
Error Correcting Speed of Adjustment:	-0.221***	-0.225***	-0.228***
	(0.0171)	(0.0175)	(0.0187)
LD.oilrent	18.94*	19.56*	23.20*
	(10.59)	(11.13)	(12.33)
L2D.oilrent	3.840	3.406	7.972
	(4.732)	(5.007)	(5.214)
L3D.oilrent	16.90**	18.11**	23.80***
	(7.854)	(8.289)	(8.299)
L4D.oilrent	8.523**	8.808**	8.270*
	(4.233)	(4.466)	(4.487)
LD.polity		0.0642	0.122
		(0.0758)	(0.0954)
LD.politicalCorruption			19.07
			(16.25)
Long run coefficients:			
L.oilrent	0.0236	0.100***	-17.39***
	(0.895)	(0.0280)	(1.984)
L2.oilrent	-0.0593	-0.0764*	-10.66***
	(1.162)	(0.0402)	(1.233)
L3.oilrent	-0.0730	-0.0842**	-6.308***
	(0.824)	(0.0392)	(0.704)
L4.oilrent	0.0247	-0.0104	34.32***
	(0.0384)	(0.0315)	(3.919)
L.polity		0.0593***	0.000426
		(0.0197)	(0.0232)
L.politicalCorruption			-9.423***
			(1.041)
Constant	3.642***	3.626***	4.842***
	(0.291)	(0.284)	(0.409)
Observations	4,387	4,227	4,227
Constrained long run relationship	YES	YES	YES
Covariates	NO	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Displays the results from the regression using the PMG model without GDP per capita. We add covariates along with the columns.

Table 6:
Oil Rents Effect (MG): With Covariates

VARIABLES	(1) MG	(2) MG	(3) MG
Short run coefficients:			
Error Correcting Speed of Adjustment:	-0.260***	-0.311***	-0.365***
	(0.0190)	(0.0217)	(0.0224)
LD.oilrent	1.700	4.774	3.072
	(5.960)	(7.134)	(5.604)
L2D.oilrent	-16.58*	-13.87	-36.30
	(9.999)	(10.17)	(39.71)
L3D.oilrent	15.64	22.45*	56.43
	(12.43)	(13.53)	(45.77)
L4D.oilrent	13.63*	14.17*	29.56
	(7.515)	(8.019)	(23.43)
LD.polity		0.0213	1.251
		(0.0887)	(1.191)
LD.politicalCorruption			18.86*
			(10.20)
Long run coefficients:			
L.oilrent	61.53	23.83	-12.73
	(42.26)	(32.38)	(12.28)
L2.oilrent	2.201	3.853	2.730
	(4.470)	(4.347)	(7.039)
L3.oilrent	-63.03	-80.59	-252.3
	(51.87)	(54.90)	(249.0)
L4.oilrent	-113.2*	-69.94	51.82
	(68.73)	(62.68)	(50.73)
L.polity		0.0479	-2.803
		(0.246)	(2.392)
L.politicalCorruption			627.9
			(681.6)
Constant	4.402***	5.365***	4.073
	(0.444)	(0.922)	(6.701)
Observations	4,387	4,227	4,227
Constrained long run relationship	NO	NO	NO
Covariates	NO	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Displays the results from the regression using the MG model without GDP per capita. We add covariates along with the columns.

Part 4

Discussion

In the analysis, we used both the MG and the PMG model, despite the Hausman specification test which recommended the PMG model. As explained earlier, assuming a similar long-run relationship between 99 oil-producing countries for the growth rate of government expenditures and oil rents is a strong assumption. However, which model is the correct model in our scenario? Could it be that one of the models produces misleading results? If so, how do we choose the correct model? We use the PMG model because the Hausman test recommends it, and we use the MG model because empirics often reject a similar long-run relationship across a large group. As the number of countries increases, the assumption of a similar long-run relationship weakens.

