Visualizing Natural Resources and Economic Growth

Les Stanaland

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Abstract

How do natural resource taxes affect growth? Specifically, can particular types of taxes prevent the resource curse? Rational choice theory suggests over-taxation of an industry may lead to lower levels of production. As larger tax rates consume more of an extraction company‘s profits, they seek opportunities elsewhere, thereby lowering output. Tying this theoretical approach to the resource curse literature, we would expect that higher tax rates benefit the state if it causes output to drop, leading to a reallocation of financial resources to the productive sector of the economy. This paper argues that tax dependence on natural resources is inversely related to economic growth; more reliance will lower output and therefore avoid the resource curse. This work analyzes panel data of 41 countries from 1999 to 2016. I find no evidence that tax structures matter, indicating revenue from the resource itself may better explain economic growth than the domestic taxation of those industries. Instead, I find that rent-seeking behavior, far from being a drag on growth, has a positive and significant effect on economic growth.

Introduction

Research, while far from clear on the subject, nevertheless posits that if the resource curse is a real and empirical phenomena, then developing countries are among those that bear the worst of the curse (Ross 2001; Sachs and Warner 2001). If the literature properly takes into account the variables necessary to find the resource curse, then we would expect countries with similar backgrounds, fuel exports, and institutions to similarly suffer the resource curse and see lower levels of economic growth. As part of the quest to further knowledge on the relationship (if any) between natural resource production and economic growth, a puzzle arises when looking at two developing countries in Latin America, Colombia and Bolivia.

Puzzle

To qualify as a puzzle, the units of analysis must be similar in respects considered unimportant to the hypothesis to act as controls for other possible effects. When comparing Colombia and Bolivia, we see several similarities. First, they both have a history of Spanish colonization, with Colombia declaring independence in 1810 and Bolivia in 1825. Also, they both have a unitary presidential constitutional republican form of government. Following Andersen and Aslaksen (2008), presidential systems are more likely to exhibit lower rates of economic growth than parliamentary systems. Lastly, fuel exports as a percentage of total exports are similar, with Colombia averaging 49% and Bolivia averaging 42% over the 17 year period 2000-2016 (World Bank).

With these similarities between the countries established, the fact that Colombia has such an economic growth advantage over Bolivia is an interesting area of inquiry. If the resource curse affects both countries, and they also have similar systems of government and colonial history, then any differences in economic output as measured by GDP per capita must have a different cause. Since Colombia has a much larger GDP per capita than Bolivia, and even showed faster year-over-year growth rates throughout most of the dataset, we must explain why.

Research Question

Broadening this puzzle to the global arena, we can ask why some countries with natural resources have economic growth while other natural resource countries do not. Developing countries are especially susceptible to the resource curse, and if a higher rate of fuel exports as a percentage of total exports meant a country was more likely to suffer the resource curse, then we would expect Colombia to be *worse off* than Bolivia in terms of per capita GDP, yet the opposite is true.

Significance

Solutions to the resource curse are essential if economic growth is a superior alternative to the status quo of sluggishness and predation. This puzzle is therefore significant because in this example, a country with a higher percentage of fuel exports is doing better in terms of economic growth than a country with lower levels of fuel exports, while keeping other factors like institutions as similar as possible.

The natural resource literature analyzes different aspects of the political economy

when seeking an answer to whether or not resource export is a good or bad thing for an economy. Political factors such as institution quality, type of government, and human rights can all be affected by or affect the existence of natural resources. Economic factors that define growth such as real per capita GDP can also either explain or be explained by natural resources. The comparison therefore is not between resource and non-resource countries, but rather given natural resources in a country, why do we still see differences in economic growth rates? How have some countries defeated the "resource curse" while others have not?

This research will test three hypotheses about the effect natural resources have on economic growth; the main finding is that perhaps counter-intuitively, higher levels of rent-seeking behavior on the part of government leaders leads to an *increase* in economic growth among resource cursed countries.

Literature Review

Following Auty's (1994) landmark study of industrializing countries, the resource curse literature has vigorously argued about its causes, whether or not it exists, and if it only exists in certain circumstances. Various methodologies have been used, from the game theoretic (Tornell and Lane 1999) to more traditional time series OLS (Crivelli and Gupta 2014). This study will seek to use the economic model found in Caselli and Cunningham (2009) and Dunning (2008) in which the economy is divided into the natural resource portion and the non-natural resource portion to better understand how the economy reacts to natural resource revenue. Revenues

flow into government coffers from both sources, but the balance between the two can serve as a predictor of the resource curse. Economic (Ricardian) rents are the natural resource revenue flow, and domestic taxes serve as the non-natural resource revenue. If the amount of revenue coming in from the resource side exceeds that of the non-resource side, then GDP will fall and the resource curse will occur.

Current Understanding

There are different causal mechanisms to explain this phenomenon. The first hypothesis is that as a state depends more on the revenue from natural resources, the government will respond with lower tax rates on the domestic, non-natural resource side of the economy. Collier, et. al. (2010) find the causal link to be the volatility in government budgets given these constraints; that less economic growth will occur given the cyclical dependence upon resource revenue. Related to this approach is that the reduction in domestic tax revenue by itself is enough to reduce economic growth, especially once the resource is exhausted (Bornhorst, Gupta, and Thornton 2009). Crivelli and Gupta (2014) follow on this study with a larger dataset and come to the same conclusions, while Ossowski and Gonzales (2012) find this effect specifically in Latin American countries. This is the rent-seeking hypothesis; that as oil revenues increase, they are more likely to decrease their dependence on tax revenue from the productive side of the economy, leading to negative growth. Explicitly stated, hypothesis 1 is: As rent-seeking behavior increases, economic growth will go down.

The second causal mechanism described in the literature revolves around the actions of rational actors in response to the fact that the resource sector is "out-

performing" the non-resource sector. Torvik (2002) shows that an increase in the resource sector of the economy in comparison to the non-resource sector leads to more requests from rent-seekers for wealth transfers, which in turn causes an upward pressure on domestic taxes to make up the shortfall, which then leads to a reduction in the domestic sector, leading to lower economic growth. This model builds upon the work of Lane and Tornell (1996), which showed this mechanism led to decreased savings, and Tornell and Lane (1999) which demonstrated the causal link as a capital reallocation to the resource sector. In all cases, this approach took the gains from the resource side of the economy and showed the way in which those resource revenue gains would lead to lower growth through an increase in taxes on domestic production. This is the investor behavior hypothesis; if investing in oil is more profitable than investing in the country (through it's other economic activities), then economic growth will slow.

So in both cases, domestic taxes are a link in the causal chain that seeks to explain why an increase in natural resource revenue leads to lower economic growth. My study seeks to add to this literature by analysing the tax policy response to an increase in rents.

Theoretical Approach

I offer a different approach. Since most natural resource extraction is still done by private companies, the dependence of domestic tax revenues on natural resource extraction is relevant. Contra Caselli and Cunningham (2009), who hold taxes as

exogenous, I hypothesize that tax structures are endogenous; therefore they may have independent effects on economic growth. The third hypothesis therefore can be defined as: A country more dependent on resource sector taxes will have lower economic growth. Figure 1 shows the potential causal mechanisms. The tax structures can have both an independent effect, but can also work *through* the first two hypotheses.

Previous work has held taxation as exogenous under the theory that it is the rents that matter for the government, and that any tax revenue gained from the extraction of natural resources is immaterial since it will represent a much smaller entry into the government's coffers than the oil income. If tax rates and structures however serve as a signal to investors and extraction companies, as rational choice theory suggests they would, then we might expect to see a particular rate or structure to be unattractive; hence oil production would be lost. We can see then why taxes may influence investor behavior.

Tax policy can also be used as a lever for power in a government. Rates can be raised or lowered as a reaction to social or economic problems of the day in a democracy; in an autocracy, they can be used to give favor or punish. In this study, the tax hypothesis can work through the rent-seeking hypothesis and we can argue domestic tax rates can be lowered (to gain favor) as long as resource tax rates can increase. However, once the government decides to rent-seek in the resource arena, it becomes more dependent on those taxes, leading to lower economic growth.

Lastly, how a country taxes its extractive industries may have an effect on GDP. In this hypothesis, different tax structures would lend themselves to either an over-

production of oil and under-reliance on domestic tax revenues or a production level that balances resource and non-resource revenue. The difference between oil tax revenue and non-resource tax revenue comprises my third variable of interest.