We find little evidence of a long run relationship independent of the assumption of a homogeneous or a heterogeneous effect amongst countries. We do, however, find stronger evidence of short-term relationships between the growth rate in government expenditures and the growth rate in oil rents. The estimates from both models display different changes when adding covariates. Hence, the models differ when it comes to both the long-run and short-run effects. The difference in the short and long-run estimates is the main reason why the Hausman specification test recommended the PMG model. When it comes to the short-run effects, both models assume short-run effects that differ between countries. We see different changes in the estimates when adding covariates, which could be explained by the different long-run effects between the models. Hence, the correct model depends entirely on the assumption of a homogeneous or a heterogeneous long-run effect.

Even though the short-run effects are different when adding covariates, both models indicate the same positive effect between the growth rates of government expenditures and oil rents. The results are therefore consistent with other studies on the short-term effect of oil rents on government expenditures reviewed earlier. In the literature review, we pointed out that the level of democracy and political corruption in a country could explain a positive relationship between oil rents and

government expenditures (Robinson and Torvik 2005; Robinson et al. 2006; Robinson et al. 2017; Matsen et al. 2016). Hence, the effect of political corruption and Polity on government expenditures is consistent with our main results from Tables 3 and 4. These results strengthen the discussion on politicians using oil rents to their benefit. As mentioned politicians may use the oil rents to supply voters with goods and services that enhance their chances of being re-elected, and even turn to over-extract oil compared to the efficient quantity when the future oil price is uncertain and discount the future too much. However, there could be other explanation for why the results in Tables 3 and 4 occurred.
The PMG model shows more robust short-run results than the MG model. This difference can be explained by the fact that the only difference between the models is the assumption on the long run relationship. Hence, once again one must decide between a long-run relationship that is same for all countries or not. One cannot just choose the model with the most significant results, because both models tell different stories. If one decides that the PMG model be correct, the short-term effects are only significant if there indeed exists a long-run relationship that is same for all countries. When we compare the upper panels in Tables 3 and 4, we see that the estimates differ. For example, we see a difference in column 1 and 2 in the upper panel for table 3 and 4, where the estimates in the PMG model are statistically significant at a higher level. Hence, the PMG model is only empirically correct if the right long-run relationship between the countries in the sample is similar for all countries. Similarly, the MG model is only empirically correct if the right long-run relationship between the countries is different between the countries.

There is little research on the long-term effect of oil rents on government expenditures that give a disadvantage when it comes to comparing our results with other literature. We find that the only statistically significant long-term effect (with covariates) between the variables of interest is positive as displayed in the lower panel of Table 3 in column 3. This effect is only significant when assuming a different long-term relationship between countries and when controlling for GDP per capita and political corruption. This effect, however, becomes insignificant when controlling for polity (level of democracy). Hence, when assuming a constrained long-run relationship, there does not exist any significant long-run effects. Therefore, the result found in table 3 is only correct if the correct long-run relationship between the growth rate in government expenditures and the oil rents differ amongst countries. When the results are different between the models one can argue that the results are dependent on whether the long run relationship between government expenditures and oil rents are homogeneous or heterogeneous amongst countries. Since most of the results differ between the models, we assume that the results are dependent on whether the long run relationship between government expenditures and oil rents are constrained or not amongst the countries.

When it comes to sensitivity, in the lower panel of Table 5, we see that the results in column 2 are similar to the results we get when controlling for GDP per capita, as seen in Table 4. It could be that the political corruption variable produces biased or spurious results. There could be some characteristics of the political corruption variable that introduces some form of bias, which causes misleading results. We know that the political corruption variable ranges between 0 and 1 and is highly serially correlated (shown in Figure 3 in the appendix). Further on, its standard deviation is almost half its mean, which we can see from table 1. There could be other characteristics of this variable that causes biased results. We see that it is only in the lower panel where political corruption causes a significant change in the estimates, we do not find such changes in the upper panel. The difference between the upper and lower panel in Table 5 is first that the variables in the lower panel are constrained, and the ones in the upper are not. Secondly, the political corruption variable in the upper panel is the first difference of political corruption while the one in the lower panel is political corruption in levels. The political corruption variable in the lower panel contains a unit root, while the first difference of this variable like the one in the upper panel does not. However, cointegration between the variables of the same order is satisfied which means that the unit root characteristics of the variable should not compute any problems.