Research Design

Approach

Potential methodological approaches for this research question include, but are not limited to: a large-n statistical study, a case study, a game theoretic model, or a natural experiment. In the natural resource literature, there are examples of all four approaches. Dube and Vargas (2013) look at Colombia to ascertain the effects of resources on civil conflict, while Robinson, et al (2006) look at leader incentives through a game theory lens. Brollo, et al (2013) use a natural experiment approach to find the effect resources have on political actors. So while these three approaches have their benefits, I posit that my question is best answered using a large-n statistical study.

This is because my research question revolves around the effect that different natural resource tax structures have on economic growth. A case study will only look at different independent variables, and will not be able to demonstrate causality, which is the goal. Second, an experimental study for this question is unfeasible since countries are my unit of analysis, and randomly selecting countries is unnecessary; what is needed is an accounting of other potential causes, which is what a regression model approach will do. Lastly, a game theoretic approach will not gather the needed

information; there are too many potential influencers in my model, so any solution gathered by this approach will not account for all potential possibilities.

For these reasons, the best research design for my question regarding the effects that natural resource tax structures have on economic growth is best found using a large-n statistical study.

Implementation

To properly adjudicate the three hypotheses, a balanced panel of 41 countries over 17 years will be used. Countries in the dataset include all those that produce at least 100,000 barrels of oil per day. Through this method, I was able to get a sample of both resource cursed and non-cursed countries; I was also able to get both democratic and autocratic forms of government. This eliminates a frequent concern of statistical work regarding case selection; I haven't "cherry-picked" countries that fit my hypothesis. Instead, government types and "cursedness" are controlled for. However, due to missing data for which no techniques such as multiple imputation could be used to recover, the original set of 44 countries was reduced to 41 by the listwise deletion of Iraq, Qatar, and Turkmenistan.

Likewise, a lengthy timeframe can show tax law changes, which is my main hypothesis. However, tax law changes are rare, therefore a longer timeframe is preferable. Therefore the overall structure of the study will be to use cross-sectional time series panel data to ascertain which hypothesis best answers the question of the effects of political actors and tax structures on economic growth. Data and case limitations led to the time series beginning in 1999 and continued until 2016, the last

year data were available.

Operationalization

Consistent with the majority of the natural resource literature, the main dependent variable will be measured as real per capita GDP. This variable removes the influence of inflation and standardizes the effect of population. The three main independent variables, representing the three hypotheses, are rent seeking behavior by government leaders, investment decision making by (potential) investors, and the differentiation of tax structures in the resource sector.

The operationalization for rent-seeking would be a ratio of oil revenue to total tax revenue; a higher ratio here would indicate a higher level of rent-seeking behavior since more of the government wealth would come from the resource sector. Theory suggests this measure will adequately demonstrate rent-seeking.

To measure investor willingness to invest in the resource sector, I use a ratio of world oil price to the percentage of total investment to GDP. Endogeneity is a concern here; my preferred method of using a ratio of oil prices and 30 year T-bills was unable to be constructed due to lack of reliable data.

Measuring the difference between total tax receipts and non-resource tax receipts to find the resource tax receipts is the way to measure the final independent variable. Tax rates are quite complex, and don't vary much; therefore, this measure is a way to find the effect that the tax structure has on economic growth. Here again specific data on point was unreliable; I constructed a measure of resource tax receipts based available data of oil rent percentage and GDP to find the resource tax revenue; then I

took total tax revenue and subtracted the resource tax revenue to get at non-resource tax revenue. While imperfect, I expect in future versions of the paper to correct this measure.

Controls

As this is an economic based hypothesis, I will need to control for all the various political variables that could also cause economic growth or that could influence the independent variables. Therefore, variables such as level of development, institutional strength, productivity, population growth, and level of technology would all need to be controlled for this model.

As this study includes both countries largely accepted to be resource cursed as well as countries that are not, I will control for this status. To do that, an independent operationalization must be constructed to avoid any bias through circular logic ("A country is resource cursed, therefore it has low economic growth"). In this analysis, a country is coded as resource cursed if it meets two conditions: One, oil exports must be at least 50% of all exports and it must be rated as a Low Income Country or Low to Middle Income Country by the World Bank. Theory is the guide here; only if a country is resource dependent (first condition) and poorer (second condition) are they classified as cursed. Simple poverty isn't enough, nor is simple dependence.

Method

The regression, correcting for autocorrelation and using robust standard errors, is

$$Y_{it} = \alpha + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 Z_{it} + \epsilon \tag{1}$$

where Z represents a matrix of controls.

We would expect all three of these independent variables to be negatively correlated with economic growth.

Main Findings

Table 1 shows the preliminary results of the model. Model 1 shows just the three hypotheses, and without controls both the rent-seeking and investor behavior are significant with the hypothesized signs; an increase in those variables lead to a decrease in real per capita GDP. The investor effect disappears once the institutional variable in introduced in Model 2, and the introduction of all controls indicate that only the rent seeking hypothesis is significant, but now in a positive direction. This could be an indication seen throughout the literature; namely that some countries can have a resource blessing. The method of country choice gave a good mix of advanced and developing countries; this could explain this seemingly incongruous relationship. Clearly the status as a "cursed" country come through as very negatively significant, as we would expect. The strongest predictor is the dummy variable for being a resource cursed country, which creates the possibility that my previous theory regarding the conditions for being coded as resource cursed country made be

an error. If more countries received the designation of a cursed country because of their low-income status, naturally that would be collinear with the main dependent variable. These results could also demonstrate evidence that resource countries do in fact have lower levels of economic growth.

The most interesting finding as seen in Table 1 is the sign switch that occurs on the rent-seeking variable. By itself, it is negative and significant, as theory and the literature suggests. However, once the resource curse dummy was added to the model, the coefficient remained significant but is now negative. Figure 3 shows the marginal effect that rent-seeking and being resource cursed has on real per capita GDP; it shows that indeed, a resource cursed country sees a statistically significant gain in GDP through increased rent-seeking.

Visualization Theory and Comparisons

Usually, when comparing different hypotheses, authors will verbalize them, like this:

H1: As variable X goes up, variable Y goes down

(2)

or something similar. Instead, a graphical representation, such as is seen in Figure 1, the hypotheses can be visualized in an easy to understand way. From a personal

standpoint, as I read hypotheses, my mind makes a causal map very much like Figure 1, so perhaps if as researchers we used this type of visualization more often, it may be easier to understand. From this graphic, we can see that I expect taxation of natural resources to have a negative impact on GDP.

A "first cut" at understanding the relationship between two variables is simply to plot them on the same set of axes, and see if a general pattern emerges, Figure 2 show a plot between oil production and real GDP. If the Resource Curse exists, we would expect this relationship to be negative, but this figure shows the regression line move in a positive direction. However, we also see that several outliers on the low end could be skewing the line, and that if they were gone, the resulting line may move. All of these insights into the data were able to be gathered by looking at one visualization, which is key to understanding how they can be used to make us into better scientists.

Another good rule of thumb when looking at data in which the unit of analysis is the country or the country-year, maps can come in quite useful. Exploring the many variables and the different countries can demonstrate a basic understanding of what might be going on before any formal analysis begins. Figure 3 is a map which explains how dependent a country is on oil rents; the explanation comes by the relative size of a blue dot. This visualization was chosen because based on visualization theory, shape is seen before color. Since I wanted to show relative dependence, size difference was a better choice than color difference. In the future, I will attempt to color the countries themselves instead of a dot, since shading different colors is the best way to get differences in a relationship across to a reader.

Also, I chose this type of visualization because according to the Gestalt rules, proximity can be used to make things seem related. In Figure 3, we can clearly see that the countries with the larger dots (more dependence on oil rents) are clustered in Africa and the Middle East, while smaller dots are in North America and Europe. This graphic alone helps to explain some of the difficulties within the Resource Curse literature; that some countries in fact see a resource blessing, while others see a curse. This figure then can lead us to ask different questions than if we simply looked a regression output table.

Table 1 shows that regression output, which is necessary for us to analyze the causal direction. Graphs can aid us tremendously in exploring data and can serve as an improvement over the traditional table. Figure 4 shows the key finding from this research; that a Resource Cursed country can see *gains* in real per capita GDP by engaging in rent-seeking behavior. The graphic itself is stripped down to just the necessary bits of information needed to see this conclusion. This key finding however requires clarification; to be able to test the relationship, I needed to construct my own definition of resource cursed because that designation is one created in the literature. My definition was a two-condition one; countries that are labeled by the IMF as "low-income" or "low-middle income" AND countries that had at least 50 % of all exports as fuel were coded as resources cursed. Countries meeting one condition or the other or neither were coded as a 0. This may not be an accurate description, so more exploration is needed.