We only experience the sudden change in the PMG model (Table 5) and not in the MG model (Table 6), the differences in the long-run assumptions between the models could, therefore, explain the sudden changes in Table 5. As explained earlier, the PMG model assumes a long run relationship that is the same across countries, while the MG model does not. Further on, we only see the sudden jump in the lower part of table 5, which represent the coefficients for the long run relationship. Hence, the sudden jump could be related to the assumption of a similar long-term effect on all countries in the sample.

Omitted variable bias (OVB) could explain the sudden change occurred in the PMG-model (Table 5). As explained earlier, GDP per capita is an important control variable when dealing with government expenditures, hence not controlling for this variable could introduce omitted variable bias. Further on, we know that the results change when including GDP per capita. Hence, the sudden changes could, therefore, hint to omitted variable bias. However, if the changes were mainly due to omitted variable bias, we should have seen the same jumps in the MG model as well, but we do not. Hence, we interpret the results as significant if the right long-run relationship between government expenditures and oil rents is the same across the countries in our sample. Because GDP per capita is a necessary control, we cannot view these results as robust. Hence, it could be that GDP per capita picks up significant variation between oil rents and government expenditures. Therefore, it is important to point out that the estimates jump when adding political corruption as a control. The estimates produced when only controlling for Polity is similar for those when adding GDP per capita. Hence, we do not experience a sudden change when only controlling for Polity, which suggests that the political corruption variable picks up some variation in the growth rate of government expenditures that polity does not. Villafuerte et al. (2008) find evidence that countries with higher levels of political corruption have higher correlations between expenditures and oil revenue. Tornell and Lane (1999) also find that countries with weak institutional structures such as high political corruption experienced increased government spending when oil revenues increased. However, Andersen et al. (2017) find no evidence between corruption and the transformation of petroleum rents into tax haven deposits. Several other authors (Mehlum, Moene, & Torvik, 2006; J. A. Robinson, Torvik, & Verdier, 2006; J. Robinson, Torvik, & Verdier, 2017; M. Ross, 2012b; M. L. Ross, 1999) link institutional qualities such as political corruption to the resource curse. Political corruption is therefore a necessary control. All in all, we do not know for sure why the results jump as they do when controlling for political corruption, we, therefore, open up for that the results in column three in the lower panel of table 5 could be biased.

Conclusion

Our paper finds substantial evidence of a positive short-run relationship between oil rents and government expenditures when the long-run relationship is both constrained and not constrained across countries. The short-run relationship varies between the homogeneous model and the heterogeneous model. Our results highly depend on the right long-run relationship between oil rents and government expenditures across countries. If the real long-run relationship is homogeneous, then one can argue that the short run and long run results with a different long-run relationship between countries produce misleading results. The opposite is exact if the real relationship is heterogeneous. Further on, our results suggest that not controlling for Gross Domestic Product per capita affects the robustness of the results and produces misleading results, mainly because of omitted-variable bias. We also see changes in the results when including political corruption and polity (level of democracy) as controls. The results on the short-run effect indicate that the short-run relationship between the growth in oil rents and the growth in government expenditures is positive. Moreover, this result varies between the lags of oil rents. However, all the significant results indicate a positive relationship. Hence, an increase in the growth rate of oil rents increases the growth in government expenditures when controlled for Gross Domestic Product per capita, political corruption, and polity. Why this is, is not the main point of this study. However, based on previous studies, this relationship could be explained by politicians using the windfall to their benefit, as re-election. Some studies show that the uncertainty of future oil prices gives the politician incentives to over-extract oil relative to the efficient extraction path. They then use these resources for their benefit such as increasing the probability of re-election by running unsustainable policies through inefficient investments or providing the voters with goods and services (Robinson and Torvik 2005; Robinson et al. 2006; Robinson et al. 2017; Matsen et al. 2016). These studies favor a positive relationship between oil rents and government expenditures.