To further explore this finding therefore, I created a Shiny app in R (code in appendix) to see if this finding was valid. The app revealed that the range in GDP

for resource cursed countries was quite small relative to non-cursed countries, but also that overlap did exist, indicating perhaps some countries were miscoded. Future research can bear this out.

Conclusion

The resource curse literature attempts to answer why certain countries seem to have lower economic growth than others. The mechanisms which might cause natural resources to lower economic growth could be mechanisms similar to the Dutch Disease, or could be due to wealth expropriation. This research seeks to explain a subarea of the resource curse line of inquiry - why some countries with natural resources have economic growth while others do not. Therefore, given that a country has natural resources, what policies can influence economic growth?

Overall, I find no evidence that the domestic taxation of the resource sector has any influence on economic growth. Investor behavior in the resource sector likewise is a poor predictor of economic growth; its significance disappears once controls for real per capita GDP are added. Most interestingly, I find that when a resource cursed country's leaders engage in rent-seeking, economic growth occurs. For our original puzzle then, we would hypothesize that more rent-seeking occurs in Colombia than in Bolivia.

Future research in this area can include further measures of domestic taxation and structures such as royalties versus flat rates, as well as changes in the tax rates themselves. With additional years of data and policy changes, perhaps a clearer

picture can emerge so that policymakers can successful use their natural resources as a blessing instead of a curse.

References

Andersen, Jorgen and Silje Aslaksen. 2008. "Constitutions and the resource curse". *Journal of Development Economics 87*: 227-246.

Auty, Richard. 1994. "Industrial policy reform in six large newly industrializing countries: the resource curse thesis." *World Development* 22(1): 11-26.

Bornhorst, Fabian, Sanjeev Gupta, and John Thornton. 2009. "Natural resource endowments and the domestic revenue effort." *European Journal of Political Economy* 25: 439-446.

Brollo, Fernanda, et al. 2013. "The political resource curse". *American Economic Review* 103 (5): 1759-1796.

Caselli, Francesco and Tom Cunningham. 2009. "Leader behavior and the natural resource curse." *Oxford Economic Papers* 61: 628-650.

Collier, Paul, Rick Van Der Ploeg, Michael Spence, and Anthony J. Venables. 2010. "Managing resource revenues in developing economies." *IMF Staff Papers* 57(1): 84-118.

Crivelli, Ernesto and Sanjeev Gupta. 2014. "Resource blessing, revenue curse? Domestic revenue effort in resource-rich countries." *European Journal of Political Economy* 35: 88-101.

Dube, Oeindrila and Juan F. Vargas. 2013. "Commodity price shocks and civil

conflict: Evidence from Colombia". *Review of Economic Studies* 80: 1384-1421.

Dunning, Thad. *Crude democracy: Natural resource wealth and political regimes*. Cambridge University Press, 2008.

Lane, Philip R. and Aaron Tornell. 1996. "Power, growth, and the voracity effect." *Journal of Economic Growth* 1(2): 213-241.

Ossowski, Rolando and Alberto Gonzales. 2012. "Manna from heaven: the impact of nonrenewable resource revenues on other revenues of resource exporters in Latin America and the Caribbean." *IDB Working Paper Series no. IDB-WP-337*.

Robinson, James A., Ragnar Torvik, and Thierry Verdier. 2006. "Political foundations of the resource curse". *Journal of Development Economics* 79: 447-468.

Ross, Michael. 2001. "Does oil hinder democracy"? *World Politics* 53: 325-361.

Sachs, Jeffery D. and Andrew M. Warner. 2001. "The curse of natural resources". *European Economic Review* 45(4-6): 827-838.

Tornell, Aaron and Philip R. Lane. 1999. "The voracity effect." *The American Economic Review* 89(1): 22-46.

Torvik, Ragnar. 2002. "Natural resources, rent seeking and welfare." *Journal of Development Economics* 67: 455-470.

World Bank.

Appendix

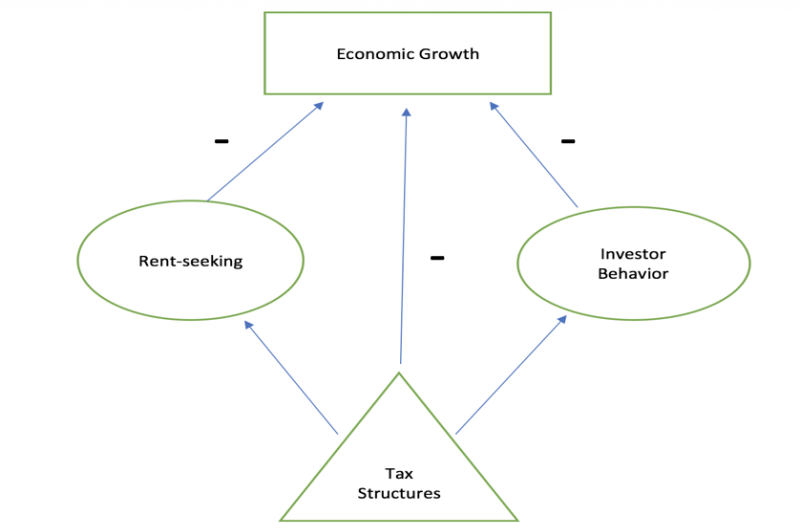

Figure 1: Causal Diagram

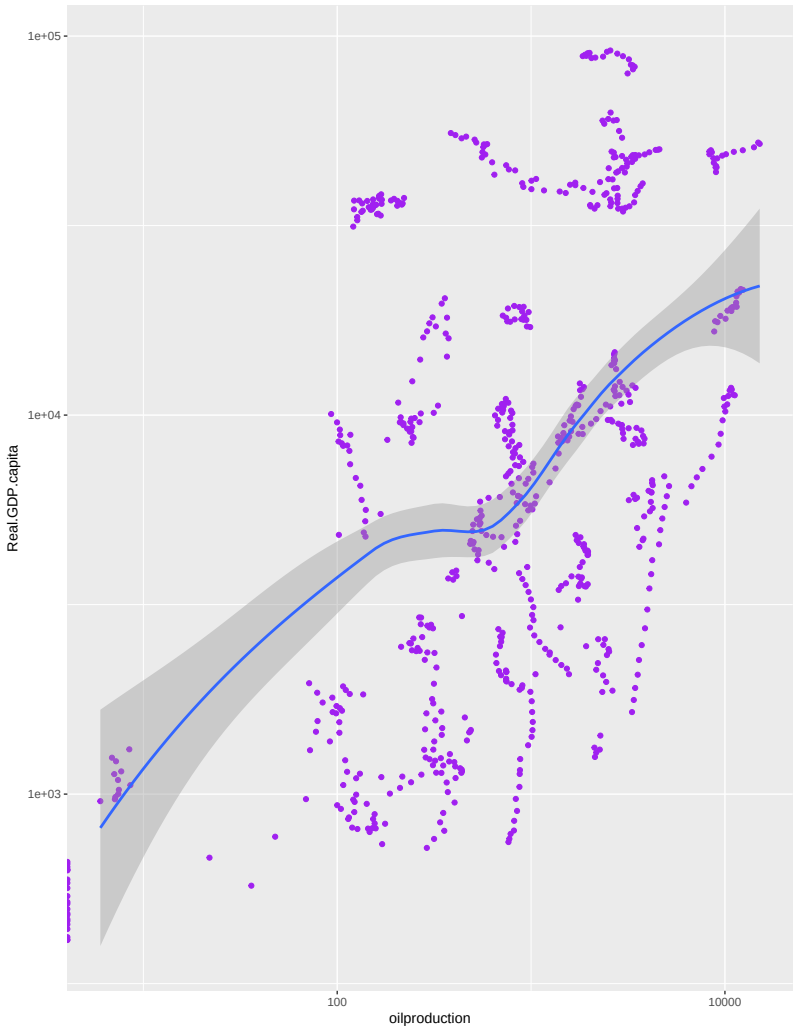

Figure 2: Relationship between Oil Production and GDP

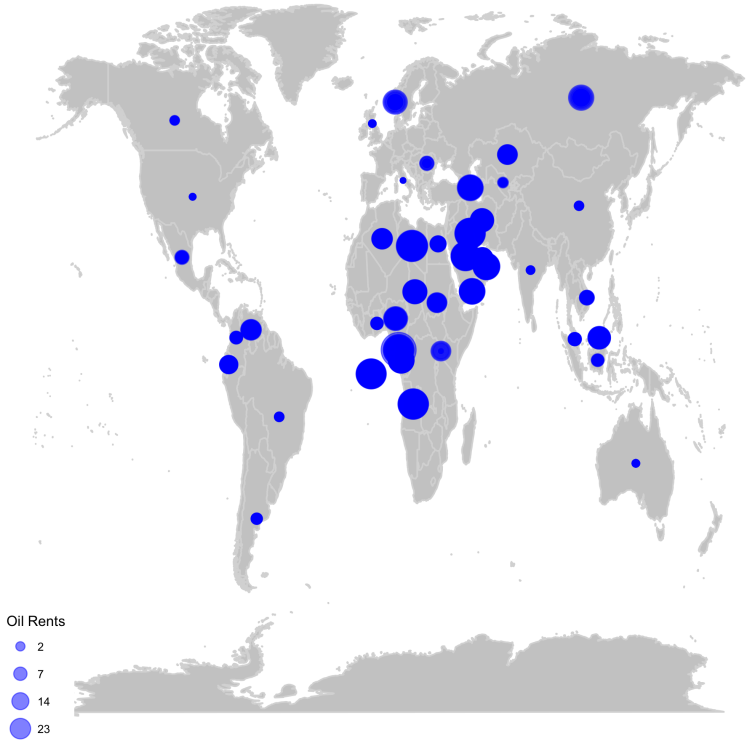

Figure 3: Countries and their Dependence on Oil Rents

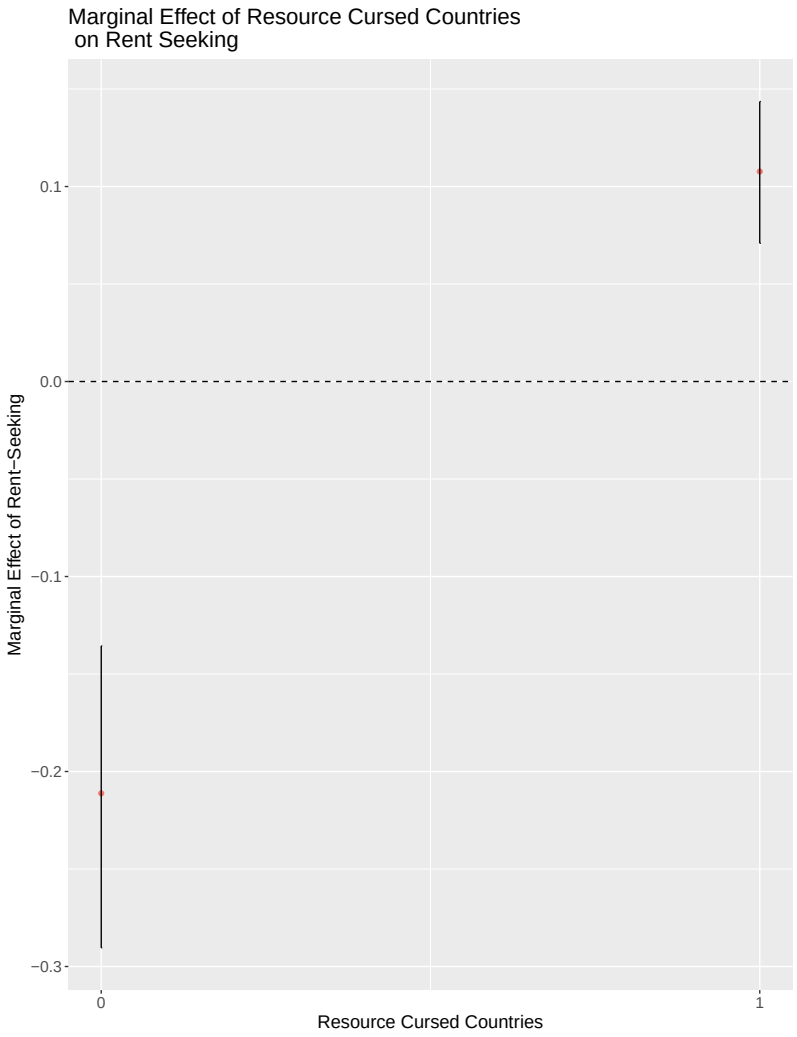

Figure 4: Conditional Effect of Rent-seeking and Resource Curse

Table 1: Regression Results - Fixed Effects

	Dependent variable:			
	Real per capita GDP, logged			
	(1)	(2)	(3)	(4)
Rent-seeking	-0.067^{***}	-0.026	0.072^{***}	0.037^{**}
	(0.022)	(0.022)	(0.019)	(0.018)
Investor Behavior	-0.029^{**}	-0.005	0.005	-0.011
	(0.011)	(0.011)	(0.010)	(0.009)
Tax Structures	-0.0004	-0.0005	0.0001	0.0001
	(0.001)	(0.001)	(0.001)	(0.001)
Polity IV		0.013^{***}	0.007^{***}	0.006^{***}
		(0.002)	(0.002)	(0.002)
Resource Curse			-0.658^{***}	-0.735^{***}
			(0.040)	(0.038)
Population				-0.000^{***}
				(0.000)
Observations	738	702	702	702
R^2	0.022	0.074	0.337	0.436
Adjusted R^2	-0.005	0.046	0.315	0.417
F Statistic	5.386^{***} (df = 3; 717)	13.620^{***} (df = 4; 680)	68.911^{***} (df = 5; 679)	87.447^{***} (df = 6; 678)

Note: *p<0.1; **p<0.05; ***p<0.01

```
##Data Visualization Project
##code for graphics used in presentation and paper
##Les Stanaland
## 25 April 2018
## R version 3.4.4

##necessary libraries
library(interplot)
library(shiny)
library(ggplot2)
library(maps)