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Appendix

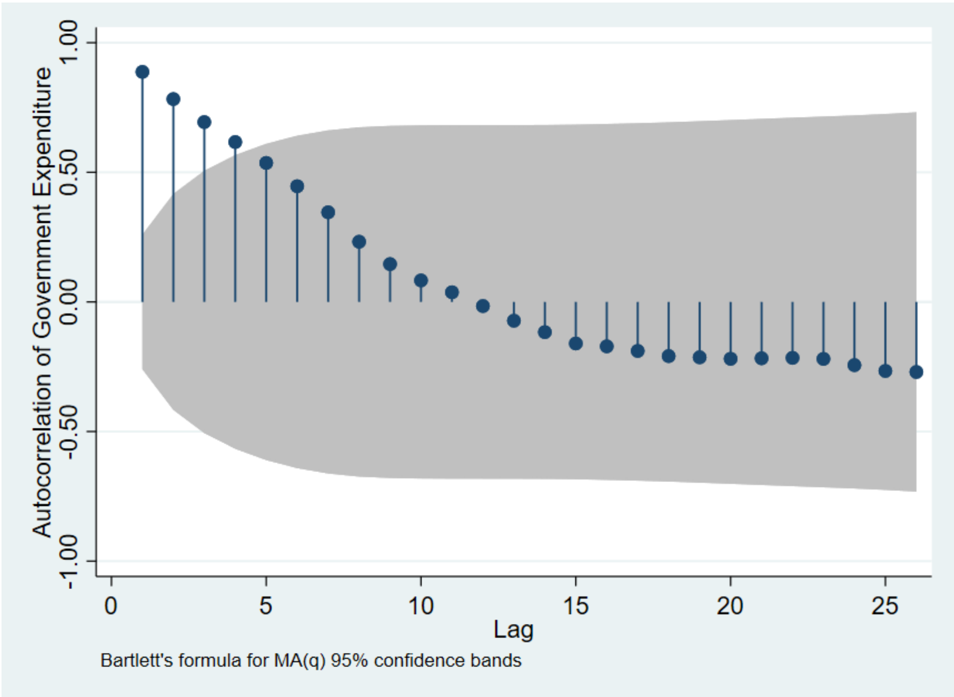

Figure 1: Display the autocorrelation of Government expenditures over 25 lag's, where one lag represents one year. The grey area represents the 95 percent confidence level.