library(ggthemes)

##Marginal effects plot

interplot(m=m10, var1="H1", var2="ResourceCursed")+
  aes(color = "blue") + theme(legend.position="none") +
  geom_hline(yintercept = 0, linetype = "dashed") + xlab("Resource Cursed
  ylab("Marginal Effect of Rent-Seeking") + labs(title="Marginal Effect of
  theme(axis.text=element_text(size=12),
        axis.title=element_text(size=14),
        title=element_text(size=14))
```

```
##world map

data <- data.frame(fulldata$country, fulldata$oilrents, fulldata$Lat, fullo
world <- ggplot() +
  borders("world", colour = "gray85", fill = "gray80") +
  theme_map()

map <- world +
  geom_point(aes(x = fulldata.Long, y = fulldata.Lat, size = fulldata.oilre
             data = data,
             colour = 'blue', alpha = .5) +
  scale_size_continuous(range = c(1, 10),
                        breaks = c(2,7,14, 23)) +
  labs(size = 'Oil Rents')
ggsave("plot.png")

# Shiny visualize relationships with RGDP
# Define UI for real gdp app ----
ui <- fluidPage(

# App title ----
  titlePanel("Real GDP per capita"),
```

```
# Sidebar layout with input and output definitions ---
  sidebarLayout(

# Sidebar panel for inputs ---
    sidebarPanel(

# Input: Selector for variable to plot against mpg ---
      selectInput("variable", "Variable:",
                  c("Polity IV" = "PolityIV",
                    "Resource Cursed" = "ResourceCursed",