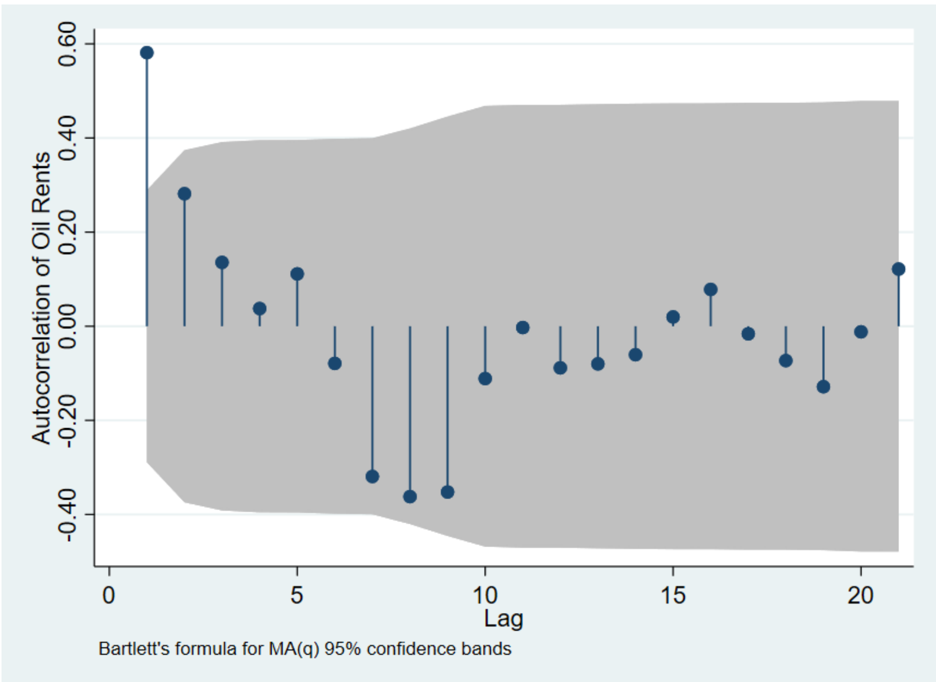

Figure 2: Display the autocorrelation of Oil Rents over 20 lag's, where one lag represents one year. The grey area represents the 95 percent confidence level.

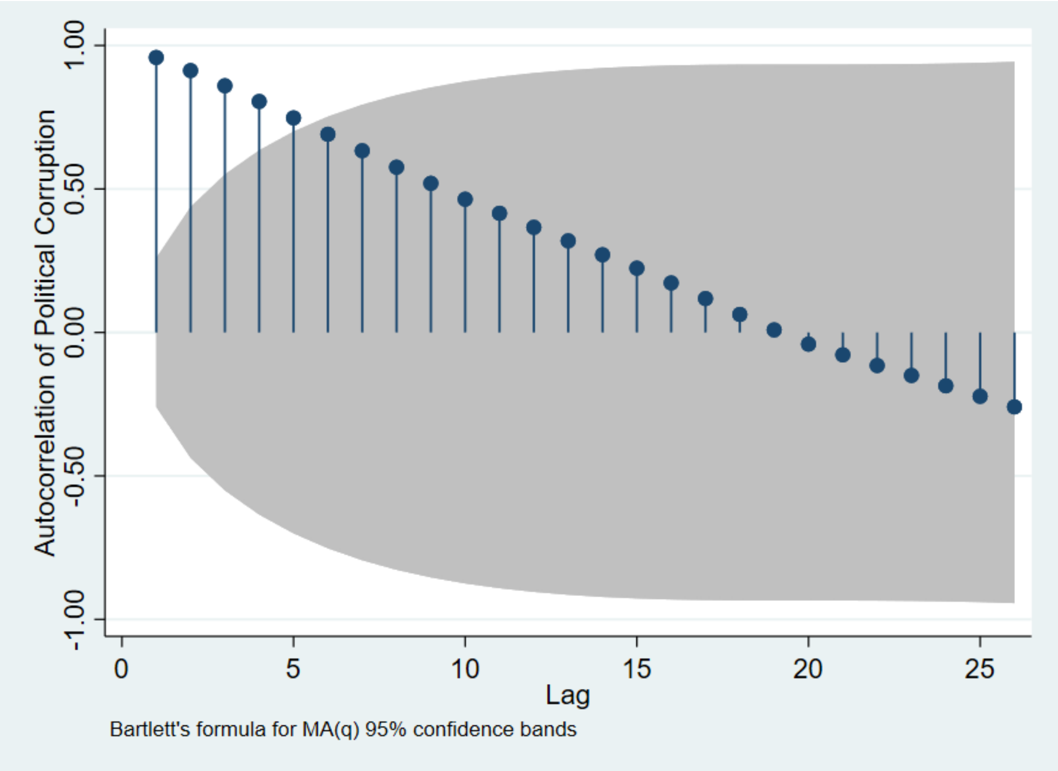

Figure 3: Display the autocorrelation of Political Corruption over 25 lag's, where one lag represents one year. The grey area represents the 95 percent confidence level.