                    "Region" = "Region",
                    "Oil Revenue / Total Tax Revenue" = "H1",
                    "Oil Revenue / Investment" = "H2",
                    "Oil Tax Revenue / Nonresource Tax Revenue" = "H3")),

# Input: Checkbox for whether outliers should be included ---
      checkboxInput("outliers", "Show outliers", FALSE)

    ),

# Main panel for displaying outputs ---
    mainPanel(
```

```
    # Output: Formatted text for caption ----
        h3(textOutput("caption")),

    # Output: Plot of the requested variable against mpg ----
        plotOutput("RGDPPlot")

      )
    )
)

# Define server logic to plot various variables against hp ----
server <- function(input, output) {

  # Compute the formula text ----
  # This is in a reactive expression since it is shared by the
  # output$caption and output$hpPlot functions
  formulaText <- reactive({
    paste("Real.GDP.capita ~", input$variable)
  })

  # Return the formula text for printing as a caption ----
  output$caption <- renderText({
    formulaText()
```

```
  })

# Generate a plot of the requested variable against gdp ----
# and only exclude outliers if requested
  output$RGDPPlot <- renderPlot({
    boxplot(as.formula(formulaText()),
            data = fulldata,
            outline = input$outliers,
            col = "#75AADB", pch = 19)
  })

}

# Create Shiny app ----
shinyApp(ui, server)
```