Table 7

Oil Producing countries used in the study

(1)	(2)	(3)	(4)
	Oil Producing Countries		
Country name abbreviation	**Country name**	**Country name abbreviation**	**Country name**
AGO	Angola	JOR	Jordan
ALB	Albania	JPN	Japan
ARE	United Arab Emirates	KAZ	Kazakhstan
ARG	Argentina	KGZ	Kyrgyzstan
AUS	Australia	KOR	South Korea
AUT	Austria	KWT	Kuwait
AZE	Azerbaijan	LBY	Libya
BEN	Benin	LTU	Lithuania
BGD	Bangladesh	MAR	Morocco
BGR	Bulgaria	MEX	Mexico
BHR	Bahrain	MNG	Mongolia
BLR	Belarus	MOZ	Mozambique
BOL	Bolivia	MYS	Malaysia
BRA	Brazil	NGA	Nigeria
BRB	Barbados	NLD	Netherlands
BRN	Brunei Darussalam	NOR	Norway
CAN	Canada	NZL	New Zealand
CHL	Chile	OMN	Oman
CHN	China	PAK	Pakistan
CIV	Ivory Coast	PER	Peru
CMR	Cameroon	PHL	Philippines
COD	Democratic Republic of Congo	POL	Poland
COG	Republic of the Congo	QAT	Qatar
COL	Colombia	ROU	Romania
CUB	Cuba	RUS	Russia
CZE	Czech Republic	SAU	Saudi Arabia
DEU	Germany	SDN	Sudan
DNK	Denmark	SEN	Senegal
DZA	Algeria	SRB	Serbia
ECU	Ecuador	SUR	Suriname
EGY	Egypt	SVK	Slovakia
ESP	Spain	SVN	Slovenia
EST	Estonia	SWE	Sweden
FRA	France	SYR	Syria
GAB	Gabon	THA	Thailand
GBR	United Kingdom	TJK	Tajikistan
GEO	Georgia	TKM	Turkmenistan
GHA	Ghana	TUN	Tunisia
GNQ	Equatorial Guinea	TUR	Turkey
GRC	Greece	TWN	Taiwan
GTM	Guatemala	TZA	Tanzania
HND	Honduras	UGA	Uganda
HRV	Croatia	UKR	Ukraine
HUN	Hungary	USA	United States
IDN	Indonesia	UZB	Uzbekistan
IND	India	VEN	Venezuela
IRN	Iran	VNM	Democratic Republic of Vietna
IRQ	Iraq	YEM	Yemen
ISR	Israel	ZAF	South Africa
ITA	Italy		

Table 8

Non-Oil producing countries used in table 1

(1)	(2)	(3)	(4)
Non-Oil Producing Countries			
Country name abbreviation	**Country name**	**Country name abbreviation**	**Country name**
ARM	Armenia	LVA	Latvia
BDI	Burundi	MDA	Moldova
BEL	Belgium	MDG	Madagascar
BFA	Burkina Faso	MDV	Maldives
BTN	Bhutan	MLI	Mali
BWA	Botswana	MUS	Mauritius
CAF	Central African Republic	MWI	Malawi
CHE	Switzerland	NAM	Namibia
CPV	Cape Verde	NIC	Nicaragua
CRI	Costa Rica	NPL	Nepal
CYP	Cyprus	PAN	Panama
DDR	German Democratic Republic	PRK	North Korea
DJI	Djibouti	PRT	Portugal
DOM	Dominican Republic	PRY	Paraguay
ERI	Eritrea	PSG	Palestine/Gaza
FIN	Finland	RWA	Rwanda
FJI	Fiji	SGP	Singapore
GIN	Guinea	SLB	Solomon Islands
GMB	Gambia	SLE	Sierra Leone
GNB	Guinea-Bissau	SLV	El Salvador
GNQ	Equatorial Guinea	SML	Somaliland
GUY	Guyana	SOM	Somalia
HTI	Haiti	STP	São Tomé och Príncipe
IRL	Ireland	SWZ	Swaziland
ISL	Iceland	SYC	Seychelles
JAM	Jamaica	TGO	Togo
KEN	Kenya	TTO	Trinidad and Tobago
KHM	Cambodia	URY	Uruguay
LAO	Laos	VDR	Republic of Vietnam
LBN	Lebanon	VUT	Vanuatu
LBR	Liberia	YMD	South Yemen
LBR	Liberia	ZWE	Zimbabwe
LKA	Sri Lanka	ZZB	Zanzibar
LSO	Lesotho		